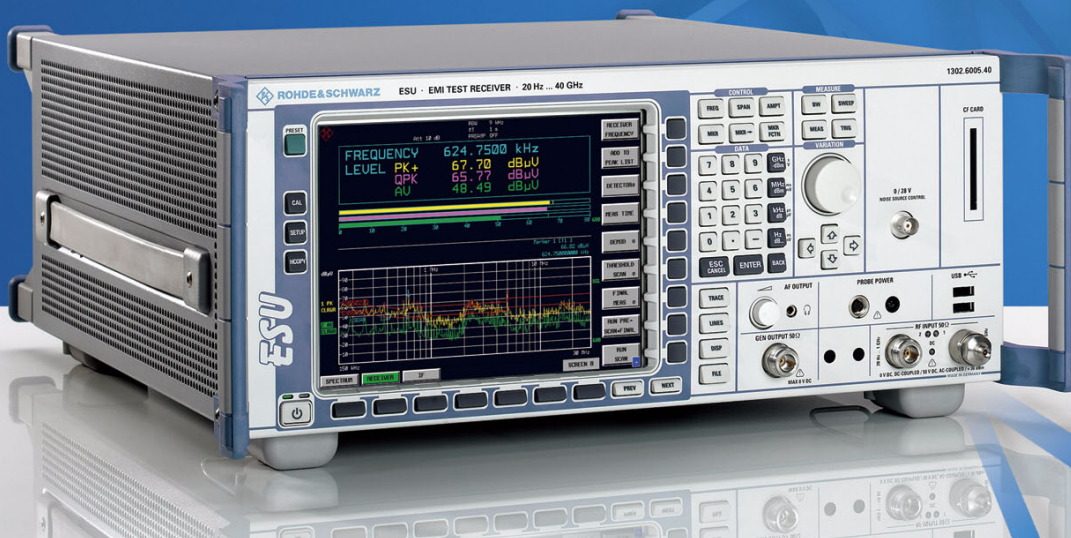# Operating Manual

EMI Test Receiver

R&S® ESU8
1302.6005.08

R&S® ESU26
1302.6005.26

R&S® ESU40
1302.6005.40

Printed in Germany

ROHDE&SCHWARZ
Test and Measurement Division

Dear Customer,

throughout this operating manual, the abbreviation ESU is used for your EMI Test Receiver R&S ESU.

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Trade names are trademarks of the owners

Tabbed Divider Overview

Safety Instructions are provided on the CD-ROM

Tabbed Divider

Documentation Overview

Documentation Overview

Quick Start Guide R&S ESU

This manual is delivered with the instrument in printed form and in PDF format on the CD. It provides the information needed to set up and start working with the instrument. Basic operations and basic measurements are described. Also a brief introduction to remote control is given. More detailed descriptions are provided in the Operating Manual. The Quick Start Guide includes general information (e.g. Safety Instructions) and the following chapters:

Chapter 1	Front and Rear Panel
Chapter 2	Preparing for Use
Chapter 3	Firmware-Update and Installation of Firmware Options
Chapter 4	Basic Operation
Chapter 5	Basic Measurement Examples
Chapter 6	Brief Introduction to Remote Control
Appendix A	Printer Interface
Appendix B	LAN Interface
Appendix C	External Generator Control

Operating Manual R&S ESU

This manual is a supplement to the Quick Start Guide and is available in PDF format on the CD delivered with the instrument. To retain the familiar structure that applies to all operating manuals of Rohde&Schwarz Test & Measurement instruments, the chapters 1 and 3 exist, but only in form of references to the corresponding Quick Start Guide chapters.

The manual describes the following models and options of EMI Test Receiver R&S ESU. Options that are not listed are described in a separate manual. These manuals are provided on the CD ROM.

The operating manual is subdivided into the following chapters:

Chapter 1	Putting into Operation see Quick Start Guide chapters 1 and 2
Chapter 2	Getting Started gives an introduction to advanced measurement tasks of the R&S ESU which are explained step by step.
Chapter 3	Manual Control see Quick Start Guide chapter 4
Chapter 4	Instrument Functions
Chapter 5	Remote Control - Basics describes the basics for programming the R&S ESU, command processing and the status reporting system.
Chapter 6	Remote Control - Description of Commands
Chapter 7	Remote Control - Programming Examples contains program examples for a number of typical applications of the R&S ESU.

Chapter 8   Maintenance and Instrument Interfaces
                     describes preventive maintenance and the characteristics of the instrument's
                     interfaces.

Chapter 9   Error Messages
                     gives a list of error messages that the R&S ESU may generate.

Index   contains an index for the chapters 1 to 9 of the operating manual.

Service Manual - Instrument

This manual is available in PDF format on the CD delivered with the instrument. It informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the R&S ESU by the replacement of modules. The manual includes the following chapters:

Chapter 1   Performance Test

Chapter 2   Adjustment

Chapter 3   Repair

Chapter 4   Software Update / Installing Options

Chapter 5   Documents

 Before putting the product into operation for the first time, make sure to read the following

S a f e t y   I n s t r u c t i o n s

Rohde & Schwarz makes every effort to keep the safety standard of its products up to date and to offer its customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. This product has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, Rohde & Schwarz will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its operating manual and within its performance limits (see data sheet, documentation, the following safety instructions). Using the products requires technical skills and knowledge of English. It is therefore essential that the products be used exclusively by skilled and specialized staff or thoroughly trained personnel with the required skills. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation.

Symbols and safety labels

Observe operating instructions	Weight indication for units >18 kg	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Attention! Electrostatic sensitive devices

Supply voltage ON/OFF	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double/reinforced insulation

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in other parts of the documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by Rohde & Schwarz, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a safety hazard with a high potential of risk for the user that can result in death or serious injuries.
WARNING	This tag indicates a safety hazard with a medium potential of risk for the user that can result in death or serious injuries.
CAUTION	This tag indicates a safety hazard with a low potential of risk for the user that can result in slight or minor injuries.
ATTENTION	This tag indicates the possibility of incorrect use that can cause damage to the product.
NOTE	This tag indicates a situation where the user should pay special attention to operating the product but which does not lead to damage.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist. It is therefore essential to make sure that the tags described here are always used only in connection with the associated documentation and the associated product. The use of tags in connection with unassociated products or unassociated documentation can result in misinterpretations and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products:
prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude max. 2000 m. Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).

3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.

4. If products/components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.

5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.

6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.

7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.

8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.

9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.

10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.

11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.

12. Never use the product if the power cable is damaged. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.

13. The product may be operated only from TN/TT supply networks fused with max. 16 A.

14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise this can result in sparks, fire and/or injuries.

15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.

16. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.

17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.

18. Never remove the cover or part of the housing while you are operating the product. This will expose circuits and components and can lead to injuries, fire or damage to the product.

19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a skilled electrician.

20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.

21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.

22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.

23. Rohde & Schwarz products are not protected against penetration of water, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock or damage to the product, which can also lead to personal injury.

24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.

25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.

26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.

27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries are hazardous waste. Dispose of them only in specially marked containers. Observe local regulations regarding waste disposal. Do not short-circuit batteries or storage batteries.

28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.

29. Please be aware of the weight of the product. Be careful when moving it; otherwise you may injure your back or other parts of your body.

30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).

31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.

32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle; the manufacturer assumes no responsibility for accidents or collisions.

33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.

Por favor lea imprescindiblemente antes de la primera puesta en funcionamiento las siguientes informaciones de seguridad

Informaciones de seguridad

Es el principio de Rohde & Schwarz de tener a sus productos siempre al día con los estandards de seguridad y de ofrecer a sus clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. Este producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los estandards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, deberá el usuario atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. Rohde&Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto solamente fue elaborado para ser utilizado en la indústria y el laboratorio o para fines de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda ser dañada. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del maluso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones del correspondiente manual del uso y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso de los productos hace necesarios conocimientos profundos y el conocimiento del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso de los productos a personas péritas o debidamente minuciosamente instruidas con los conocimientos citados. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente.

Símbolos y definiciones de seguridad

Ver manual de instrucciones del uso	Informaciones para maquinaria con uns peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construción con peligro de carga electroestática

potencia EN MARCHA/PARADA	Indicación Stand-by	Corriente continua DC	Corriente alterna AC	Corriente continua/alterna DC/AC	El aparato está protegido en su totalidad por un aislamiento de doble refuerzo

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en otro capítulo de esta documentación y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por Rohde&Schwarz bajo la denominación de „producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO	Indica un punto de peligro con gran potencial de riesgo para el ususario.Punto de peligro que puede llevar hasta la muerte o graves heridas.
ADVERTENCIA	Indica un punto de peligro con un protencial de riesgo mediano para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas .
ATENCIÓN	Indica un punto de peligro con un protencial de riesgo pequeño para el usuario. Punto de peligro que puede llevar hasta heridas leves o pequeñas
CUIDADO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.
INFORMACIÓN	Indica una situación en la que deberían seguirse las instrucciones en el uso del producto, pero que no consecuentemente deben de llevar a un daño del mismo.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el ámbito de la comunidad económica europea. Pueden existir definiciones diferentes a esta definición. Por eso se debera tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue: como posición de funcionamiento se define principalmente la posición con el suelo de la caja para abajo , modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar. A menos que se especifique otra cosa en la hoja de datos, se aplicará una tolerancia de ±10% sobre el voltaje nominal y de ±5% sobre la frecuencia nominal.

2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal périto autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Despues de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de

seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de medición de la corriente conductora, control de funcionamiento).

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se producieran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.

4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.

5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberan ser tenidas en cuenta las prescipciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescipciones de seguridad especiales en la descripción del producto.

6. Ciertos productos, como por ejemplo las instalaciones de radiación HF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética. El empresario está comprometido a valorar y señalar areas de trabajo en las que se corra un riesgo de exposición a radiaciones aumentadas de riesgo aumentado para evitar riesgos.

7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.

8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del prodcuto.

9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.

10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto ya que puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro, que es controlado su estado técnico de seguridad.

11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (medida del cable de distribución aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en construcciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

12. No utilice nunca el producto si está dañado el cable eléctrico. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.

13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A.

14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.

15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.

16. En las mediciones en circuitos de corriente con una tensión de entrada de Ueff > 30 V se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).

17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos de la EC950/EN60950.

18. Nunca abra la tapa o parte de ella si el producto está en funcionamiento. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.

19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.

20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, deberá la toma de corriente estar protegida de manera que los productos o los usuarios estén suficientemente protegidos.

21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir corto circuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.

22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.

23. Los productos R&S no están protegidos contra el agua si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente o de daños en el producto lo cual también puede llevar al peligro de personas.

24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.

25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.

26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención celulas de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Baterías y acumuladores son deshechos problemáticos. Por favor tirenlos en los recipientes especiales para este fín. Por favor tengan en cuenta las prescripciones nacionales de cada país referente al tratamiento de deshechos. Nunca sometan las baterías o acumuladores a un corto circuito.

28. Tengan en consideración de que en caso de un incendio pueden escaparse gases tóxicos del producto, que pueden causar daños a la salud.

29. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.

30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).

31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujecion en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean tenidas en cuenta. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.

32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo y el fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.

33. Dado el caso de que esté integrado un producto de laser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación. De otra manera pondrá en peligro su salud, ya que el rayo laser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo laser.

Certified Quality System

DIN EN ISO   9001 : 2000
DIN EN   9100 : 2003
DIN EN ISO 14001 : 1996

DQS REG. NO 001954 QM/ST UM

QUALITÄTSZERTIFIKAT

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Managementsystems entwickelt, gefertigt und geprüft.
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DIN EN ISO 9001:2000
DIN EN 9100:2003
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DIN EN ISO 9001:2000
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DIN EN ISO 9001:2000
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ROHDE & SCHWARZ

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 2006-17

This is to certify that:

Equipment type	Stock No.	Designation
ESU8	1302.6005.08	EMI Test Receiver
ESU26	1302.6005.26	
ESU40	1302.6005.40	

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits
  (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility
  (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN 61010-1 : 2001
EN 55011 : 1998 + A1 : 1999 + A2 : 2002, Klasse B
EN 61326 : 1997 + A1 : 1998 + A2 : 2001 + A3 : 2003

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2006

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2006-04-27   Central Quality Management MF-QZ / Radde

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1   Putting into Operation

For details refer to the Quick Start Guide chapters 1, "Front and Rear Panel", and 2, "Preparing for Use".

2   Getting Started

For details refer to the Quick Start Guide chapter 5, "Basic Measurement Examples".

3   Manual Control

For details refer to the Quick Start Guide, chapter 4, "Basic Operation".

4   Instrument Functions

Introduction

All functions of the EMI test receiver and their application are explained in detail in this chapter. The sequence of the described menu groups depends on the procedure selected for the configuration and start of a measurement:

1. Resetting the instrument - *PRESET* key

2. Setting the mode – hotkey bar and *LOCAL* key

3. Setting the measurement parameters - keys *FREQ*, *SPAN*, *AMPT*, *BW*, *SWEEP*, *TRIG*, *TRACE*, *CAL*

4. Selecting and configuring the measurement function - keys *MKR*, *MKR->*, *MKR FCTN*, *MEAS*, *LINES*

The instrument functions for general settings, printout and data management are described at the end of this chapter – keys *LINES*, *DISP*, *SETUP*, *FILE* and *HCOPY*.

The different softkeys of a menu are described from top to bottom and from the left to the right side menu. The submenus are marked by an indentation or displayed in a separate section. The whole path (key - softkey - ...) is indicated in the line above the menu display.

The operating concept is described in the Quick Start Guide, chapter 4, "Basic Operation".

The IEC/IEEE-bus commands (if any) are indicated for each softkey. For a fast overview a list of softkeys with the associated IEC/IEEE-bus commands is given at the end of chapter "Remote Control – Description of Commands".

An index at the end of the manual serves as further help for the user.

ESU Initial Configuration – PRESET Key

PRESET
Using the *PRESET* key, the ESU can be set to a predefined initial state.

Notes

The settings are selected in a way that the RF input is always protected against overload, provided that the applied signal levels are in the allowed range for the instrument.

The initial instrument state set by the *PRESET* key can be adapted to arbitrary applications using the STARTUP RECALL function. With this function the STARTUP RECALL data set is loaded upon pressing the *PRESET* key. For further information refer to section "Saving and Recalling Data Sets – FILE Key" on page 4.299.

Two predefined initial states can be selected in the *SETUP* side menu. Default state is the receiver mode (*RECEIVER PRESET* softkey). The analyzer mode (*ANALYZER PRESET* softkey) is compatible with the settings of EMI Test Receiver R&S ESU and Spectrum Analyzer R&S FSU. It facilitates programming of control software for several instrument types.

Table 4-1   Initial State of R&S ESU in receiver preset mode

Parameter	Settings
Mode	IF (bar graph in screen A and IF spectrum in screen B)
Center frequency step size	AUTO COARSE
RF attenuation	auto (10 dB)
Level range	100 dB log
Level unit	dBμV
Resolution bandwidth	Bar graph 120 kHz / 6 dB, IF bandwidth 10 kHz
Video bandwidth	Bar graph 1 MHz
FFT filters	off
Sweep	cont
Trigger	free run
Trace 1	clr write
Cal correction	on
Noise source	off
Input	RF 1, AC-coupled
Display	Split screen A
Tracking generator (only with option R&S FSU-B9)	off
External generator 1/2 (only with option R&S FSP-B10)	off
Preamplifier	off
Preselector	on

Table 4-2   Initial State of R&S ESU in analyzer preset mode

Parameter	Settings
Mode	Spectrum
Center frequency step size	0.1 * center frequency
RF attenuation	auto (10 dB)
Reference level	-20 dBm
Level range	100 dB log
Level unit	dBm
Sweep time	auto
Resolution bandwidth	auto (3 MHz)
Video bandwidth	auto (10 MHz)
FFT filters	off
Span / RBW	50
RBW / VBW	0.33
Sweep	cont
Trigger	free run
Trace 1	clr write
Trace 2/3	blank
Detector	auto peak
Trace math	off
Frequency offset	0 Hz
Reference level offset	0 dB
Reference level position	100%
Grid	abs
Cal correction	on
Noise source	off
Input	RF Input 1, AC-coupled
Display	Full screen, active screen A
Tracking generator (only with option R&S FSU-B9)	off
External generator 1/2 (only with option R&S FSP-B10)	off
Preamplifier	off
Preselector	off

Mode Selection – Hotkey Bar

For fast mode selection the ESU has keys located under the measurement screen, the so-called hotkeys. These hotkeys are displayed depending on the options installed on the instrument. According to the selected mode, the corresponding softkey menus are displayed (on the right side of the measurement screen).

Three keys are reserved for the basic model:

SPECTRUM	RECEIVER	IF		SCREEN B

SPECTRUM

The *SPECTRUM* hotkey sets ESU to spectrum analysis mode.

IEC/IEEE bus command: `INST:SEL SAN`

RECEIVER

The *RECEIVER* hotkey sets the ESU in the test receiver mode.

IEC/IEEE bus command: `INST:SEL REC`

IF

The *IF* hotkey activates the IF analysis mode.

IEC/IEEE bus command: `INST IFAN`

**SCREEN A /
SCREEN B**

With the *SCREEN A / SCREEN B* hotkey two different settings can be selected on the ESU in the FULL SCREEN mode.

In the SPLIT SCREEN mode the key switches between active diagram A and B.

The key designation indicates the diagram which has been activated by means of the key.

The currently active window is marked by **A** or **B** on the right of the diagram.

IEC/IEEE bus command: `DISP:WIND<1|2>:SEL`

The other keys are described with the corresponding options.

Return to manual control – LOCAL Menu
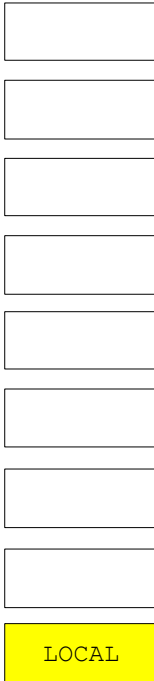
LOCAL

The LOCAL menu is displayed on switching the instrument to remote control mode.

At the same time, the hotkey bar is blanked out and all keys are disabled except the *PRESET* key. The diagram, traces and display fields are then blanked out (they can be activated using the remote control command `SYSTem:DISPlay: UPDate ON`).

The menu contains only one softkey, the *LOCAL* key. The *LOCAL* key switches the instrument from remote to manual control, with the assumption that the remote controller has not previously set the LOCAL LOCKOUT function.

A change in the control mode consists of:

– **Enabling the Front Panel Keys**

Returning to manual mode enables all inactive keys and turns on the hotkey bar. The softkey menu which is displayed is the main menu of the current mode.

Inserting the measurement diagrams

The blanked diagrams, traces and display fields are inserted.

– **Generating the message OPERATION COMPLETE**

If, at the time of pressing the *LOCAL* softkey, the synchronization mechanism via *OPC, *OPC? or *WAI is active, the currently running measurement procedure is aborted and synchronization is achieved by setting the corresponding bits in the registers of the status reporting system.

– **Setting Bit 6 (User Request) of the Event Status Register**

With a corresponding configuration of the status reporting system, this bit immediately causes the generation of a service request (SRQ) which is used to inform the control software that the user wishes to return to front-panel control. This information can be used, e.g., to interrupt the control program so that the user can make necessary manual corrections to instrument settings. This bit is set each time the *LOCAL* softkey is pressed.

Note

If the LOCAL LOCKOUT function is active in the remote control mode, the front-panel *PRESET* key is also disabled. The LOCAL LOCKOUT state is left as soon as the process controller de-activates the REN line or the IEC/IEEE-bus cable is disconnected from the instrument.

Receiver Mode

RECEIVER

The mode is selected using the *RECEIVER* hotkey (see also section "Mode Selection – Hotkey Bar" on page 4.10)
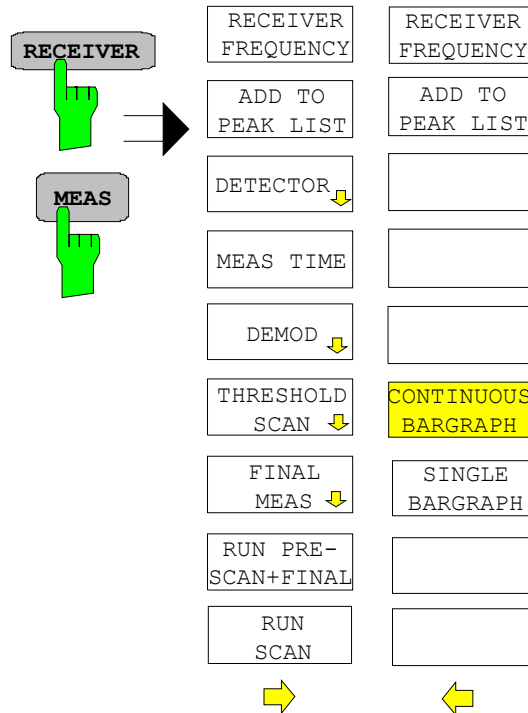
The *RECEIVER* hotkey selects the receiver mode (RFI reception) and activates the menu for setting the receiver parameters.

For description of the softkeys see the following menus:

RECEIVER FREQUENCY	"Operation on a Discrete Frequency – FREQ Key" on page 4.14
DETECTOR	"Selecting the Detector" on page 4.25
MEAS TIME	"Setting the Measurement Time" on page 4.28
DEMOD	"AF Demodulators" on page 4.30
THRESHOLD SCAN	"Automatic Final Measurement with Threshold Scan" on page 4.43
FINAL MEAS	"Data Reduction and Peak List" on page 4.32
RUN SCAN	"Running a Scan" on page 4.66
RUN PRE SCAN+FINAL	"Running a Scan" on page 4.66

IEC/IEEE bus command: INST REC

In the receiver mode, R&S ESU measures the level at the set frequency with a selected bandwidth and measurement time (*RES BW* and *MEAS TIME* softkeys). Signal weighting is by means of the average, max peak, min peak, RMS, quasi-peak, CISPR-RMS, and CISPR-AV detectors (*DETECTOR* softkey).

The functions for data reduction and the control of line impedance simulating network are available in the *FINAL MEAS* submenu.

A frequency scan can be performed after setting the start and stop frequency and the step width. The scan subranges can be defined in a table (*DEFINE SCAN* softkey).

The scan is started with the *RUN SCAN* softkey. In operating mode *RECEIVER*, the *RECEIVER* hotkey and the *MEAS* hotkey directly open the *RECEIVER* menu. For a detailed description refer to "Selection of the Measurement Function – MEAS Key" on page 4.24.

The R&S ESU is fitted with a preselection with switchable preselection. Preselection is always switched on in receiver mode.

Operation on a Discrete Frequency – FREQ Key

The *FREQ* key opens the *FREQUENCY* menu for setting the receive frequency in manual mode and the frequency axis for scan display.

```
                    ┌──────────────┐              ┌──────────────┐
┌──────┐            │  RECEIVER    │     ┌───────▶ │    AUTO      │
│ FREQ │ ─────────▶ │  FREQUENCY   │     │         │   COARSE     │
└──────┘            ├──────────────┤     │         ├──────────────┤
  🖐                 │   STEPSIZE   │ ────┘         │    AUTO       │
                    ├──────────────┤               │    FINE       │
                    │              │               ├──────────────┤
                    │              │               │   STEPSIZE   │
                    ├──────────────┤               │   MANUAL     │
                    │    START     │               ├──────────────┤
                    │              │               │   STEPSIZE   │
                    ├──────────────┤               │   = FREQ     │
                    │    STOP      │               ├──────────────┤
                    │              │               │              │
                    ├──────────────┤               ├──────────────┤
                    │              │               │              │
                    ├──────────────┤               ├──────────────┤
                    │              │               │              │
                    ├──────────────┤               ├──────────────┤
                    │  RUN PRE-    │               │              │
                    │  SCAN+FINAL  │               ├──────────────┤
                    ├──────────────┤               │              │
                    │  RUN SCAN    │               └──────────────┘
                    └──────────────┘
```

RECEIVER FREQUENCY

The *RECEIVER FREQUENCY* softkey activates the entry field of the receive frequency.

The tuning frequency has to be set to at least twice the IF bandwidth.

When the tuning frequency is lower than twice the IF bandwidth, the IF bandwidth is automatically reduced so that this condition is met again.

If the frequency is increased again, the original IF bandwidth is restored (memory function). The memory is cleared when the IF bandwidth is manually changed.

Range: $20\ Hz \leq f_{rec} \leq f_{max}$

➡ **Note**

This softkey is also available in the *RECEIVER / MEAS* menu.

IEC/IEEE bus command: `FREQ:CENT 300 MHz`

STEPSIZE   The *STEPSIZE* opens a submenu for setting the step size of the receive frequency. The step size can be coupled to the set frequency or be manually set to a fixed value. The softkeys of the submenu are mutually exclusive selection switches. Only one switch can be activated at any one time.

AUTO COARSE   If the *AUTO COARSE* softkey is activated, the receive frequency is set in coarse steps. The 4th digit of the selected frequency is varied.

                       IEC/IEEE bus command: --

AUTO FINE   If the *AUTO FINE* softkey is activated, the receive frequency is set in fine steps. he 7th digit of the selected frequency is varied.

                       IEC/IEEE bus command: --

STEPSIZE MANUA   The *STEPSIZE MANUAL* softkey activates the entry window for the input of a fixed step size.

                       IEC/IEEE bus command: `FREQ:CENT:STEP 50 kHz`

STEPSIZE = FREQ   The *STEPSIZE = FREQ* softkey sets the step size to a value equal to the receive frequency.

                       This function is especially useful during measurements of the signal harmonic content, because, when entering the receiver frequency, the receiver frequency of another harmonic is selected with each stroke of the *STEP* key.

                       IEC/IEEE bus command: --

START   The *START* softkey opens a window where the start frequency of the scan diagram can be entered.

                       IEC/IEEE bus command: `:FREQ:STAR 20 MHz`

STOP   The *STOP* softkey opens a window where the stop frequency of the scan diagram can be entered.

                       IEC/IEEE bus command: `:FREQ:STOP 2000 MHz`

RUN PRE-SCAN+FINAL For details refer to the *SWEEP* menu, "RUN PRE-SCAN+FINAL" on page 4.67.

RUN SCAN   For details refer to the *SWEEP* menu, "RUN SCAN" on page 4.66.

Level Display and RF Input Configuration – AMPT Key

The *AMPT* key is used to set the input attenuation, the preamplifier, the auto range function and the display unit.

In addition, the level display range for the scan can be set.
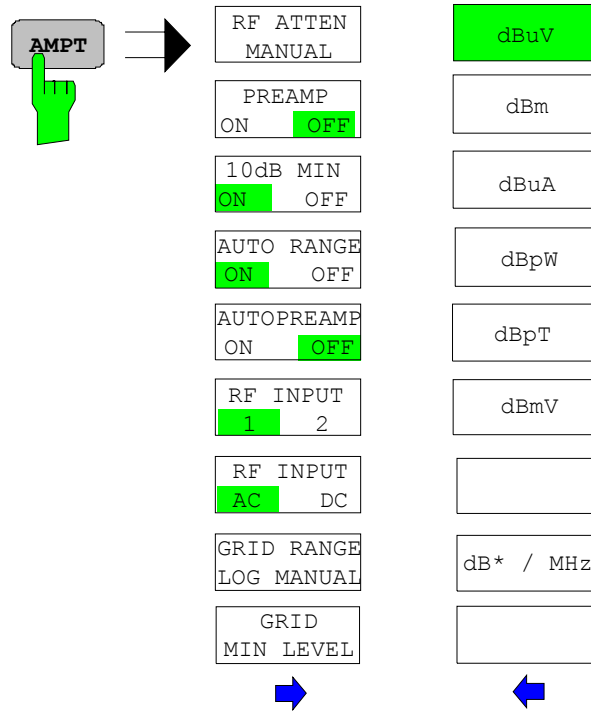
RF ATTEN MANUAL   The *RF ATTEN MANUAL* softkey activates the attenuation entry field.

The attenuation can be set between 0 and 75 dB in 5 dB steps. Other entries are rounded to the next higher integer.

 Note

To protect the input mixer against inadvertent overload, 0 dB can only be switched on when the *10 dB MIN* softkey is switched off.

IEC/IEEE bus command: INP:ATT 40 DB

Preamplifier

R&S ESU is provided with a switchable preamplifier of 20 dB gain in the frequency range up to 3.6 GHz.

Switching on the preamplifier reduces the total noise figure of R&S ESU and thus improves the sensitivity. The disadvantage of a poorer large-signal immunity (intermodulation) is reduced by the connected preselector. The signal level of the subsequent mixer is 20 dB higher so that the maximum input level is reduced by the gain of the preamplifier. The use of the preamplifier is recommended when measurements with a maximum sensitivity are to be performed. On the other hand, if the measurement should be performed at maximum dynamic range, the preamplifier should be switched off.

The gain of the preamplifier is automatically considered in the level display. The preamplifier follows the preselection filters so that the risk of overdriving by strong out-of-band signals is reduced to a minimum.

PREAMP ON/OFF   The *PREAMP ON/OFF* softkey switches the preamplifier (1 kHz to 3.6 GHz) on and off.

Default value is OFF.

IEC/IEEE bus command: `:INP:GAIN:STAT ON | OFF`

10 DB MIN ON/OFF   The *10 DB MIN* softkey determines whether the 10 dB setting of the attenuator may be used in the manual or automatic setting of the attenuator.

10 DB MIN ON is the default value, i.e. an RF attenuation of at least 10 dB is always set on R&S ESU to protect the input mixer.

An attenuation of 0 dB cannot be set manually either. This avoids 0 dB being switched on inadvertently particularly when DUTs with high RFI voltage are measured.

IEC/IEEE bus command: `:INP:ATT:PROT ON | OFF`

AUTO RANGE ON/OFF   The *AUTO RANGE ON/OFF softkey* switches the autorange function on and off.

ON   The attenuation is automatically set so that a good S/N ratio is obtained without the receiver stages being overdriven.

OFF   The attenuation is set manually.

IEC/IEEE bus command: `:INP:ATT:AUTO ON | OFF`

AUTOPREAMP ON/OFF   The *AUTOPREAMP ON/OFF* softkey switches the auto preamp function and or off.

ON   The preamplifier is considered in the autorange procedure. The preamplifier is cut in when the RF attenuation is reduced to the minimum settable value.

OFF   The preamplifier is not considered in the autorange procedure.

IEC/IEEE bus command: `:INP:GAIN:AUTO ON | OFF`

dBμV
dBm
dBμA
dBpW
dBpT
dBmV
dB* / MHz

In the side menu, the desired units for the level axis can be selected. Default setting is dBμV.

In general, a receiver measures the signal voltage at the RF input. The level display is calibrated in rms values of an unmodulated sinewave signal.

Via the known input resistance of 50 Ω a conversion can be made to other units. The units dBm, dB A, dBpW, dBpT and dBmVpT are directly convertible.

The dB*/MHz softkey activates/deactivates the display of results in units relative to the bandwidth. These units are derived from the logarithmic units dBμV, dBμV/m, dBμA and dBμA/m:

Unit	Relative unit
dBμV	dBμV/MHz
dBμV/m	dBμV/mMHz
dBμA	dBμA/MHz
dBμA/m	dBμA/mMHz
dBpW	dBpW/MHz
dBpT	dBpT/MHz
dBmV	dBmV/MHz

Switching over is possible also if a transducer fixes the unit to be used.

Conversion to 1 MHz is via the pulse bandwidth of the selected resolution bandwidth B_{imp} according to the following equation (example for dBμV):

$$P \ / \ (\text{dB}\mu V \ / \ \text{MHz}) \ = \ 20 \cdot \log \frac{B_{imp} \ / \ \text{MHz}}{1\text{MHz}} \ + \ P \ / \ (\text{dB}\mu V)$$

with P = display level; other combinations are not allowed.

IEC/IEEE bus command: `:CALCulate<1|2>:UNIT:POWer`
                          `DBUV_MHZ|DBUA_MHZ|DBMV_MHZ`

RF INPUT AC/DC

The *RF INPUT AC/DC* softkey switches between AC and DC coupling of the instrument input.

IEC/IEEE bus command: `INP:COUP AC|DC`

RF INPUT 1/2

The *INPUT 1/2* softkey selects RF input 1 (default setting) or 2.

INPUT 2 is the pulse-resistant input 2. With the input 2 used, the frequency range is limited to 1 GHz. Higher frequencies cannot be set.

IEC/IEEE bus command: `INP:TYPE INPUT1 | INPUT2`

GRID RANGE LOG MANUAL

The *GRID RANGE LOG MANUAL* softkey activates the entry of the level display range for the scan diagram.

The display ranges go from 10 to 200 dB in 10-dB steps. Invalid entries are rounded off to the nearest valid value.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LOG`
                          `DISP:WIND:TRAC:Y 120DB`

GRID MIN LEVEL   The *GRID MIN LEVEL* softkey activates the entry of the minimum level of the display range. Allowed values are:

- 200 ≤ GRID MIN LEVEL ≤ + 200 dB - GRID RANGE

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LOG`
                          `DISP:WIND:TRAC:Y:BOTT 0DBM`

Setting the IF Bandwidth – BW Key

R&S ESU offers the IF bandwidths (3 dB bandwidths) from 10 Hz to 10 MHz available in steps of 1/2/3/5/10 and the IF bandwidths (6 dB bandwidths) 10 Hz, 100 Hz, 200 Hz, 1kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, and 1 MHz.

The resolution bandwidths up to 120 kHz are implemented by digital Gaussian bandpass filters. As far as attenuation characteristic is concerned, they behave like analog filters, but they have a much higher measurement speed than comparable analog filters. This is due to the fact that the transient response can be compensated because the filters have an accurately defined behavior.

Bandwidths of 200 kHz and higher are implemented by decoupled LC filters. These filters contain 5 filter circuits.

BW →	RES BW
	200 Hz
	9 kHz
	120 kHz
	1 MHz
	QP RBW UNCOUPLED
	FILTER TYPE
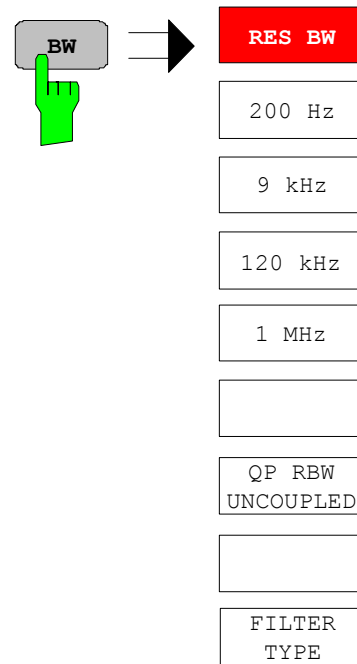
The *BW* key opens the menu for setting the resolution bandwidth.

RES BW The *RES BW* softkey activates the manual entry mode for the resolution bandwidth.

For filter type NORMAL (3dB), the bandwidth can be set from 10 Hz to 10 MHz in steps of 1/2/3/5/10. For filter type EMI (6dB), the 6-dB bandwidth 10 Hz, 100 Hz, 200 Hz, 1kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, and 1 MHz can be set.

For numerical inputs, the values are always rounded to the next valid bandwidth. For rotary knob or the *UP/DOWN* key entries, the bandwidth is adjusted in steps either upwards or downwards.

For the CHANNEL and RRC filter types, the bandwidth is selected from a list of available channel filters, which is included at the end of this section. The list can be scrolled with the ⬆ and ⬇ keys to select a filter (see section "List of Available Channel Filters" on page 4.22).

When the quasi-peak detector, the CISPR-AV detector, or the CISPR-RMS detector are switched on, a fixed bandwidth is preset depending on the frequency. The coupling of the IF bandwidth to the frequency range with activated quasi peak detector can be cancelled using the *QP RBW UNCOUPLED* softkey (see below).

The bandwidth is limited by the set receive frequency:

RES BW $\leq f_{in}$ /2

IEC/IEEE bus command: `BAND 1 MHz`

200 Hz   The *200 Hz* softkey sets the CISPR bandwidth 200 Hz.

IEC/IEEE bus command: `BAND 200 Hz`

9 kHz   The *9 kHz* softkey sets the CISPR bandwidth 9 kHz.

IEC/IEEE bus command: `BAND 9 kHz`

120 kHz   The *120 kHz* softkey sets the CISPR bandwidth 120 kHz.

IEC/IEEE bus command: `BAND 120 kHz`

1 MHz   The *1 MHz* softkey sets the 6-dB bandwidth 1 MHz.

IEC/IEEE bus command: `BAND 1 MHz`

QP RBW   The *QP RBW UNCOUPLED* softkey cancels the coupling of the IF bandwidth
UNCOUPLED   to the frequency range with activated quasi peak detector, CISPR-AV detector, or CISPR-RMS detector.

If the coupling is cancelled, any of the 4 CISPR bandwidths (200 Hz, 9 kHz, 120 kHz, 1 MHz) can be selected for a given frequency range.

IEC/IEEE bus command: `BAND:AUTO ON`

FILTER TYPE   The *FILTER TYPE* softkey opens a list of available filter types. Gaussian bandpass filters of 3 dB and 6 dB bandwidth as well as particularly steep-edged channel filters for power measurements are available.

FILTER TYPE
NORMAL (3dB)
✓ EMI (6dB)
CHANNEL
RRC
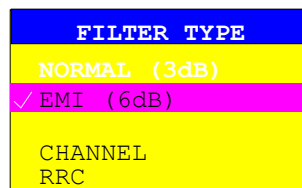
• *NORMAL(3dB)*

The resolution bandwidths are implemented by Gaussian filters with the set 3 dB bandwidth and correspond approximately to the noise bandwidth. For bandwidths up to 100 kHz, digital bandpass filters are used.

IEC/IEEE bus command: `BAND:TYPE NOIS`
                         `BAND:TYPE NORM`

- *EMI (6dB)*

    The resolution bandwidths are implemented by Gaussian filters with the set 6 dB bandwidth and correspond approximately to the pulse bandwidth. For bandwidths up to 1 MHz, digital bandpass filters are used.

IEC/IEEE bus command: `BAND:TYPE PULS`

- *CHANNEL*

    steep-edged channel filters

IEC/IEEE bus command: `BAND:TYPE CFIL`

- *RRC*

    Root Raised Cosine filters

IEC/IEEE bus command: `BAND:TYPE RRC`

List of Available Channel Filters

The channel filters included in the following table are available as resolution filters (softkey *RES BW*) after activation with softkey *FILTER TYPE*.

> **Note**
>
> For filter type RRC (Root Raised Cosine) the filter bandwidth indicated describes the sampling rate of the filter.
>
> For all other filters (CFILter), the filter bandwidth is the 3-dB bandwidth.

Filter Bandwidth	Filter Type	Application
100 Hz	CFILter	
200 Hz	CFILter	A0
300 Hz	CFILter	
500 Hz	CFILter	

Filter Bandwidth	Filter Type	Application
1 kHz	CFILter	
1.5 kHz	CFILter	
2 kHz	CFILter	
2.4 kHz	CFILter	SSB
2.7 kHz	CFILter	
3 kHz	CFILter	
3.4 kHz	CFILter	
4 kHz	CFILter	DAB, Satellite
4.5 kHz	CFILter	
5 kHz	CFILter	
6 kHz	CFILter	
8.5 kHz	CFILter	ETS300 113 (12.5 kHz channels)
9 kHz	CFILter	AM Radio
10 kHz	CFILter	
kHz	CFILter	CDMAone
14 kHz	CFILter	ETS300 113 (20 kHz channels)
15 kHz	CFILter	
16 kHz	CFILter	ETS300 113 (25 kHz channels)
18 kHz, α=0.35	RRC	TETRA
20 kHz	CFILter	
21 kHz	CFILter	PDC
24.3 kHz, α=0.35	RRC	IS 136
25 kHz	CFILter	
30 kHz	CFILter	CDPD, CDMAone
50 kHz	CFILter	
100 kHz	CFILter	
150 kHz	CFILter	FM Radio
192 kHz	CFILter	PHS
200 kHz	CFILter	
300 kHz	CFILter	
500 kHz	CFILter	J.83 (8-VSB DVB, USA)
1.0 MHz	CFILter	CDMAone
1.2288 MHz	CFILter	CDMAone
1.5 MHz	CFILter	DAB
2.0 MHz*	CFILter	
3.0 MHz*	CFILter	
3.84 MHz, α=0.22*	RRC	W-CDMA 3GPP
4.096 MHz, α=0.22*	RRC	W-CDMA NTT DOCoMo
5.0 MHz*	CFILter	

Selection of the Measurement Function – MEAS Key

The *MEAS* key opens the menu to select the detectors and set the measurement time for the receiver and the audio demodulator.

To reduce the amount of data in RFI voltage measurements, a list of subrange maxima (softkey *PEAK SEARCH*) can be generated from the scan results and an acceptance line (softkey *MARGIN*) may be defined in the *FINAL MEAS* submenu. A final measurement is performed only for frequencies with high RFI level.

The final measurement may be either automatic (softkey *AUTOMATIC FINAL*) or in interactive mode (softkey *INTERACTIVE*). Automatic control functions for line impedance stabilization networks (softkey *LISN*) are available in the side menu. The final measurement is started with the softkey *RUN FINAL MEAS*.

The *THRESHOLD SCAN* function is also used to reduce data. The scan is immediately interrupted when a limit violation is detected and the final measurement performed within a short time.
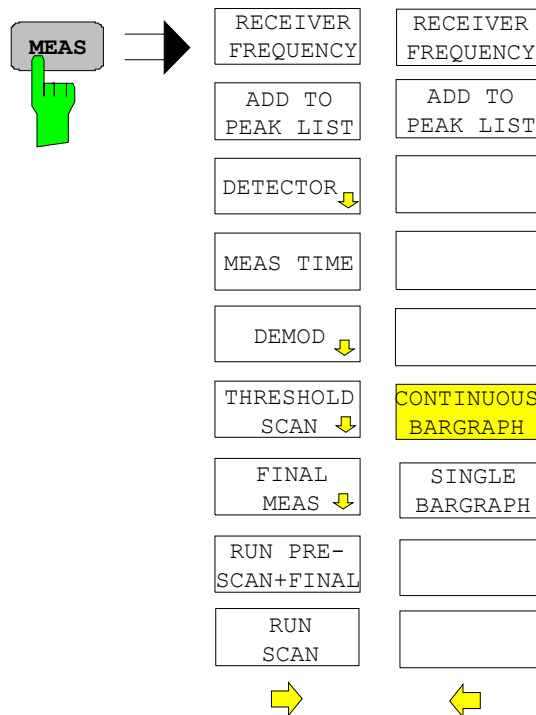
RECEIVER FREQUENCY

The *RECEIVER FREQUENCY* softkey activates the entry field of the receive frequency.

The tuning frequency has to be set to at least twice the IF bandwidth.

When the tuning frequency is lower than twice the IF bandwidth, the IF bandwidth is automatically reduced so that this condition is met again.

If the frequency is increased again, the original IF bandwidth is restored (memory function). The memory is cleared when the IF bandwidth is manually changed.

Range: 20 Hz $\leq$ f$_{rec}$ $\leq$ f$_{max}$

> **Note**
>
> This softkey is also available in the *RECEIVER / MEAS* menu.

IEC/IEEE bus command: `:FREQ:CENT 300 MHz`

ADD TO PEAK LIST   The *ADD TO PEAK LIST* softkey adds the receiver frequency of the current marker to the peak list (see also section "Data Reduction and Peak List" on page 4.32).

IEC/IEEE bus command: `--`

CONTINUOUS BARGRAPH   The *CONTINUOUS BARGRAPH* softkey selects the continuous measurement mode.

IEC/IEEE bus command: `INITiate:CONTinuous ON`

SINGLE BARGRAPH   Pressing the *SINGLE BARGRAPH* softkey triggers a single level measurement. The enhancement label SGL displayed at the screen edge indicates that the single-measurement mode is set.

IEC/IEEE bus command: `INITiate:CONTinuous OFF`

Selecting the Detector

Six different detectors can be selected for weighting the receive signal.

- The max peak detector yields the largest sample values of the levels measured during the set measurement time.

- The min peak detector yields the smallest sample values of the levels measured during the set measurement time.

- The average detector yields the average level of the samples measured during the set measurement time.

- The CISPR average detector supplies a weighted average. When measuring the average according to CISPR 16-1, the maximum value of the linear average during the measurement time is displayed. The detector is used, for example, to measure pulsed sinusoidal signals with a low pulse frequency. It is calibrated with the rms value of an unmodulated sinusoidal signal. Averaging is with lowpass filters of the 2nd order (simulation of a mechanical instrument). The lowpass time constants and the IF bandwidths are fixed depending on the frequency. The main parameters are listed in the following table:

	Band A	**Band B**	**Band C/D**	**Band F**
Frequency range	< 150 kHz	150 kHz to 30 MHz	30 MHz to 1 GHz	> 1 GHz
IF bandwidth	200 Hz	9 kHz	120 kHz	1 MHz
Time constant of instrument	160 ms	160 ms	100 ms	100 ms

Coupling of the IF bandwidth to the frequency range with the CISPR average detector activated can be switched off by the *QP RBW UNCOUPLED* softkey.

- The rms detector yields the rms level of the samples measured. The integration time corresponds to the set measurement time.

- The CISPR rms detector supplies a weighted average. When measuring the average according to CISPR 16-1, the maximum value of the linear average during the measurement time is displayed. The detector is used, for example, to measure pulsed sinusoidal signals with a low pulse frequency. It is calibrated with the rms value of an unmodulated sinusoidal signal. Averaging is with lowpass filters of the 2nd order (simulation of a mechanical instrument). The lowpass time constants and the IF bandwidths are fixed depending on the frequency. The main parameters are listed in the following table:

	Band A	**Band B**	**Band C/D**	**Band E**
Frequency range	< 150 kHz	150 kHz to 30 MHz	30 MHz to 1 GHz	> 1 GHz
IF bandwidth	200 Hz	9 kHz	120 kHz	1 MHz
Time constant of instrument	160 ms	160 ms	100 ms	100 ms
Corner frequency	10 Hz	100 Hz	100 Hz	1 kHz

- The quasi-peak detector yields the maximum detected value weighted to CISPR 16. Depending on the set frequency, the R&S ESU automatically selects the detectors and IF bandwidths defined for bands A, B and C/D listed in the following table:

	Band A	**Band B**	**Band C/D**
Frequency range	< 150 kHz	150 kHz to 30 MHz	> 30 MHz
IF bandwidth	200 Hz	9 kHz	120 kHz
Charge time constant	45 ms	1 ms	1 ms
Discharge time constant	150 ms	500 ms	550 ms
Time constant of instrument	160 ms	160 ms	100 ms

For frequencies above 1 GHz, the R&S ESU uses the 120 kHz bandwidth of band C/D.

The coupling of the IF bandwidth to the frequency range with activated quasi peak detector can be cancelled using the *QP RBW UNCOUPLED* softkey.

- The input signal of R&S ESU can be displayed weighted by three detectors simultaneously.

Multiple detection is important in EMI measurements since, for example, civil standards specify limits for both the quasi-peak and the average value. Thanks to the multiple use of detectors, only one test run is needed. The peak detector can be combined with any other detector since it is the fastest detector and therefore ideal for overview measurements.

DETECTOR
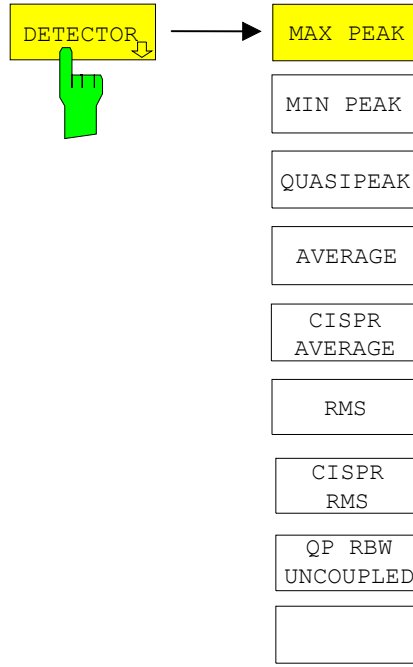
The *DETECTOR* softkey opens a submenu to select the detector and combinations of detectors.

A maximum of three detectors can be switched on simultaneously.

> **Note**
>
> This softkey is also available in the *RECEIVER / MEAS* menu.

MAX PEAK   The *MAX PEAK* softkey activates the max peak detector.

IEC/IEEE bus command: `DET:REC POS`

MIN PEAK   The *MIN PEAK* softkey activates the min peak detector.

IEC/IEEE bus command: `DET:REC NEG`

QUASIPEAK   The *QUASIPEAK* softkey selects the quasi-peak detector.

The IF bandwidth is adapted as a function of the frequency range. The coupling of the IF bandwidth to the frequency range can be cancelled using softkey *QP RBW UNCOUPLED*.

IEC/IEEE bus command: `DET:REC QPE`

AVERAGE   The *AVERAGE* softkey activates the average detector.

IEC/IEEE bus command: `DET:REC AVER`

CISPR AVERAGE   The *CISPR AVERAGE* softkey activates the weighting average detector according to CISPR 16-1. The IF bandwidth is automatically set to the required value according to the receiving frequency. This coupling can be cancelled by the *QP RBW UNCOUPLED* softkey.

IEC/IEEE bus command: `DET:REC CAV`

RMS   The *RMS* softkey activates the rms detector.

IEC/IEEE bus command: `DET:REC RMS`

CISPR RMS   The *CISPR RMS* softkey activates the weighting rms detector according to CISPR 16-1. The IF bandwidth is automatically set to the required value according to the receiving frequency. This coupling can be cancelled by the *QP RBW UNCOUPLED* softkey.

IEC/IEEE bus command: `DET:REC CRMS`

QP RBW
UNCOUPLED   The *QP RBW UNCOUPLED* softkey cancels the coupling of the IF bandwidth to the frequency range with activated quasi peak or CISPR average detector.

IEC/IEEE bus command: `BAND:AUTO OFF`

Setting the Measurement Time

The measurement time can be set with a 2-digit resolution in the range 10 µs to 100 s.

The measurement time is the time during which R&S ESU measures the input signal and forms a measurement result weighted by the selected detector. The measurement time does not include settling times of the synthesizer and the IF filter. R&S ESU automatically waits until transients are over.

When the quasi-peak detector is used, the minimum measurement time is 0.5 ms. When the CISPR average detector or the CISPR rms detector is used, the minimum measurement time is 100 ms. With the average, RMS, or min/max peak detector the smallest settable measurement time depends on the bandwidth.

Bandwidth	Shortest measurement time AV, RMS	Shortest measurement time PK+, PK-
≤ 10 Hz	1 sec	10 msec
100 Hz	100 msec	1 msec
200 Hz	50 msec	1 msec
1 kHz	10 msec	0,1 msec
9 kHz	1 msec	0,1 msec
≥ 100 kHz	0,1 msec	0,01 msec

MEAS TIME   The *MEAS TIME* softkey activates the entry field for the measurement time.

Note

This softkey is also available in the *RECEIVER / MEAS* menu.

IEC/IEEE bus command: `SWE:TIME 100ms`

Effect of measurement time with different weighting modes:

*   MIN/MAX PEAK measurement:

    With peak weighting selected, the maximum or minimum level during the selected measurement time is displayed. The peak detector is reset at the beginning of each measurement. At the end of the measurement time the maximum or minimum level occurred during the measurement time is displayed. Since the peak detector of R&S ESU is a digital detector, discharging is irrelevant even with long measurement times.

    Unmodulated signals can be measured with the shortest possible measurement time. When pulses are measured, the selected measurement time must be long enough for at least one pulse to occur during the measurement time.

*   Average measurement:

    With average detection selected, the video voltage (envelope of IF signal) is averaged during the measurement time. Averaging is digital, i.e. the digitized values of the video voltage are summed up and divided by the number of samples at the end of the measurement time. This corresponds to a filtering with a rectangular window in the time domain and a filtering with sin x/x characteristic in the frequency domain. With unmodulated signals the shortest possible measurement time can be selected. With modulated signals the measurement time is determined by the lowest modulation frequency to be averaged. With pulse signals, the selected measurement time should be long enough for sufficient number of pulses (>10) to occur in the measurement window for averaging.

- CISPR average and CISPR rms measurement:

  With a CISPR average or a CISPR rms measurement, the maximum value of the weighted signal during the measurement time is displayed. The relatively long time constants used with CISPR average and CISPR rms detectors result in long measurement times in order to obtain a correct measurement result. If unknown signals are measured, the measurement time should be at least one second so that pulses down to a frequency of 5 Hz are correctly weighted.

  After a frequency change or a modification of the attenuation, the receiver waits until the lowpass has settled before the measurement time starts. The measurement time is selected depending on the IF bandwidth and the characteristics of the signal to be measured. Unmodulated sinusoidal signals as well as signals with high modulation frequency can be measured within a short time. Slowly fluctuating signals or pulse signals require longer measurement times.

- RMS measurement:

  With RMS weighting the same applies to the measurement time as with the average measurement.

- Quasi-peak measurement:

  With quasi-peak measurements, the maximum value of the weighted signal during the measurement time is displayed. The relatively long time constants used with quasi-peak detectors entail long measurement times to obtain correct results. With unknown signals the measurement time should be at least 1 s. This ensures correct weighting of pulses down to a pulse frequency of 5 Hz.

  After internal switching, R&S ESU waits until the measurement result has stabilized before it starts the actual measurement. Since the level does not change during a frequency scan, known signals (e.g. broadband RFI) can be correctly measured with a much shorter measurement time.

- Measurement with several detectors:

  If several detectors are used simultaneously, a measurement time suiting the slowest detector should be selected to obtain correct results for all detectors. It is therefore recommended to set a measurement time that matches the average detector when the peak and average detectors are used.

AF Demodulators

The R&S ESU provides demodulators for AM and FM signals. With these demodulators selected, a displayed signal can be monitored using the internal loudspeaker or external headphones.

DEMOD

```
        DEMOD  ⇩    →      DEMOD
                          ON    OFF

                            AM

                            FM

                          SQUELCH
```
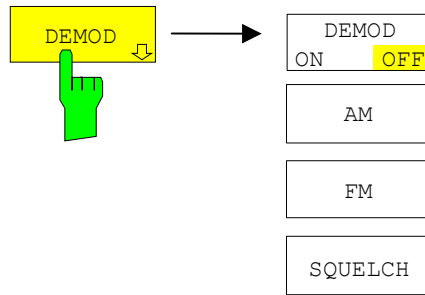
The *DEMOD* softkey calls a submenu in which the desired type of demodulation can be switched on.

The volume for loudspeaker and headphones is set by means of control knob on the front panel. The volume can also be remote-controlled (IEC/IEEE-bus command SYST:SPE:VOL 0.7).

A squelch function enables the input of a level threshold below which the audible AF is cut off.

> **Note**
>
> This softkey is available also in the *RECEIVER / MEAS* menu.

DEMOD ON/OFF   The *DEMOD ON/OFF* softkey switches demodulation on/off.

IEC/IEEE bus command: DEM OFF
                          (DEModulation ON automatically switched on
                          with DEM AM | FM)

AM / FM   The *AM* and *FM* softkeys can be activated one at a time. They are used to set the desired demodulation type, FM or AM.

IEC/IEEE bus command: DEM AM | FM

SQUELCH   The *SQUELCH* softkey enables the input of a level threshold below which the audible AF is cut off. The squelch function is associated with the internal trigger function (*TRIGGER* menu), which will be switched on automatically with the squelch. Squelch level and trigger level do have the same value.

The default setting for the squelch is off.

IEC/IEEE bus command: :SENS:DEM:SQU ON | OFF
                          :SENS:DEM:SQU:LEV 80 PCT

Data Reduction and Peak List

EMI measurements may involve much time because the time constants prescribed by the standard for the quasi-peak weighting require transients which lead to long measurement times per each value. In addition, the standards stipulate procedures for finding local EMI maxima such as shifting the absorbing clamp, variation of the test antenna height and rotating the DUT. Measuring with quasi-peak weighting at each frequency and for each setting of the test configuration would lead to unacceptably long measurement times. For this reason, R&S has developed a method which reduces the time-consuming measurements to a minimum with an optimum reliability of detection.

Data Reduction using the Subrange Maximum

The interference spectrum is first pre-analyzed in a fast prescan to optimize the duration of the measurement. Data reduction follows so that the time-consuming final measurement is performed at only some important frequencies:
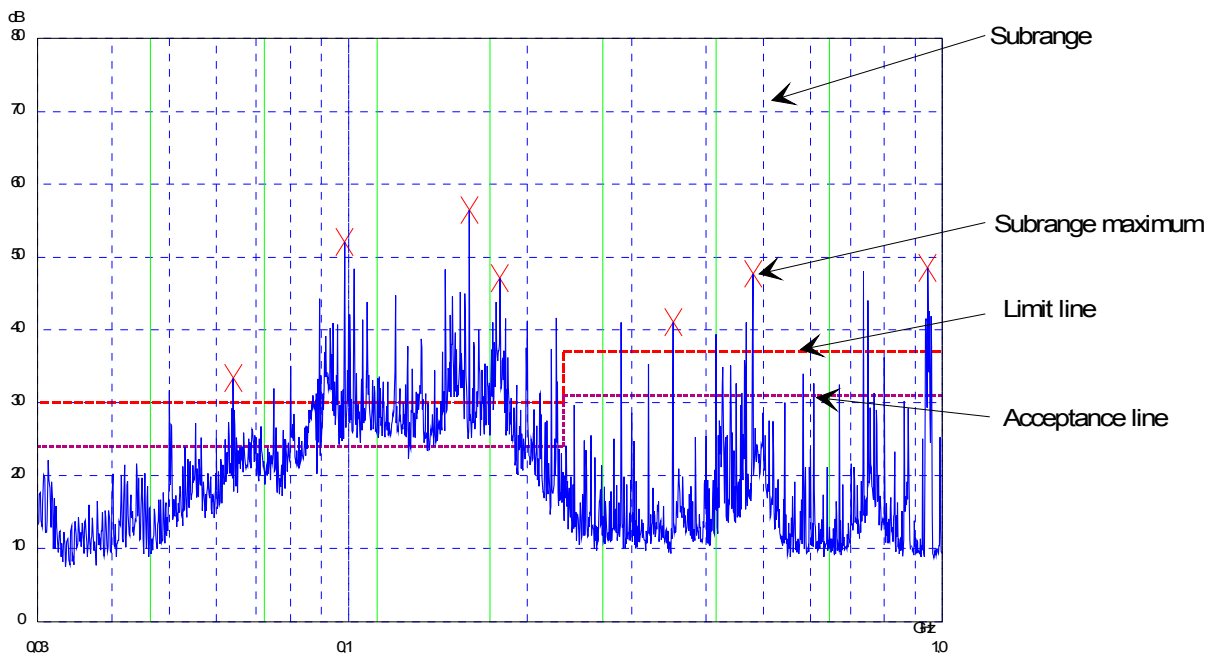
Fig. 4-1   Dividing the spectrum into eight subranges

Data reduction is of crucial importance. It is initiated by the user pressing a key after the prescan and then automatically performed by the receiver. Data reduction is used to select frequencies with a very high interference level. Several data reduction methods are used:

- Acceptance analysis, i.e. the interference spectrum is further analyzed at frequencies with levels above a line parallel to a limit line.

- Generating subrange maxima, i.e. the interference spectrum is further analyzed at frequencies with the highest interference level of a frequency subrange (search method SUBRANGES).

- Determination of a specific number of peak values relative to the limit lines with the level values being independent of their frequency spectral distribution (search method PEAKS).

For generation of subrange maxima, the whole frequency range is divided into equidistant subranges. A subrange maximum is determined for each subrange (search method SUBRANGES).

Determining the level maxima irrespective of their distribution in the frequency spectrum (search mode PEAKS) is suitable for measurement regulations that demand determination of the relatively highest level irrespective of the distribution in the measured frequency range, e.g. FCC.

If the prescan is performed in parallel with several detectors, typically with peak value and average value, the maxima are determined separately for the two detectors so that the distribution of narrowband and wideband sources of interference can be taken into account. For example, the frequency of the maximum determined with the average detector can be used for the final measurement performed with this detector and the frequency found in the prescan carried out with the peak detector is taken for the final measurement using the quasi-peak detector.

Consideration of the limit lines ensures that the final measurement is not performed at frequencies at which the inference level is far below the limit value. The margin between the acceptance line and the limit line can be selected by the user in dB as the *MARGIN*. Each limit line is allocated to a trace, i.e. different limit lines are taken for the different detectors.

Two values should therefore be defined for this purpose:

- the number of subranges or highest level values (*NO OF PEAKS* in the range from 1 to 500; default value: 25)

- the acceptance margin (*MARGIN*; default value: 6 dB). It is valid for all limit lines.

As an alternative method, it is possible to preset a list of frequencies at which the final measurements are performed. A typical application is, for example, the statistical analysis of several units.

The peak list can be either edited manually or can be filled with desired values by adopting the marker values.

If no limit lines are activated, the measurement procedure is as if all measured values would exceed the limit line.

FINAL MEAS   The *FINAL MEAS* softkey opens the following submenu:

> PEAK
> SEARCH

> EDIT PEAK
> LIST ⬇

> NO OF
> PEAKS

> PEAKS
> SUBRANGES

> MARGIN

> FINAL
> MEAS TIME

> AUTOMATIC
> FINAL

> INTER
> ACTIVE

> RUN FINAL
> MEAS
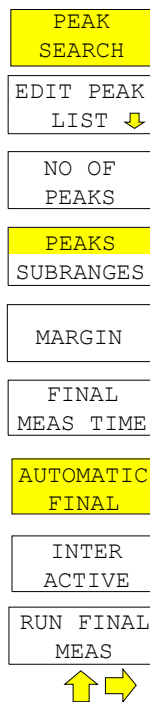
PEAK SEARCH   The *PEAK SEARCH* softkey starts the determination of the subrange maxima
                 list from the available scan results. The procedure can be repeated as often as
                 desired to try out different settings of margin and number of subranges.

                 IEC/IEEE bus command: `:CALC:PEAK`

                 The following table shows the peak list which is determined by the peak-search
                 function after the prescan:

EDIT PEAK LIST (Prescan results)

Trace1: 014QP
Trace2: 014AV
TRACE3: ---

TRACE		FREQUENCY	LEVEL dBpT	DELTA LIMIT dB
1	Average	80.0000 MHz	35.34	-3.91
2	Average	89.4800 MHz	38.83	-0.91
1	Max Peak	98.5200 MHz	47.53	-2.63
2	Average	98.5200 MHz	46.63	6.47
1	Max Peak	100.7200 MHz	54.14	3.88
2	Average	102.3200 MHz	50.89	10.56
1	Max Peak	113.2400 MHz	49.68	-1.08
2	Average	116.9200 MHz	44.81	3.91
1	Max Peak	125.8800 MHz	55.01	3.78
2	Average	125.8800 MHz	53.55	12.33
1	Max Peak	138.4800 MHz	45.68	-5.95
2	Average	138.4800 MHz	42.17	0.53
2	Average	144.0400 MHz	43.72	1.90
2	Average	167.0400 MHz	44.77	2.32
2	Average	176.2400 MHz	45.52	2.83
1	Max Peak	200.4800 MHz	52.49	-0.75
2	Average	200.4800 MHz	48.76	5.51
1	Max Peak	210.2800 MHz	60.55	7.09
2	Average	226.5600 MHz	59.02	15.24
2	Average	239.0000 MHz	48.59	4.75

EDIT PEAK LIST

```
EDIT PEAK        EDIT
  LIST     →   FREQUENCY

               INSERT

               DELETE

              SORT BY
             FREQUENCY

              SORT BY
             DELTA LIM

            ASCII FILE
              EXPORT

            DECIM SEP
             .      ,

             PAGE UP

            PAGE DOWN
```
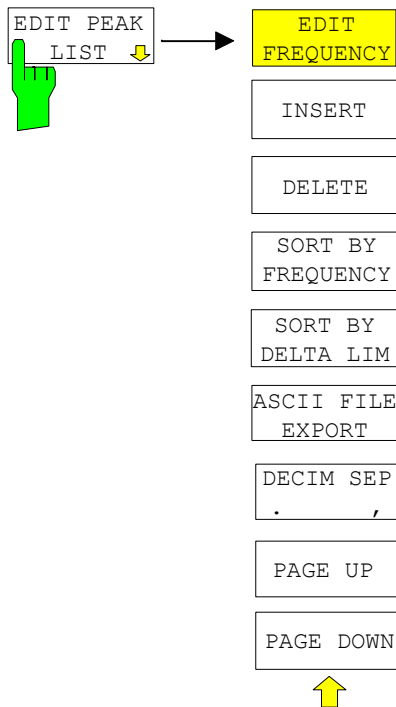
The *EDIT PEAK LIST* softkey calls the *EDIT PEAK LIST* submenu used for editing the peak list. A frequency list can thus be predefined and a final measurement carried out at these frequencies.

A peak list can also be generated by adopting the marker values (see section "Change of Settings via Markers – MKR-> Key" on page 4.72)

EDIT FREQUENCY   The *EDIT FREQUENCY* softkey activates table *EDIT PEAK LIST.* The cursor marks the upper field of column *FREQUENCY*.

IEC/IEEE bus command: --

INSERT   The *INSERT* softke*y* creates an empty line above the current cursor position

IEC/IEEE bus command: --

DELETE   The *DELETE* softkey erases the complete line at the cursor position. Before deletion, a message appears requesting confirmation.

IEC/IEEE bus command: --

SORT BY FREQUENCY   The softkey *SORT BY FREQUENCY* sorts the table in a descending order according the entries in the *FREQUENCY* column.

IEC/IEEE bus command: --

SORT BY DELTA LIMIT   The softkey *SORT BY DELTA LIMIT* sorts the table in a descending order according to the entries in the *DELTA LIMIT* column.

IEC/IEEE bus command: --

ASCII FILE EXPORT   The *ASCII FILE EXPORT* softkey stores the final measurement data in a file with ASCII format, e.g. on memory stick.

IEC/IEEE bus command: `FORM ASC;`
`MMEM:STOR:FIN 1,'FINAL.DAT'`

The file consists of the header containing important scaling parameters, several data sections containing the scan settings and a data section containing the results of the final measurement.

The data of the file header consist of three columns, each separated by a semicolon:

parameter name; numeric value; basic unit

The data section for the trace date starts with the keyword " Trace <n> Final" (<n> = number of stored trace), followed by the measured data in one or several columns which are also separated by a semicolon.

This format can be read in from spreadsheet calculation programs, e.g. MS-Excel. It is necessary to define ';' as a separator.

Note

Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using softkey *DECIM SEP*.

DECIM SEP   The *DECIM SEP* softkey selects the decimal separator between '.' (decimal point) and ',' (comma) with floating-point numerals for the function ASCII FILE EXPORT.

With the selection of the decimal separator different language versions of evaluation programs (e.g. MS-Excel) can be supported.

IEC/IEEE bus command: `FORM:DEXP:DSEP POIN`

Structure of the ASCII file

Table 4-1   RECEIVER mode, final measurement data – File header

Content of file	Description
Type; R&S ESU;	Instrument model
Version;2.32;	Firmware version
Date;03.Aug 2004;	Date record storage date
Mode;Receiver;	Instrument operating mode
Start;10000;Hz	Start/stop of the display range.
Stop;100000;Hz	Unit: Hz
x-Axis;LIN;	Scaling of x axis linear (LIN) or logarithmic (LOG)
Scan Count;1;	Number of scans set
Transducer;TRD1;	Transducer name (if switched on)
Scan 1:	Loop over all defined scan ranges (1-10)
Start;150000;Hz	Range - start frequency in Hz
Stop;1000000;Hz	Range – stop frequency in Hz
Step;4000;Hz	Range - step width in Hz for linear step width or in% (1-100) for logarithmic step width
RBW;100000;Hz	Range - resolution bandwidth
Meas Time;0.01;s	Range - measurement time
Auto Ranging;ON;	Auto ranging on - or off for current range
RF Att;20;dB	Range - input attenuation
Auto Preamp;OFF;	Auto Preamp on or off for current range
Preamp;0;dB	Range - preamplifier on (20dB) or off (0dB)

Table 4-2   RECEIVER mode, final measurement data – Data section of the file

Content of file	Description
TRACE 1 FINAL:	Selected trace
Trace Mode;CLR/WRITE;	Trace mode: CLR/WRITE,AVERAGE,MAX HOLD,MIN HOLD, VIEW, BLANK
Final Detector, QUASI PEAK;	Final detector MAX PEAK, MIN PEAK, RMS, AVERAGE, QUASI PEAK, AC VIDEO
x-Unit;Hz;	Unit of x values:
y-Unit;dBuV;	Unit of y values:
Final Meas Time;1.000000;s	Final measurement time
Margin;6.000000:s	Margin
Values;8;	Number of test points
2;154000.000000;81.638535;15.638 535;N;GND	Measured values:
	<Trace>;<x-value>, <y-value>; <phase>; <ground>
1;158000.000000;86.563789;7.5637 89;N;GND	Phase and protective grounding are output only if a line impedance stabilization has been activated. They specify the setting at which the maximum RFI level at the associated frequency was found.
2;1018000.000000;58.689873;- 1.310127;N;GND	
...	

Example for exported final measurement data

```
Type;ESU;
Version;2.23;
Date;03.Mar 04;
Mode;Receiver;
Start;150000.000000;Hz
Stop;30000000.000000;Hz
x-Axis;LOG;
Scan Count;1;
Transducer;;
Scan 1:
Start;150000.000000;Hz
Stop;30000000.000000;Hz
Step;4000.000000;Hz
RBW;9000.000000;Hz
Meas Time;0.001000;s
Auto Ranging;OFF;
RF Att;10.000000;dB
Auto Preamp;OFF;
Preamp;0.000000;dB
TRACE 1 FINAL:
Trace Mode;CLR/WRITE;
```

```
Final Detector;MAX PEAK;
TRACE 2 FINAL:
Trace Mode;CLR/WRITE;
Final Detector;AVERAGE;
x-Unit;Hz;
y-Unit;dBuV;
Final Meas Time;1.000000;s
Margin;6.000000;dB
Values;11;
2;154000.000000;81.638535;15.638535;N;GND
1;158000.000000;86.563789;7.563789;N;GND
2;1018000.000000;58.689873;-1.310127;N;GND
2;302000.000000;63.177345;-2.822655;L1;GND
2;3294000.000000;56.523022;-3.476978;N;GND
2;1122000.000000;53.849747;-6.150253;N;GND
2;10002000.000000;47.551216;-12.448784;N;GND
1;3390000.000000;59.762917;-13.237083;N;GND
1;9998000.000000;58.309189;-14.690811;L1;GND
2;20002000.000000;45.142456;-14.857544;L1;GND
2;7502000.000000;36.406967;-23.593033;L1;GND
```

NO OF PEAKS

The *NO OF PEAKS* softkey activates the entry field of the number of subranges or peaks for the determination of the peak list. The range of values is 1 to 500.

IEC/IEEE bus command: `:CALC:PEAK:SUBR 1 to 500`

PEAKS SUBRANGES

The *PEAKS SUBRANGES* softkey defines the search method with which maxima are searched for within a scan.

PEAKS   Determination of a specific number of peak values relative to the limit lines with the level values being independent of their frequency spectral distribution.

SUBRANGES   Generating subrange maxima, i.e. the interference spectrum is further analyzed at frequencies with the highest interference level of a frequency subrange.

IEC/IEEE bus command: `:CALC:PEAK:METH SUBR|PEAK`

MARGIN

The *MARGIN* softkey activates the entry field of the margin, i.e. of an additional acceptance threshold for the determination of the peak list. The limit line currently used is shifted by this amount for defining the maxima. The range of values is -200 dB to 200 dB.

IEC/IEEE bus command: `:CALC:PEAK:MARG -200dB to 200dB`

FINAL MEAS TIME

The *FINAL MEAS TIME* softkey activates the entry field of the time of final measurement.

IEC/IEEE bus command: `:SWEep:TIME:FME <num_value>`

AUTOMATIC FINAL   The *AUTOMATIC FINAL* softkey selects the automatic routine for the final measurement. This routine is run according to the available frequency list without user interaction.

IEC/IEEE bus command: `:FME:AUTO ON`

INTERACTIVE   The *INTERACTIVE* softkey selects the following sequence for the final measurement:

- A frequency from the frequency list is set on the receiver together with the associated settings from the corresponding partial scan.

- The marker is set on this frequency in the scan diagram.

- The final measurement sequence switches to the *Interrupted* status.

- The signal can be exactly analyzed by modifying the receiver settings.

- *CONTINUE AT HOLD* starts the actual final measurement, the receiver settings being restored except the frequency.

- The current frequency replaces the original one in the frequency list (drifting interference sources)

- Next frequency of frequency list.....

Note

With the *AUTOMATIC FINAL* softkey in the *CONTINUE FINAL MEAS* submenu a switchover can be made to the automatic mode before the measurement is started anew.

IEC/IEEE bus command: `:FMEA:AUTO OFF`

RUN FINAL MEAS   **Sequence for *RUN FINAL MEAS***
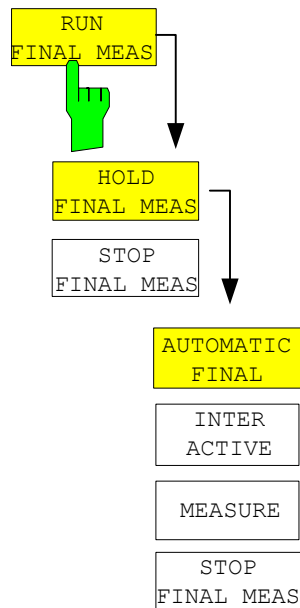
The *RUN FINAL MEAS* softkey starts the final measurement sequence as described above. The *HOLD FINAL MEAS* submenu is called.

The detectors used for the final measurement replace those used in the list or for the prescan.

The out-of-limit condition is shown by a plus sign preceding the values in the *DELTA LIMIT* column (see table below).

IEC/IEEE bus command: --

Note

The final measurement function is only available in the manual mode. For operation under program control it is preferable to read the prescan results and the data-reduced peak list, if any, from the R&S ESU with the controller and carry out the individual measurements with the controller. This considerably makes the control of the interactive mode easier.

HOLD FINAL MEAS
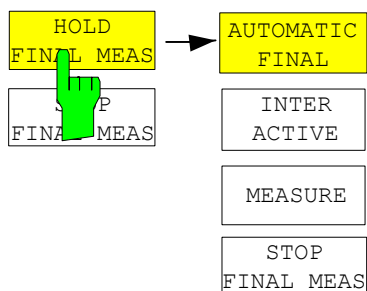
The *HOLD FINAL MEAS* softkey interrupts the automatic run of the final measurement.

The *CONTINUE FINAL MEAS* submenu appears.

With the final measurement halted all receiver settings can be modified for example for examining the signal in detail.

The mode of the measurement (automatic or interactive) can again be selected.

The final measurement can be started with the *MEASURE* softkey.

IEC/IEEE bus command: --

AUTOMATIC FINAL   The *AUTOMATIC FINAL* softkey selects the automatic mode for the final measurement (see above).

IEC/IEEE bus command: :FME:AUTO ON

INTERACTIVE   The *INTERACTIVE* softkey selects the interactive mode for the final measurement as described above.

IEC/IEEE bus command: :FME:AUTO OFF

MEASURE   The *MEASURE* softkey continues with the final measurement. The final measurement starts at the next frequency entry on the peak list or at a marked frequency if one or several lines have been skipped with the *SKIP FREQUENCY* softkey.

IEC/IEEE bus command: --

STOP FINAL MEAS   The *STOP FINAL MEAS* softkey halts the final measurement. The final measurement starts from the beginning on a new start. The previously collected data is lost.

IEC/IEEE bus command: --

The peak list available after the final measurement:

EDIT PEAK LIST (Final Measurement Results)			
Trace1: 014QP			
Trace2: 014AV			
TRACE3: ---			
TRACE	**FREQUENCY**	**LEVEL dBpT**	**DELTA LIMIT dB**
1 Average	80.0000 MHz	29.99	-9.25
2 Average	89.4800 MHz	35.64	-4.09
1 Quasi Peak	98.5200 MHz	49.94	-0.22
2 Average	98.5200 MHz	48.32	8.15
1 Quasi Peak	100.7200 MHz	55.33	5.07
2 Average	102.3200 MHz	50.86	10.53
1 Quasi Peak	113.2400 MHz	42.50	-8.26
2 Average	116.9200 MHz	44.44	3.53
1 Quasi Peak	125.8800 MHz	54.91	3.68
2 Average	125.8800 MHz	53.86	12.64
1 Quasi Peak	138.4800 MHz	41.83	-9.81
2 Average	138.4800 MHz	39.38	-2.25
2 Average	144.0400 MHz	40.77	-1.04
2 Average	167.0400 MHz	44.82	2.37
2 Average	176.2400 MHz	46.56	3.87
1 Quasi Peak	200.4800 MHz	50.93	-2.31
2 Average	200.4800 MHz	48.27	5.02
1 Quasi Peak	210.2800 MHz	58.71	5.25
2 Average	226.5600 MHz	59.07	15.29
2 Average	230.0000 MHz	46.90	3.05

Automatic Final Measurement with Threshold Scan

The interference spectrum is first pre-analyzed in a fast prescan to optimize the duration of the measurement. If the measured level exceeds a limit line, or violates a margin defined for this line, the time-consuming final measurement is performed. The final measurement is, therefore, carried out only for a reduced number of frequencies of interest. For this measurement, each scan trace to be taken into account has to be assigned a limit line, and the limit line and the limit check function have to be activated in the *LIMIT LINE* menu.

The prescan is interrupted immediately for each final measurement to be performed, i.e. the final measurement immediately follows the prescan measurement. In the case of drifting or fluctuating interferers, this increases the probability that the signal of interest will be reliably detected in the final measurement.

If the narrowband/broadband discrimination function is activated (*NB/ BB DISCR* softkey), the receiver automatically selects the detector to use in the final measurement. To this end, the receiver compares the positive and the negative peak value obtained in the prescan. If the difference between the two values exceeds a user-selected threshold, a broadband interferer is assumed, and the quasi-peak detector is used in the final measurement. If the difference falls below this threshold, a narrowband interferer is assumed, and the average detector is used in the final measurement. (The receiver automatically determines the positive and the negative peak value during the prescan.)

The value obtained in the final measurement is added to the peak list, where it replaces the result of the prescan. With *NO OF PEAKS*, the maximum number of peak values to be included in the list can be defined. If this number is attained, the prescan will be continued, but no further final measurements will be performed.

THRESHOLD SCAN The *THRESHOLD SCAN* submenu is called from the *RECEIVER* main menu:
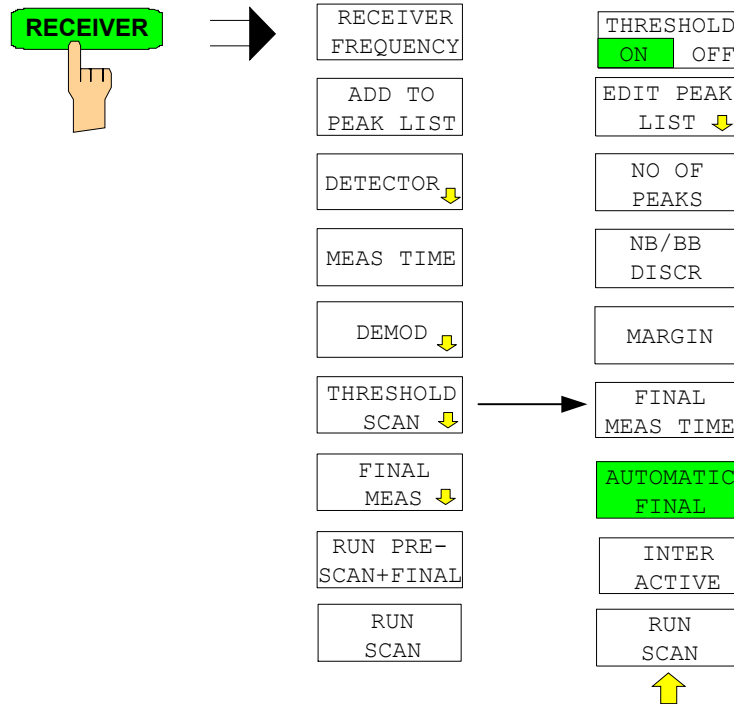
THRESHOLD ON OFF The *THRESHOLD ON OFF* softkey activates or deactivates the *THRESHOLD SCAN* measurement function. This function will also be activated on opening the submenu with the *THRESHOLD SCAN* softkey from the *RECEIVER* main menu.

EDIT PEAK LIST

```
                              EDIT PEAK
                                LIST
  EDIT PEAK   ────────▶      EDIT
    LIST                   FREQUENCY

                             INSERT

                             DELETE


                                                    ASCII
                                                   CONFIG
                            SORT BY              EDIT PATH
                           FREQUENCY

                            SORT BY             DECIM SEP
                          DELTA LIM             .       ,

                             ASCII                 NEW
                            EXPORT               APPEND

                             ASCII               HEADER
                            CONFIG             ON     OFF

                            PAGE UP              ASCII
                                               COMMENT

                           PAGE DOWN
```
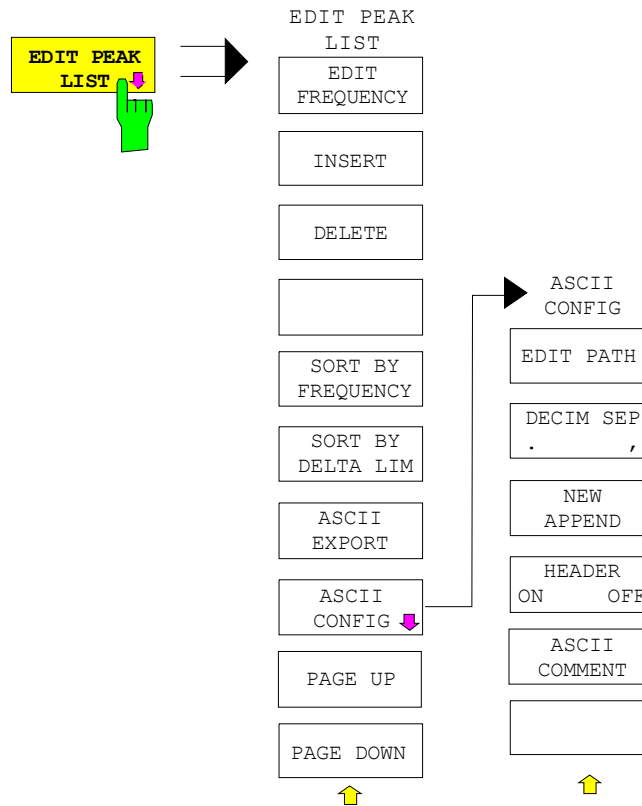
The *EDIT PEAK LIST* softkey calls the *EDIT PEAK LIST* submenu used for editing the peak list.

Further functions relating to the peak list are described in the operating manual, section .

NO OF PEAKS   With the *NO OF PEAKS* softkey, you can enter the number of final measurement peaks to be stored. Numbers between 1 and 500 can be entered. If the selected number is attained, no further final measurements will be performed.

IEC/IEEE bus command: `:CALC:PEAK:SUBR 1...500`

NB/BB DISCR   With the *NB/BB DISCR* softkey, you can enter the decision threshold to be used by the analyzer to discriminate between broadband and narrowband interference. Values between 0 dB and 200 dB can be entered.

IEC/IEEE bus command: `:FMEasurement:NBBB ON | OFF`
                          `:FMEasurement:NBBB:LEVel 0..200dB`

MARGIN   The *MARGIN* softkey activates the entry field of the margin, i.e. of an additional acceptance threshold for the determination of the peak list. The limit line currently used is shifted by this amount for defining the maxima. The range of values is -200 dB to 200 dB.

IEC/IEEE bus command: `:CALC:PEAK:MARG −200dB...200dB`

FINAL MEAS TIME   The *FINAL MEAS TIME* softkey activates the entry field of the time of final measurement.

IEC/IEEE bus command: `:SWE:TIME:FME <num_value>`

AUTOMATIC FINAL   The *AUTOMATIC FINAL* softkey activates the automatic mode for the final measurement, i.e. a final measurement will be performed automatically and immediately each time a value out of limit is detected.

IEC/IEEE bus command: `:FMEasurement:AUTO ON`

INTERACTIVE   The *INTERACTIVE* softkey selects the following sequence for the final measurement:

- The prescan is interrupted – *HOLD SCAN* state.

- The bar graph measurement is started in the free running mode.

- The signal can be exactly analyzed by modifying the receiver settings.

- The actual final measurement is started, the receiver settings being restored except the frequency.

- The current frequency replaces the original one in the frequency list (drifting interference sources).

- The prescan is continued at the frequency at which it was interrupted....

Note

With the *AUTOMATIC FINAL* softkey in the CONTINUE FINAL MEAS submenu a switchover can be made to the automatic mode before the measurement is started anew.

IEC/IEEE bus command: `:FMEasurement:AUTO OFF`

Sequence for *AUTOMATIC FINAL*

RUN SCAN
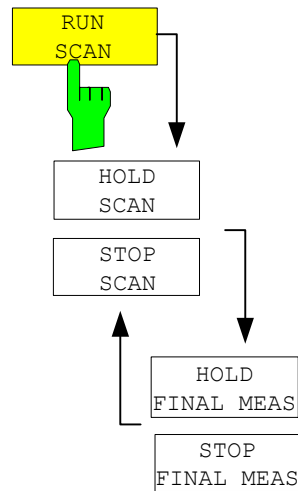
```
┌──────────┐
│  RUN     │
│  SCAN    │──────┐
└──────────┘      │
      👆          │
                  ▼
┌──────────┐
│  HOLD    │
│  SCAN    │
└──────────┘
┌──────────┐
│  STOP    │─────┐
│  SCAN    │     │
└──────────┘     │
      ▲          │
      │          ▼
      │    ┌────────────┐
      │    │   HOLD     │
      │    │ FINAL MEAS │
      │    └────────────┘
      │    ┌────────────┐
      └────│   STOP     │
           │ FINAL MEAS │
           └────────────┘
```

The *RUN SCAN* softkey starts the prescan. The *HOLD SCAN* submenu is called.

If an out-of-limit value is detected, the receiver automatically goes to the HOLD SCAN state and starts the final measurement. The *HOLD FINAL MEAS* submenu comes up. On completion of the final measurement, the receiver continues the prescan, and the *HOLD SCAN* submenu is displayed again.

Sequence for *INTERACTIVE*
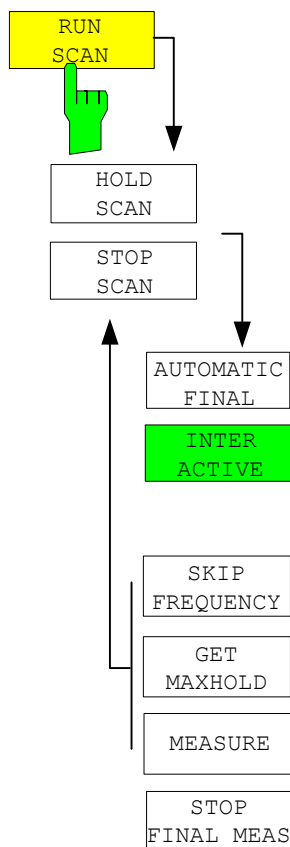
```
      ┌─────────┐
      │  RUN    │───────┐
      │  SCAN   │       │
      └─────────┘       │
        👉              │
                        ▼
      ┌─────────┐
      │  HOLD   │
      │  SCAN   │
      └─────────┘
      ┌─────────┐───────┐
      │  STOP   │       │
      │  SCAN   │       │
      └─────────┘       │
        ▲               ▼
        │         ┌──────────┐
        │         │ AUTOMATIC│
        │         │  FINAL   │
        │         └──────────┘
        │         ┌──────────┐
        │         │  INTER   │
        │         │  ACTIVE  │
        │         └──────────┘
        │
        │         ┌──────────┐
        │         │  SKIP    │
        │         │FREQUENCY │
        │         └──────────┘
        │         ┌──────────┐
        │         │  GET     │
        │         │ MAXHOLD  │
        │         └──────────┘
        │         ┌──────────┐
        └─────────│ MEASURE  │
                  └──────────┘
                  ┌──────────┐
                  │  STOP    │
                  │FINAL MEAS│
                  └──────────┘
```

The *RUN SCAN* softkey starts the prescan. The *HOLD SCAN* submenu is called.

If an out-of-limit value is detected, the receiver automatically goes to the HOLD SCAN state. A submenu with several options for the final measurement comes up:

- *AUTOMATIC FINAL* activates the automatic final measurement mode for the rest of the test run.

- *SKIP FREQUENCY* skips the final measurement and continues with the prescan.

- *GET MAXHOLD* accepts the highest level measured during the HOLD SCAN state as the result of the final measurement and continues the prescan. (The level value in question is displayed as a small bar in the bar graph.)

- *MEASURE* starts the final measurement, the receiver settings being restored except the frequency.

- *STOP FINAL MEAS* aborts the final measurement and the prescan.

Selection of Detectors for Final Measurement

The selection of detectors for the final measurement is made in the right side menu *TRACE DETECTOR* (see section "Selection and Setting of Traces – TRACE Key" on page 4.78).

The detectors to be used for the final measurement can be set here for each trace, i.e. any combination of prescan and final measurement is possible. The required flexibility is thus obtained for the diverse test specifications which are covered by means of the R&S ESU.

In the *THRESHOLD SCAN* mode, with the *NB/BB DISCR* function active, the receiver automatically selects the detector to be used in the final measurement on the basis of the results obtained in the prescan.
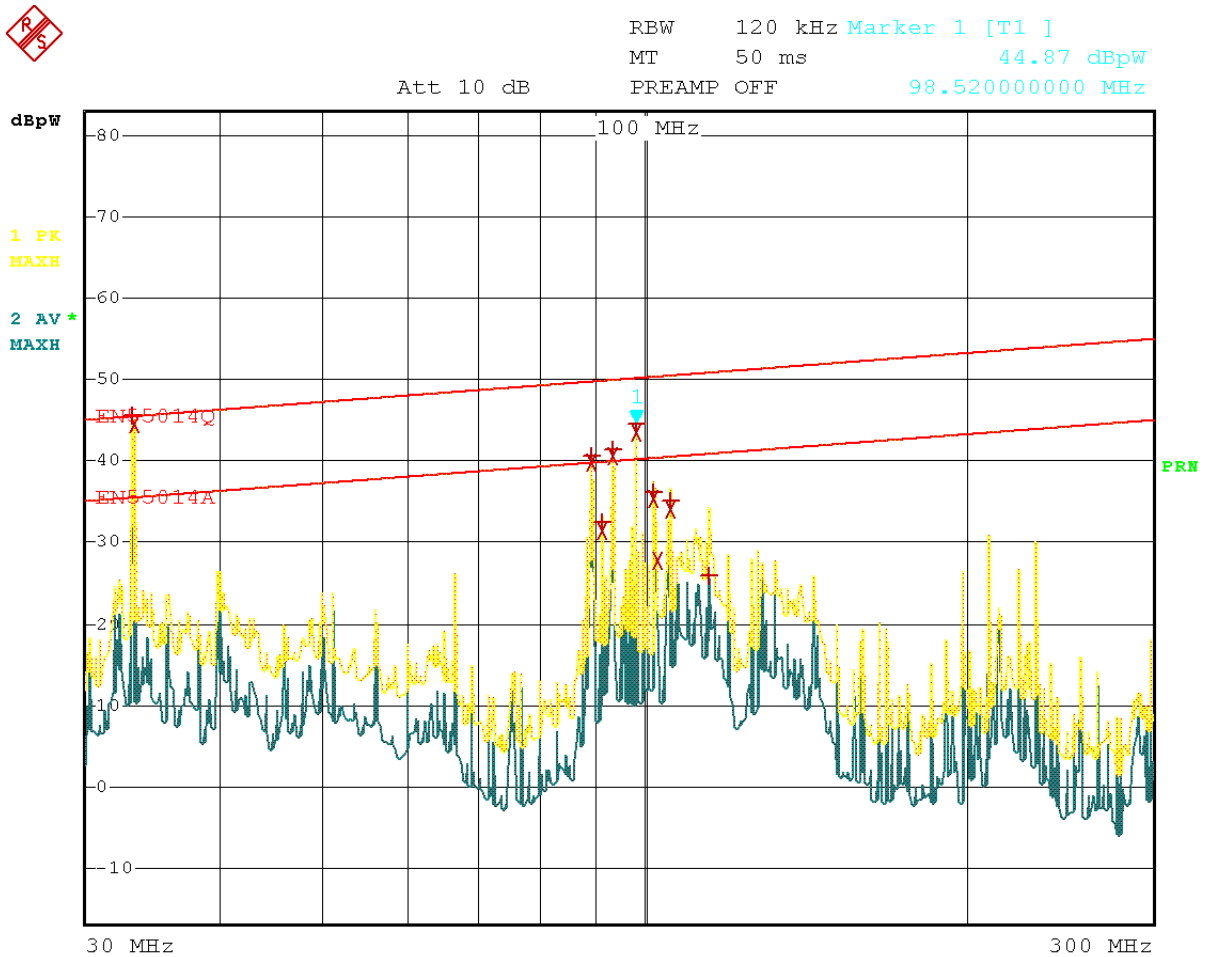
Fig. 4-2   Results of prescan and final measurement

Automatic Control of Line Impedance Stabilization Networks

The selected phases are controlled during the prescan and the final measurement via the USERPORT with the LISN switched on.

In contrast, the *LISN* menu in the *SETUP* menu is used for the direct control of the LISN and is not included in the automatic sequences.

Only one phase and one PE setting (1 out of n) can be selected for the prescan. Any number of settings can be selected for the final measurement (m out of n).

All selected phase/PE combinations are measured during the final measurement and the maximum value is determined.

In the *FINAL MEAS* side menu, the following softkeys are available:

```
┌──────────────┐
│   ESH2-Z5    │
└──────────────┘
┌──────────────┐
│   ESH3-Z5    │
└──────────────┘
┌──────────────┐
│   ENV 4200   │
└──────────────┘
┌──────────────┐
│   ENV 216    │
└──────────────┘
┌──────────────┐
│     OFF      │
└──────────────┘
┌──────────────┐        ┌──────────────┐
│   PRESCAN    │───────▶│   PHASE N    │
│   PHASES     │        └──────────────┘
└──────────────┘        ┌──────────────┐
┌──────────────┐        │   PHASE L1   │
│    FINAL     │───────▶└──────────────┘
│   PHASES     │        ┌──────────────┐
└──────────────┘        │   PHASE L2   │
                        └──────────────┘
                        ┌──────────────┐
                        │   PHASE L3   │
                        └──────────────┘
                        ┌──────────────┐
                        │   150 KHZ    │
                        │   HIGHPASS   │
                        └──────────────┘
                        ┌──────────────┐
                        │     PE       │
                        │   GROUNDED   │
                        └──────────────┘
                        ┌──────────────┐
                        │     PE       │
                        │   FLOATING   │
                        └──────────────┘
                               ⬆
```
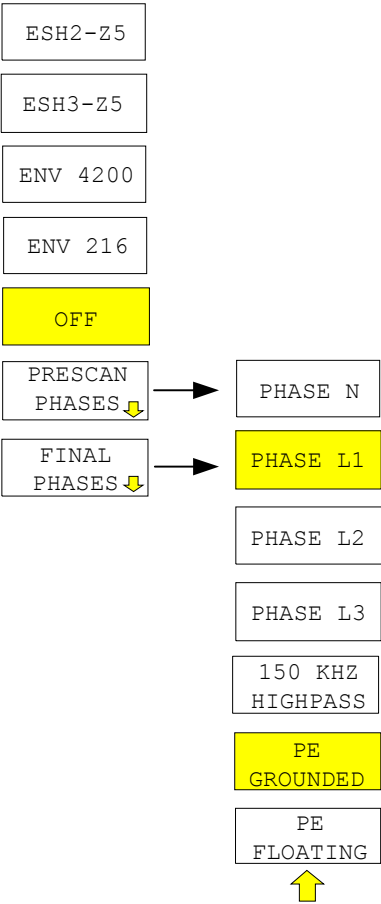
ESH2-Z5	The *ESH2-Z5, ESH3-Z5, ENV 4200,* and *OFF* softkeys allow to select the V-network to be controlled via the user port.
ESH3-Z5	
ENV 4200	
ENV 216	
OFF	

ESH2-Z5	four-line V-network is controlled
ESH3-Z5	two-line V-network is controlled
ENV 4200	four-line V-network is controlled
ENV 216	two-line V-network is controlled
OFF	remote control is deactivated

IEC/IEEE bus command: `:INPut:LISN[:TYPE] TWOPhase|`
`FOURphase| ENV4200 | ENV216 | OFF`

PRESCAN PHASES The *PRESCAN PHASES* and *FINAL PHASES* softkeys open the submenu for
FINAL PHASES the selection of phase and protective earth setting.

PRESCAN PHASES: Softkeys ESH2-Z5, ESH3-Z5, ENV 4200, ENV 216 and OFF or PHASE N, PHASE L1, PHASE L2 and PHASE L3 as well as PE GROUNDED and PE FLOATING are toggle keys. Only one of them can be activated at a time.

FINAL PHASES: All combinations of phases and PE setting are possible.

PHASE N The *PHASE N, PHASE L1, PHASE L2* and *PHASE L3* softkeys select the
PHASE L1 phase of the V-network on which the RFI voltage is to be measured.
PHASE L2
PHASE L3

PHASE N	RFI on phase N is measured,
PHASE L1	RFI on phase L1 is measured,
PHASE L2	RFI on phase L2 is measured (only for ESH2-Z5/ENV 4200),
PHASE L3	RFI on phase L3 is measured (only for ESH2-Z5/ENV 4200).

IEC/IEEE bus command: `:INP:LISN:PHAS L1 | L2 | L3 | N`

150 KHZ HIGHPASS The *150 KHZ HIGHPASS* softkey switches an 150 kHz highpass on to protect the receiver input from high signal levels below 150 kHz (only for ENV 216).

IEC/IEEE bus command: `INP:LISN:FILT:HPAS ON | OFF`

PE GROUNDED The *PE GROUNDED* and *PE FLOATING* softkeys switch the protective earth
PE FLOATING conductor chokes on or off (only for ESH2-Z5/ESH3-Z5).

| *PE GROUNDED* | protective earth conductor choke switched off, |
| *PE FLOATING* | protective earth conductor choke switched on. |

IEC/IEEE bus command: `:INP:LISN:PEAR GRO |FLO`

Settings made in the *PRESCAN PHASES* menu are immediately output at the user port. This way, the menu can be used to remote control the V-networks during manual measurements.

For automatic phase selection with the V-networks, the R&S ESU user interface and the V-networks have to be connected via a control line:

Receiver-User-Interface   ESH2-Z5

	PIN	Filter	PIN	
N	14		46	N
L1	15		21	L1
L2	16		22	L2
L3	17		23	L3
GND	12		50	GND
PE fl.	18		47	PE fl.
+5 V	13		48	+5 V
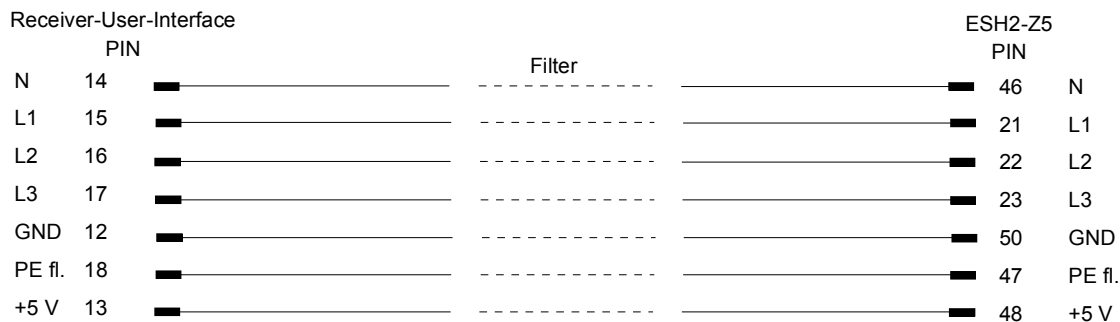
Fig. 4-3   Connection R&S ESU with R&S ESH2-Z5 (for direct connection without a filter: cable EZ-13)

Receiver-User-Interface   ESH3-Z5

	Pin	Filter	PIN	
N	14		2	N
L	15		6	L
PE fl.	18		3	PE fl.
GND	12		8	DGND
+5 V	13		1	+5 V
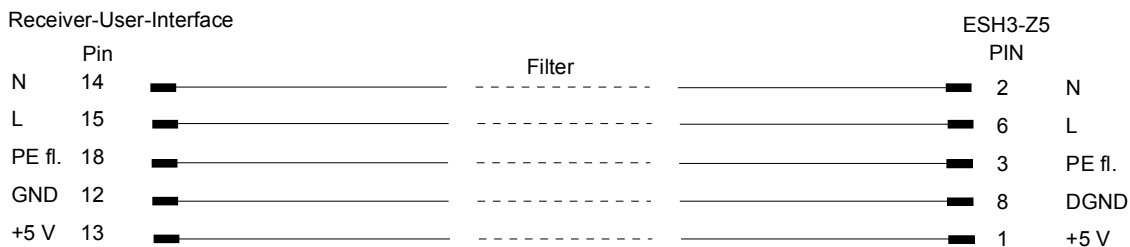
Fig. 4-4   Connection R&S ESU with R&S ESH3-Z5 or ENV 216 (for direct connection without a filter: cable EZ-14, model 02)

Receiver-User-Interface   ENV 4200

	Pin	Filter	PIN	
N	14		14	N
L1	15		15	L1
L2	16		16	L2
L3	17		17	L3
GND	12		12	GND
+5 V	13		13	+5 V
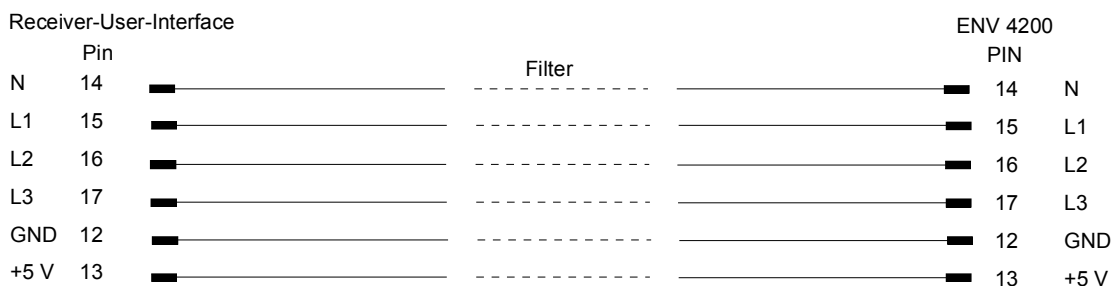
Fig. 4-5   Connection R&S ESU with R&S ENV4200 (for direct connection without a filter: cable EZ-21)

For controlling the phase selection and the PE simulating network of the V-networks ESH2-Z5, ESH3-Z5 and ENV42000, the +5-V supply voltage and some control lines are to be routed through the wall of the shielded room.

The connection cables EZ-14 and EZ-5 can be provided for the 4-line V-network ESH2-Z5, the connection cable EZ-14 and EZ-6 for the two-line V-network ESH3-Z5 and the connection cables ES-14 and EZ-21 for the 4-line V-network ENV4200.

Suggested configuration of cables EZ-14/EZ-5/EZ-6/EZ-21
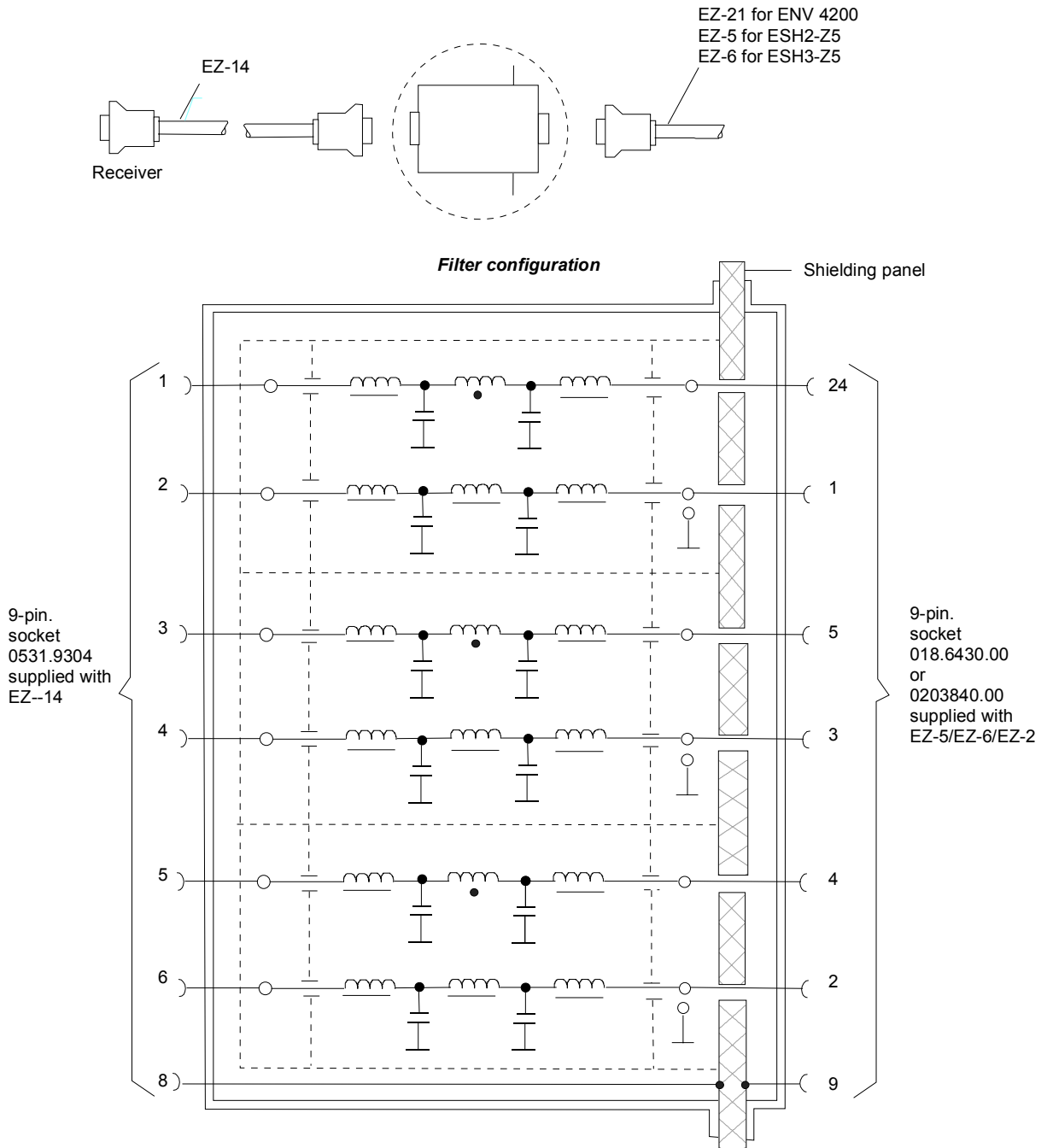
Fig. 4-6   Assignment of connection cables EZ-5, -6, -14 and –21 with AF
filters for feeding the 5-V supply and the control information for the
V-networks R&S ESH2-Z5, R&S ESH3-Z5 and R&S ENV4200 into
a shielded room.

Note

When the R&S ESU is used inside the shielded room, the filter configuration is omitted. The cable EZ-14 is then used for controlling the R&S ESH3-Z5, the cable EZ-13 for controlling the R&S ESH2-Z5, and the cable EZ-21 for controlling the R&S ENV4200.

Frequency Scan and Time Domain Scan – SWEEP Key

Stepped Scan in the Frequency Domain

In the scan mode, R&S ESU measures in a predefined frequency range with selectable step width and measurement time for each frequency.

Either the current receiver settings or the settings defined in the Scan table are used. Up to 10 subranges which need not be next to each other can be defined within one scan. The subranges are then scanned by R&S ESU one after the other. Measurement ranges should not overlap. The parameters to be measured in each subrange can be selected independently (*SWEEP* menu, *SCAN TABLE* table).

Transducer factors or transducer sets and limit lines can be defined and displayed separately and are not part of the scan data record.

The scanned frequency range is defined by the start and stop frequency set independently of the scan table (*SCAN TABLE* table or *FREQUENCY* menu). A scan table can thus be defined for each measurement task, which can be stored and reloaded. The required frequency range can be defined by means of two parameters which can be set via keys so that no elaborate editing has to be done in the scan table.
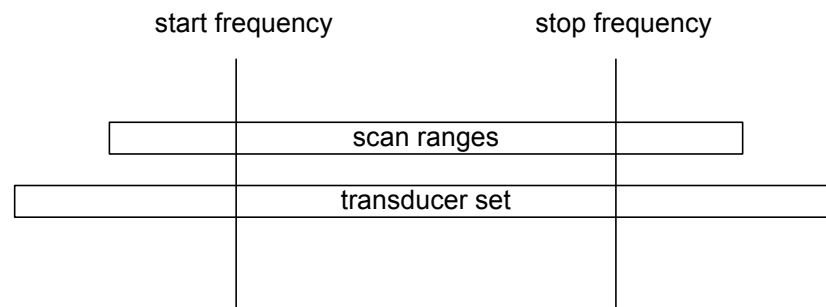
Fig. 4-7   Definition of scan range

Scanning is started with the *RUN* softkey. The scan can be performed as a single scan or continuously. In the case of single scan it is stopped when the stop frequency is reached. The continuous scan can be interrupted with the *HOLD SCAN* softkey or terminated with *STOP SCAN.*

The maximal number of measured frequencies is limited to 2.000.000. A maximum of 3 x 2.000.000 values (2.000.000 per detector) can be stored for postprocessing. If the scan subranges are defined so that more than the possible values would be measured, a respective message is output upon the scan start. Afterwards the scan is performed up to the maximum value.

At least one scan is defined in the list. Two subranges are defined in the default setup. All other parameters are shown in the following table:

Table 4-1   Default setup of scan table

	Range 1	Range 2
Start frequency	150 kHz	30 MHz
Stop frequency	30 MHz	1 GHz
Step width	Auto	Auto
IF bandwidth	9 kHz	120 kHz
Measurement time	1 ms	100 µs
Auto ranging	OFF	OFF
Attenuation mode	Normal	Normal
RF attenuation	10 dB	10 dB
Preamplification	OFF	OFF

The diagram parameters to be defined are: start frequency 150 kHz, stop frequency 1 GHz, min. level 0 dBµV, grid range log 100 dB, log. frequency axis and continuous scan.

The measurement parameters correspond to the settings recommended for overview measurements to CISPR 16.

Time Domain Scan in the Frequency Domain

> **Note**
>
> This functionality is only available with the R&S ESU-K53 option.

Up till now, long EMI measurement times were necessary in EMC test laboratories, when correct measurements of unknown EUTs had to be made. Time saving procedures as explained in "Data Reduction and Peak List" on page 4.32 reduced the total measurement time by reducing the number of quasi-peak measurements to a minimum. But this time is still very long, because it is often in the order of hours, especially for the CISPR radiated emission test. A way out of this situation can be time-domain measurements. Whereas in conventional EMI measurement systems, only the spectrum within the IF filter can be measured during a certain measurement time of e.g. 100 ms, in TDEMI measurement systems, large parts of the spectrum at the receiver input can be measured during the same time and it depends on the dynamic range and the resolution of the A/D conversion system, how accurate the measurement results are. Systems with higher resolution can provide a higher dynamic range.

The R&S ESU uses an internal fast A/D converter with up to 80 MHz sampling rate to convert a spectrum width of up to 7 MHz at a time. The restriction of the FFT width is due to the built-in preselection.

Frequency range	Max. Resolution Bandwidth	FFT width
<= 150 kHz	50 kHz	150 kHz
150 kHz … 2 MHz	50 kHz	2 MHz
2 MHz … 8 MHz	50 kHz	500 kHz
9 MHz … 15 MHz	120 kHz	1 MHz
15 MHz … 45 MHz	200 kHz	2 MHz
45 MHz … 70 MHz	500 kHz	4 MHz
> 70 MHz	1 MHz	7 MHz

Table 4-2   Frequency range vs. limitation of resolution bandwidth and FFT width

The A/D converter has 14 bit resolution, which in combination with the built-in preselector allows the high dynamic range which is needed for compliance with CISPR 16-1-1.

The prescan is used to get a detailed overview of the emission spectrum. It normally occupies the longest time of the whole emission test. Using partial fast fourier transform (FFT) of frequency sections, this time is reduced by factors. The prescan result is then analyzed and the critical frequencies can be determined. On the critical frequencies, if further maximization with antenna mast and turntable movement is needed, the receiver can be used in its conventional measurement function with quasi-peak and/or average detection to provide a measurement result which fully complies with CISPR 16 standards.

Scan on a Fixed Frequency in the Time Domain

It is also possible to carry out the scan in the time domain, i.e. at a fixed frequency. Time domain analysis is generally used to examine the time characteristics of interferences. Evaluating the detected voltage with an oscilloscope is useful in order to correctly set the receiver measurement time. By doing so, you can determine whether and how strongly a narrowband interference fluctuates and whether it is amplitude-modulated or pulsed. You can also determine the pulse rate of a broadband interference. You can set the measurement time to a value that is greater than or equal to the reciprocal of the pulse rate.

Thermostat-controlled, software-controlled and other electrically controlled instruments generate discontinuous interferences. CISPR 14 and EN 55014 contain limit values for RFI voltage with click rate weighting in the range 0.15 MHz to 30 MHz. Clicks can usually be measured using click rate analyzers. However, a factor that is often critical in click rate measurements is the occurrence of successive pulses whose individual pulse heights cannot be exactly assigned by using the time constants of the quasi-peak weighting and can thus lead to the limit value being exceeded.

Time domain analysis can determine the pulse height and duration, which can be useful in such cases. It meets the requirements of CISPR 16-1 with regard to accuracy of the pulse duration measurement when the pulse duration is 10 ms and longer. Triggering can be performed internally – level set with display line – or externally with a TTL level.

The result memory capacity is 2.000.000 measured values per trace in time domain analysis. The measured values are stored internally and can, for example, then be analyzed by zooming in on them with the marker. At a measurement time of 5 ms per measured value, the memory depth is large enough to record the peak value and quasi-peak value continuously for two hours. Thus, measurement objects such as washing machines can be evaluated for click interferences.

Once measurement has been completed, the display of the measured values can be enlarged down to the individual measured values by using the zoom function. Thus, each individual click interferer can be evaluated in detail if necessary.
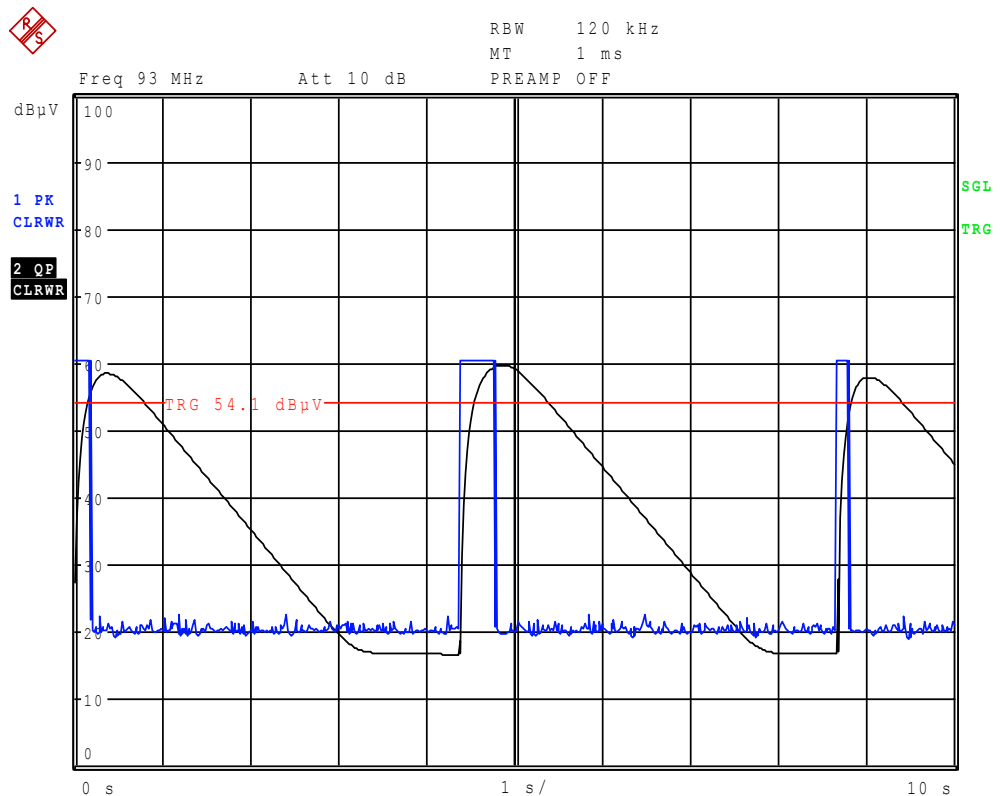
Fig. 4-8　　　Scan in the time range

Time domain analysis is started with the *RUN* softkey. It can be performed as a single operation (*SINGLE*) or as a repeating operation (*CONTINUOUS*). In *SINGLE* operation, time domain analysis stops after the total run time has elapsed. In *CONTINUOUS* operation, time domain analysis can either be interrupted with the *HOLD SCAN* softkey or stopped with the *STOP SCAN* softkey. The measurement itself is continuous, i.e. if the end of the graph is reached and recording starts again at the beginning of the graph, the measurement keeps running internally without any interruption.

Display of Measurement Results

Full-screen or split-screen mode can be selected for result display. In the full-screen mode, the result diagram covers the whole screen area.

In split-screen mode, the upper half of the screen displays the frequency and level readout, i.e. a bar graph. The diagram is displayed in the lower half

Up to 3 detectors can be measured simultaneously. They are assigned to traces 1 to 3. Since the detectors are set only once, it is not possible to measure with different detectors in different the subranges.

Entry of Scan Data

Pressing the *SWEEP* key opens the menu to configure and start the scan.

```
SWEEP ──▶  ┌──────────┐   ┌──────────┐        ┌──────────┐
           │ TDOMAIN  │──▶│  ADJUST  │        │   HOLD   │
           │  SCAN ⇩  │   │   AXIS   │        │   SCAN   │
           ├──────────┤   ├──────────┤        ├──────────┤
           │ STEPPED  │──▶│INS BEFORE│        │   STOP   │
           │  SCAN ⇩  │   │  RANGE   │        │   SCAN   │
           ├──────────┤   ├──────────┤
           │ USE CURR │   │INS AFTER │
           │ SETTINGS │   │  RANGE   │
           ├──────────┤   ├──────────┤
           │  FIXED   │   │  DELETE  │
           │FREQUENCY │   │  RANGE   │
           ├──────────┤   ├──────────┤
           │  SINGLE  │   │  RANGES  │
           │  SCAN    │   │ 1-5 6-10 │
           ├──────────┤   ├──────────┤
           │CONTINUOUS│   │FREQ AXIS │
           │  SCAN    │   │ LIN  LOG │
           ├──────────┤   ├──────────┤
           │FREQ AXIS │   │ 10dB MIN │
           │ LIN  LOG │   │  ON  OFF │
           ├──────────┤   ├──────────┤
           │ RUN PRE- │   │ RUN PRE- │
           │SCAN+FINAL│   │SCAN+FINAL│
           ├──────────┤   ├──────────┤
           │  RUN     │   │   RUN    │
           │  SCAN    │   │   SCAN   │
           └──────────┘   └──────────┘

           CONT AT    CONT AT    STOP
           REC FREQ   HOLD       SCAN
```
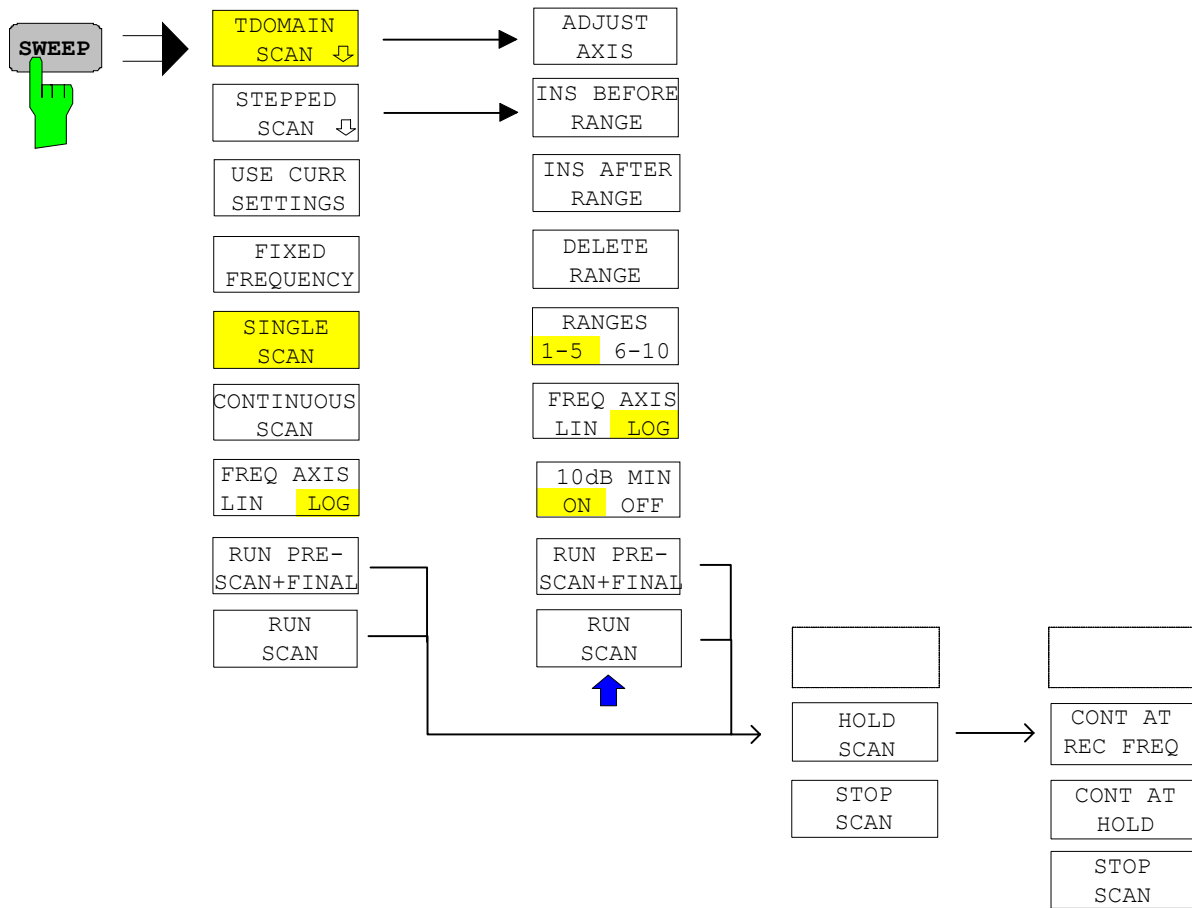
A scan is defined in the form of tables or it is performed using the current setting.

In the *SCAN* table, the scan subranges are defined. Each scan range is specified by start frequency, stop frequency, step width and the measurement parameters that are valid for this range.

The scan can be performed as a single scan or continuously (softkeys *SINGLE SCAN* and *CONTINUOUS SCAN*).

Scanning is started with the *RUN SCAN* softkey.

TDOMAIN SCAN
STEPPED SCAN

```
┌──────────┐
│ TDOMAIN  │ ──────────→    ┌──────────┐
│ SCAN  ⇩  │                │  ADJUST  │
└──────────┘                │   AXIS   │
                            └──────────┘
┌──────────┐
│ STEPPED  │ ──────────→    ┌──────────┐
│ SCAN  ⇩  │                │INS BEFORE│
└──────────┘                │  RANGE   │
                            └──────────┘

                            ┌──────────┐
                            │INS AFTER │
                            │  RANGE   │
                            └──────────┘

                            ┌──────────┐
                            │  DELETE  │
                            │  RANGE   │
                            └──────────┘

                            ┌──────────┐
                            │  RANGES  │
                            │ 1-5  6-10│
                            └──────────┘

                            ┌──────────┐
                            │FREQ AXIS │
                            │ LIN  LOG │
                            └──────────┘

                            ┌──────────┐
                            │ 10dB MIN │
                            │ ON   OFF │
                            └──────────┘

                            ┌──────────┐
                            │ RUN PRE- │
                            │SCAN+FINAL│
                            └──────────┘

                            ┌──────────┐
                            │   RUN    │
                            │   SCAN   │
                            └──────────┘
```
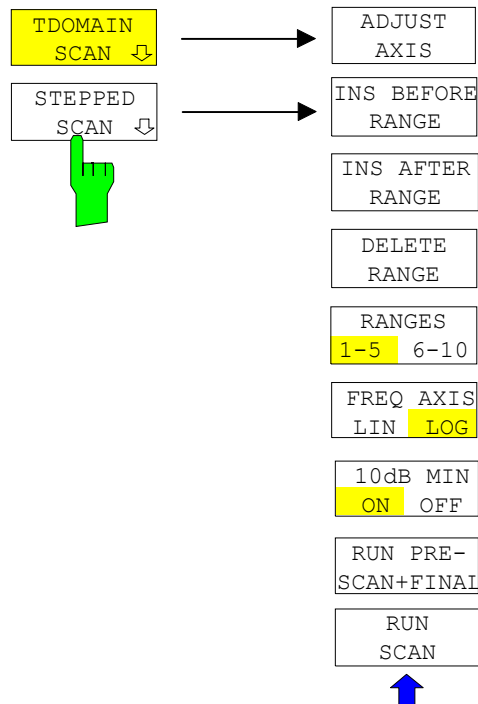
The *TDOMAIN SCAN* and *STEPPED SCAN* softkeys open a submenu where existing scan tables can be edited or new ones created. Tables with the current scan settings are displayed.

> **Note**
>
> The *TDOMAIN SCAN* softkey is only available with the R&S ESU-K53 option.

IEC/IEEE bus command: --

In the *SCAN TABLE* the parameters for the individual subranges can be set.

Scan Start	start frequency of display range
Scan Stop	stop frequency of display range
Step Mode	step mode (linear or logarithmic frequency switching)
Start	start frequency of scan range
Stop	stop frequency of scan range
Step Size	step size
RES BW	resolution bandwidth
Meas Time	measurement time
Auto Ranging	automatic selection of attenuation
RF Attn	RF attenuation
Preamp	20 dB preamplification

Auto Preamp	auto range with preamplification
Input	selected RF input

SCAN TABLE				
Scan Start	20.000 MHz			
Scan Stop	1.250 GHz			
Step Mode	LIN			
	RANGE1	**RANGE2**	**RANGE3**	**RANGE4**	**RANGE5**
Start	150.000 kHz	30.000 MHz	1.000 GHz		
Stop	30.000 MHz	1.000 GHz	2.000 GHz		
Step Size	4 kHz	40 kHz	400 kHz		
Res BW	9 kHz	120 kHz	1 MHz		
Meas Time	1 ms	100 us	100 us		
Auto Ranging	OFF	OFF	OFF		
RF Attn	10 dB	10 dB	10 dB		
Preamp	OFF	OFF	OFF		
Auto Preamp	OFF	OFF	OFF		

Scan Start - start frequency of display range

Range is f_{min} to f_{max}. – 10 Hz

This value can also be set in the *FREQ* menu (*START* softkey).

IEC/IEEE bus command: FREQ:STAR 20 MHz

Scan Stop - stop frequency of display range

Range is f_{min} to f_{max}.

his value can also be set in the *FREQ* menu (*STOP* softkey).

IEC/IEEE bus command: FREQ:STOP 1250 MHz

Step Mode - selection of frequency switching mode

The selection of frequency switching is different for *TDOMAIN SCAN* and *STEPPED SCAN*.

•   *STEPPED SCAN*

   Linear or logarithmic frequency switching can be selected. The selected setting is valid for all scan ranges.

STEP MODE
LIN
LOG
√ AUTO
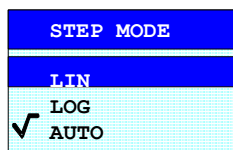
   LIN   linear frequency switching.

   AUTO   linear frequency switching.

            The step width is selected automatically depending on the set resolution bandwidth so that all signals occurring in the scan range are reliably detected without any significant measurement error (about one third of resolution bandwidth)

LOG   logarithmic frequency switching.

The frequency is incremented in % of the current frequency.

- *TDOMAIN SCAN (*only available with the R&S ESU-K53 option)

A selection between an algorithm for pulsed signal or for CW signals can be made.

```
       STEP MODE
  √  AUTO PULSE
     AUTO CW
```

AUTO PULSE   the FFT algorithm is suitable for all types off signals - pulsed and continuous.

AUTO CW   the FFT algorithm is only suitable for continuous signals. The measurement speed is higher than with AUTO PULSE.

IEC/IEEE bus command: `SWE:SPAC LIN`

Start - **Entry of start frequency**

The start frequency of a subrange must be equal to or greater than the stop frequency of the previous subrange.

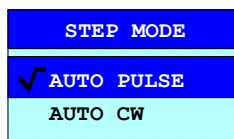On entering the start frequency, the preceding scan range is – if necessary – adapted automatically to avoid overlapping of scan ranges.

IEC/IEEE bus command: `SCAN1:STAR 150 kHz`

Stop - **Entry of stop frequency**

The stop frequency of a subrange must be equal to or greater than the start frequency of the subrange.

On entering the stop frequency, the preceding scan range is – if necessary – adapted automatically to avoid overlapping of scan ranges.

IEC/IEEE bus command: `SCAN1:STOP 30 MHz`

Step Size - **Entry of step size**

In the case of linear frequency increments, step widths between 1 Hz and the maximum R&S ESU frequency can be set. When a step size greater than the scan range is entered (from start to stop), R&S ESU performs a measurement at the start and stop frequency.

With logarithmic frequency increments, values between 0.1% and 100% can be set with steps of ½/3/5.

With *STEP AUTO* selected, the step size cannot be changed because it is automatically set with respect to the IF bandwidth.

IEC/IEEE bus command: `SCAN1:STEP 4 kHz`

RES BW - **Entry of IF bandwidth**

In the case of quasi-peak weighting, usually a fixed bandwidth is set which cannot be changed (CISPR).

However, the coupling of the IF bandwidth to the frequency range can be cancelled using softkey *QP RBW UNCOUPLED* in the *MEAS DETECTOR* menu.

IEC/IEEE bus command: `SCAN1:BAND:RES 9 kHz`

Meas Time - **Entry of measurement time**

The measurement time can be set between 100 µs and 100 s separately for each subrange. In the case of quasi-peak weighting, the minimum is 1 ms. The measurement time can be set independently for each scan range.

IEC/IEEE bus command: `SCAN1:TIME 1ms`

Auto Ranging - **Activates the autorange function**

ATTENTION

If 0 dB RF attenuation is used with autoranging, care must be taken that the permissible signal level at the RF input is not exceeded.

Exceeding this level would damage the input mixer.

The 0 dB attenuation should under no circumstances be used when RFI voltage measurements are performed with the aid of artificial networks as in this case very high pulses occur during phase switching.

ON   R&S ESU automatically sets the input attenuation as a function of the signal level.

OFF   The input attenuation setting of the scan table is used.

IEC/IEEE bus command: `SCAN1:INP:ATT:AUTO OFF`

RF Atten - **Entry of a fixed RF attenuation**

The RF attenuation can be set separately for each subrange

IEC/IEEE bus command: `SCAN1:INP:ATT:AUTO OFF`

Preamp - **Switching the preamplifier on and off**

The preamplifier can be switched on/off separately for each subrange

IEC/IEEE bus command: `SCAN1:INP:GAIN:STAT OFF`

Auto Preamp - **Activates the auto preamp function**

ON   The preamplifier is considered in autoranging. It is only cut in after the attenuation has been reduced to the minimum settable value.

ON   Auto ranging without preamplification

IEC/IEEE bus command: `SCAN1:INP:GAIN:AUTO OFF`

RF Input - Selects the RF Input

INPUT 1- Input 1 covers the whole frequency range.

INPUT 2 - Input 2 is pulse resistant and is limited to 1 GHz

IEC/IEEE bus command: `SCAN1:INP:TYP INPUT1`

ADJUST AXIS   The *ADJUST AXIS* softkey automatically sets the limits of the diagram so that the lower limit frequency corresponds to the start frequency of range 1 and the upper limit frequency to the stop frequency of the last range.

IEC/IEEE bus command: --

INS BEFORE RANGE   The *INS BEFORE RANGE* softkey shifts the active scan range in the table to the left by one column. A new column with identical settings is created. The limit frequencies can be changed accordingly.

IEC/IEEE bus command: --

INS AFTER RANGE   The *INS AFTER RANGE* softkey shifts the active scan range in the table to the right by one column. A new column with identical settings is created. The limit frequencies can be changed accordingly.

IEC/IEEE bus command: --

DELETE RANGE   The *DELETE RANGE* softkey clears the activated scan range

. All other ranges are shifted to the left by one column.

IEC/IEEE bus command: --

RANGES 1-5/6-10   With the *RANGES 1-5/6-10* softkey a switchover can be made between ranges 1-5 and 6-10.

IEC/IEEE bus command: --

FREQ AXIS LIN/LOG   For details refer to "FREQ AXIS LIN/LOG" on page 4.65.

10dB MIN ON/OFF   For details refer to "10 DB MIN ON/OFF" on page 4.17 (*AMPT* menu).

RUN PRE-
SCAN+FINAL   For details refer to "RUN PRE-SCAN+FINAL" on page 4.67.

RUN SCAN   For details refer to "RUN SCAN" on page 4.66.

USE CURR SETTINGS

The *USE CURR SETTINGS* softkey activates a scan which is performed using the current receiver settings. The step size is automatically set with respect to the IF bandwidth (Step Mode Auto). The start and stop frequency is set via the *FREQUENCY* menu.

IEC/IEEE bus command: `--`

FIXED FREQUENCY

The *FIXED FREQUENCY* softkey activates time domain analysis.

The overall measurement time for time domain analysis can be defined in a data entry field. The range is 10 µs to 10.000 s. The value entered is rounded to next integer that is a multiple of the measurement time of a single bar graph measurement. The minimum value also depends on the set measurement time of a single bar graph measurement and is at least twice this value.

IEC/IEEE bus command: `FREQuency:MODE CW`
                          `SCAN:TDOMain 100 s`

SINGLE SCAN

Pressing the *SINGLE SCAN* softkey triggers a frequency scan. R&S ESU stops at the end frequency.

The enhancement label SGL displayed at the screen edge indicates that the single-scan mode is set.

IEC/IEEE bus command: `:INIT2:CONT OFF`

CONTINUOUS SCAN

The *CONTINUOUS SCAN* softkey selects the continuous scan mode. R&S ESU scans continuously until the scan is stopped.

IEC/IEEE bus command: `:INIT2:CONT ON`
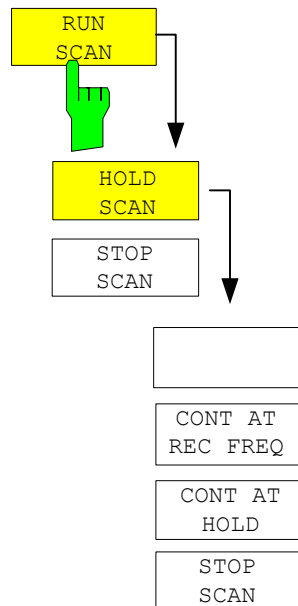
FREQ AXIS LIN/ LOG

The *FREQ AXIS LIN/LOG* switches between linear and logarithmic frequency axis.

Default is LOG.

IEC/IEEE bus command: `DISP:TRAC:X:SPAC LOG`

RUN SCAN   **Running a Scan**

```
┌──────────┐
│   RUN    │
│   SCAN   │
└──────────┘
   │
   ▼
┌──────────┐
│   HOLD   │
│   SCAN   │
└──────────┘
┌──────────┐
│   STOP   │
│   SCAN   │
└──────────┘
          │
          ▼
   ┌──────────┐
   │          │
   └──────────┘
   ┌──────────┐
   │ CONT AT  │
   │ REC FREQ │
   └──────────┘
   ┌──────────┐
   │ CONT AT  │
   │   HOLD   │
   └──────────┘
   ┌──────────┐
   │   STOP   │
   │   SCAN   │
   └──────────┘
```

The *RUN SCAN* softkey starts the frequency scan with the selected settings. The *HOLD SCAN* submenu is displayed instead of the menu shown before the scan is started.

At the beginning of the scan, R&S ESU sets up the diagram as specified in the scan table and starts the scan in the selected mode (*SINGLE* or *CONTINUOUS*). With *SINGLE* selected, R&S ESU performs a single scan and stops at the end frequency. With *CONTINUOUS* selected, the scan is performed continuously until it is deliberately stopped.

The measurement can be interrupted with *HOLD SCAN* or stopped with *STOP SCAN*. The two softkeys are displayed instead of the menu shown before the scan is started.

If a transducer set is defined with points of changeover, the scan automatically stops at the frequencies of the new subrange of the transducer set and the user may exchange the transducer.

The following message informs the user that the limit has been reached:

TDS Range # reached, CONTINUE / BREAK

He can continue the scan at the point of change over by confirming the message (*CONTINUE*) or he can switch off the transducer (*BREAK*).

IEC/IEEE bus command: INITiate2

HOLD SCAN   The *HOLD SCAN* softkey interrupts the scan.

The scan stops at the frequency at which it was interrupted until it is continued with the *CONT AT REC FREQ* or *CONTINUE AT HOLD* softkeys.

While the scan is stopped, the receiver settings can be changed, e.g. for a detailed analysis of the recorded trace.

IEC/IEEE bus command: :HOLD

CONT AT REC FREQ   With the *CONT AT REC FREQ* softkey the scan is continued at the current receiver frequency when the receiver frequency is lower than the frequency at which the scan was interrupted. Otherwise the scan continues at the frequency at which it was interrupted.

The scan is always continued with the settings in the scan table.

IEC/IEEE bus command: `:INITiate2:CONMeasure`

CONT AT HOLD   With the *CONT AT HOLD* softkey the scan is continued where it was interrupted. The scan is always continued with the settings in the scan table.

IEC/IEEE bus command: `--`

STOP SCAN   The *STOP SCAN* softkey stops the scan. Upon restart, scanning starts at the beginning. The results of the performed measurements are lost.

IEC/IEEE bus command: `:ABORt`

RUN PRE-SCAN+FINAL   The *RUN PRE-SCAN+FINAL* softkey is starting a sequence, consisting of a prescan, the peak search-function and the final measurement.

IEC/IEEE bus command: `INITiate:EMITest`

Triggering the Scan – TRIG Key

The *TRIG* key opens a menu for selection of the trigger sources and the trigger polarity. The active trigger mode is indicated by highlighting the corresponding softkey.

To indicate that a trigger mode other than *FREE RUN* has been set, the enhancement label **TRG** is displayed on the screen. If two windows are displayed, TRG appears next to the appropriate window.

```
TRIG  ─►   ┌─────────────┐
           │  FREE RUN   │
           └─────────────┘
           ┌─────────────┐
           │    VIDEO    │
           └─────────────┘
           ┌─────────────┐
           │   EXTERN    │
           └─────────────┘
           ┌─────────────┐
           │             │
           └─────────────┘
           ┌─────────────┐
           │             │
           └─────────────┘
           ┌─────────────┐
           │             │
           └─────────────┘
           ┌─────────────┐
           │  POLARITY   │
           │  POS   NEG  │
           └─────────────┘
           ┌─────────────┐
           │             │
           └─────────────┘
           ┌─────────────┐
           │             │
           └─────────────┘
```
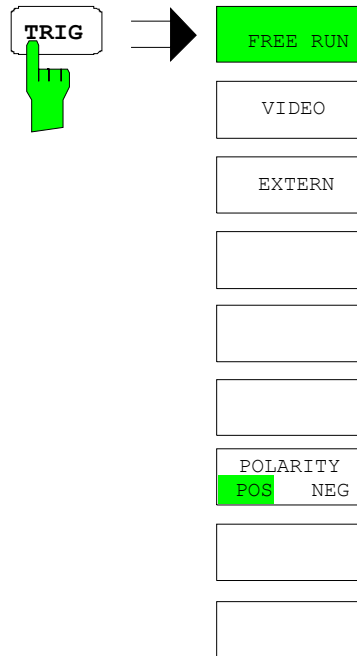
FREE RUN

The *FREE RUN* softkey activates the free-run sweep mode, i.e. start of a scan is not triggered. Once a measurement is completed, another is started immediately.

FREE RUN is the default setting of R&S ESU.

IEC/IEEE bus command: `TRIG:SOUR   IMM`

VIDEO

The *VIDEO* softkey activates triggering via the displayed voltage.

For the video triggering mode, a level line showing the trigger threshold is displayed. Using the level line, the threshold can be adjusted between 0% and100% of the diagram height.

IEC/IEEE bus command: `TRIG:SOUR   VID`
                                   `TRIG:LEV:VID 50 PCT`

EXTERN

The *EXTERN* softkey activates triggering via a TTL signal at the input connector *EXT TRIGGER/GATE* on the rear panel.

IEC/IEEE bus command: `TRIG:SOUR   EXT`

POLARITY POS/ NEG

The *POLARITY POS/NEG* softkey selects the polarity of the trigger source.
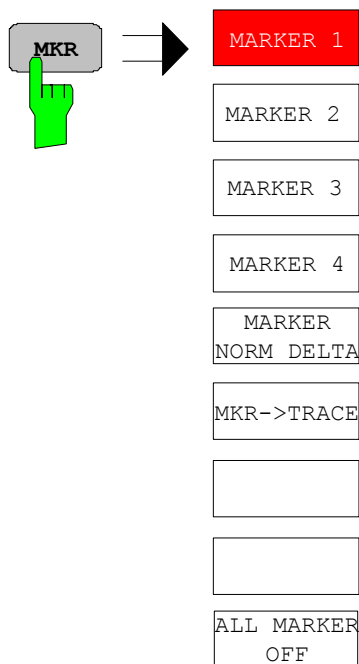
The scan starts after a positive or negative edge of the trigger signal. The selected setting is highlighted.

The selection is valid for all trigger modes with the exception of *FREE RUN*.

The default setting is *POLARITY POS.*

IEC/IEEE bus command: `TRIG:SLOP  POS`

Marker Functions – MKR Key

```
MKR  →   ┌──────────────┐
         │   MARKER 1    │
         └──────────────┘
         ┌──────────────┐
         │   MARKER 2    │
         └──────────────┘
         ┌──────────────┐
         │   MARKER 3    │
         └──────────────┘
         ┌──────────────┐
         │   MARKER 4    │
         └──────────────┘
         ┌──────────────┐
         │    MARKER     │
         │  NORM DELTA   │
         └──────────────┘
         ┌──────────────┐
         │  MKR->TRACE   │
         └──────────────┘
         ┌──────────────┐
         │              │
         └──────────────┘
         ┌──────────────┐
         │              │
         └──────────────┘
         ┌──────────────┐
         │  ALL MARKER   │
         │     OFF       │
         └──────────────┘
```

MARKER 1/2/3/4
The *MARKER 1/2/3/4* softkey selects the corresponding marker and activates it.

MARKER 1 is always the normal marker. After they have been switched on, *MARKERS 2 to 4* are delta markers that refer to *MARKER 1*. These markers can be converted into markers with absolute value display by means of the *MARKER NORM DELTA* softkey. When *MARKER 1* is the active marker, pressing the *MARKER NORM DELTA* softkey switches on an additional delta marker.

Pressing the *MARKER 1/2/3/4* softkey again switches off the selected marker.

IEC/IEEE bus command: `:CALC:MARK  ON;`
                                   `:CALC:MARK:X  10.7MHz;`
                                   `:CALC:MARK:Y?`

When several traces are being displayed, the marker is set to the maximum value (peak) of the active trace which has the lowest number (1 to 3). In case a marker is already located there, it will be set to the frequency of the next lowest level (next peak).

A marker can only be enabled when at least one trace in the corresponding window is visible.

If a trace is turned off, the corresponding markers and marker functions are also deactivated. If the trace is switched on again (*VIEW*, *CLR/WRITE*;..), the markers along with coupled functions will be restored to their original positions provided the markers have not been used on another trace.

MKR→TRACE   The *MKR→TRACE* softkey places the marker on a new trace. The trace is selected via a data entry field. Only those traces can be selected which are visible on the screen in the same window.

Example:

Three traces are presented on the screen. The marker is always on Trace 1 on switching on.

[*MKR ->TRACE]* "2"<*ENTER*>

   The marker jumps to Trace 2 but remains on the previous frequency or time.

[*MKR ->TRACE]* "3"<ENTER>

   The marker jumps to Trace 3. '

IEC/IEEE bus command: CALC:MARK1:TRAC 1
                          CALC:DELT:TRAC 1

Change of Settings via Markers – MKR-> Key

The *MKR->* menu offers functions through which instrument parameters can be changed with the aid of the currently active marker. The functions can be used on markers and delta markers.

On opening the menu, the entry for the last active marker is activated; if no marker was enabled, *MARKER 1* is activated and a peak search is performed.
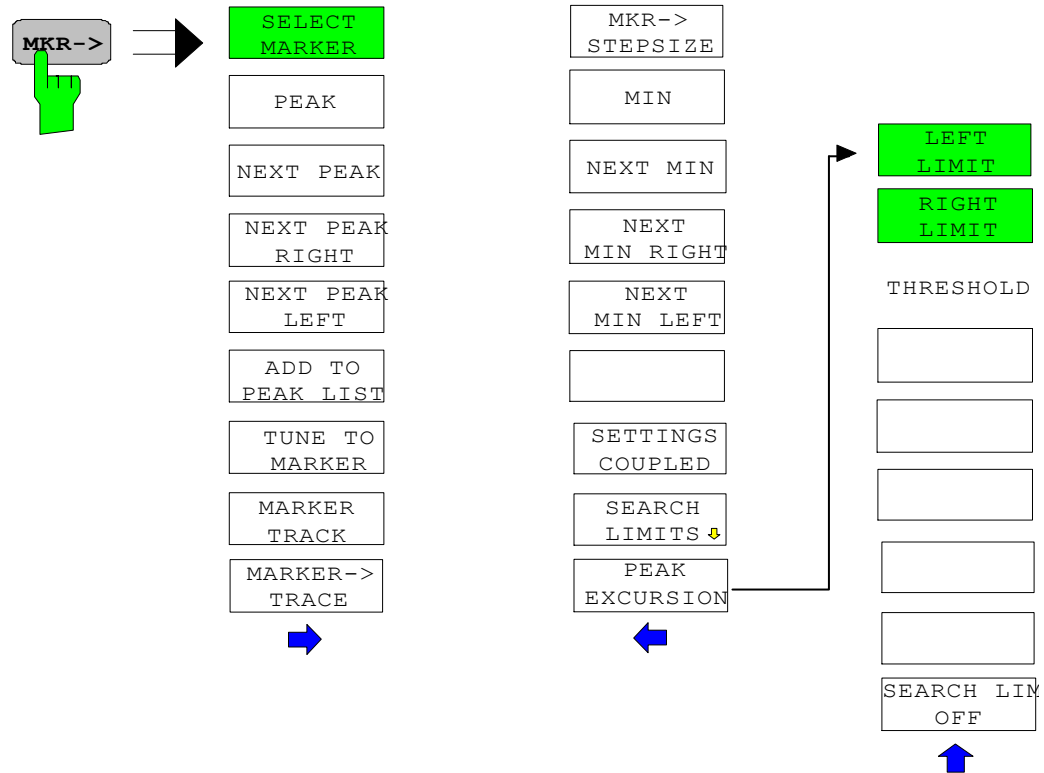
SELECT MARKER　　The *SELECT MARKER* softkey activates the numerical selection of the marker in the data entry field. If no marker is active when *MKR->* menu is called, *MARKER 1* is automatically switched on. Delta marker 1 is selected by input of ' 0 '.

IEC/IEEE bus command:　　CALC:MARK1 ON;
　　　　　　　　　　　　　　CALC:MARK1:X <value>;
　　　　　　　　　　　　　　CALC:MARK1:Y?

PEAK　　　　　　The *PEAK* softkey sets the active marker or delta marker to the peak of the trace.

If no marker is active when *MKR->* menu is called, *MARKER 1* is automatically switched on and the peak search
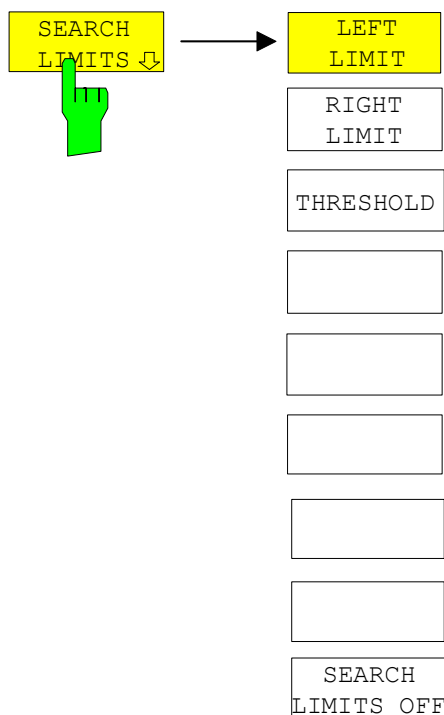
is performed.

IEC/IEEE bus command:　　CALC:MARK:MAX
　　　　　　　　　　　　　　CALC:DELT:MAX

NEXT PEAK

The *NEXT PEAK* softkey sets the active marker/delta marker to the next lower peak value on the trace. The search direction is defined in the *NEXT MODE* submenu (see analyzer mode).

IEC/IEEE bus command: `CALC:MARK:MAX:NEXT`
                                        `CALC:DELT:MAX:NEXT`

NEXT PEAK RIGHT

The *NEXT PEAK RIGHT* softkey sets the active marker/delta marker to the next lower peak value to the right on the trace.

IEC/IEEE bus command: `CALC:MARK:MAX:RIGH`
                                        `CALC:DELT:MAX:RIGH`

NEXT PEAK LEFT

The *NEXT PEAK LEFT* softkey sets the active marker/delta marker to the next lower peak value to the left on the trace.

IEC/IEEE bus command: `CALC:MARK:MAX:LEFT`
                                        `CALC:DELT:MAX:LEFT`

ADD TO PEAK LIST

The *ADD TO PEAK LIST* softkey adds the receiver frequency of the current marker to the peak list (see also section "Data Reduction and Peak List" on page 4.32).

IEC/IEEE bus command: `--`

TUNE TO MARKER

The *TUNE TO MARKER* softkey sets the receiver frequency to the marker frequency.

IEC/IEEE bus command: `:CALC:MARK:FUNC:CENT`

MARKER TRACK

The *MARKER TRACK* softkey couples the current receive frequency to the marker frequency.

IEC/IEEE bus command: `:CALC:MARK:COUP ON`

MKR→TRACE

The *MKR→TRACE* softkey sets the active marker to a new trace. Please note that only a trace visible in the measurement window can be selected.

This softkey is also available in the *MARKER* menu.

IEC/IEEE bus command: `CALC:MARK:TRAC 2`

Example:

Three traces are displayed on the screen. The marker is always on Trace 1 after switching on.

[*MKR ->TRACE*] *"2"* *<ENTER>*

    The marker jumps to Trace 2 but remains at the previous frequency or time.

[*MKR ->TRACE*] *"3"* *<ENTER>*

    The marker jumps to Trace 3.

MKR→CF
STEPSIZE

The *MKR→CF STEPSIZE* softkey sets the step size for the receiver frequency variation to the current marker frequency, and also sets step size adaptation to *MANUAL*. *STEPSIZE* remains at this value until the receiver frequency entry mode in the *STEP* menu is switched from *MANUAL* to *AUTO* again.

The *MKR→CF STEPSIZE* function is, above all, useful in the measurement of harmonics.

IEC/IEEE bus command: `CALC:MARK:FUNC:CST`

MIN

The *MIN* softkey sets the active marker to the minimum value on the corresponding trace.

IEC/IEEE bus command: `CALC:MARK:MIN`
                         `CALC:DELT:MIN`

NEXT MIN

The *NEXT MIN* softkey sets the active marker to the next higher minimum value on the corresponding trace. The search direction is defined in the *NEXT MODE* submenu (see below).

IEC/IEEE bus command: `CALC:MARK:MIN:NEXT`
                         `CALC:DELT:MIN:NEXT`

NEXT MIN LEFT

The *NEXT MIN LEFT* softkey sets the active marker to the next higher minimum value to the left on the corresponding trace.

IEC/IEEE bus command: `CALC:MARK:MIN:LEFT`
                         `CALC:DELT:MIN:LEFT`

NEXT MIN RIGHT

The *NEXT MIN RIGHT* softkey sets the active marker to the next higher minimum value to the right on the corresponding trace.

IEC/IEEE bus command: `CALC:MARK:MIN:RIGH`
                         `CALC:DELT:MIN:RIGH`

SETTINGS
COUPLED

The *SETTINGS COUPLED* softkey couples the receiver frequency settings from the corresponding subscans to the marker frequency for functions *TUNE TO MARKER* and *MARKER TRACK*.

IEC/IEEE bus command: `:CALC:MARK:SCO ON`

SEARCH LIMITS

```
┌─────────────┐          ┌─────────────┐
│   SEARCH    │    ───►   │    LEFT     │
│  LIMITS ⇩   │           │    LIMIT    │
└─────────────┘          └─────────────┘
                          ┌─────────────┐
                          │   RIGHT     │
                          │   LIMIT     │
                          └─────────────┘
                          ┌─────────────┐
                          │  THRESHOLD  │
                          └─────────────┘
                          ┌─────────────┐
                          │             │
                          └─────────────┘
                          ┌─────────────┐
                          │             │
                          └─────────────┘
                          ┌─────────────┐
                          │             │
                          └─────────────┘
                          ┌─────────────┐
                          │             │
                          └─────────────┘
                          ┌─────────────┐
                          │             │
                          └─────────────┘
                          ┌─────────────┐
                          │   SEARCH    │
                          │ LIMITS OFF  │
                          └─────────────┘
```

The *SEARCH LIMITS* softkey limits the search range for maximum or minimum search. The softkey switches to a submenu in which the search range limits can be set in the x and y direction.

LEFT LIMIT
RIGHT LIMIT

The *LEFT LIMIT* and *RIGHT LIMIT* softkeys define the two vertical lines SL1 and SL2. The search is performed between these lines in the frequency and time domain.

If only one line is enabled, line SL1 is the lower limit and the upper limit corresponds to the stop frequency. If SL2 is also enabled, it determines the upper limit.

IEC/IEEE bus command: `CALC:MARK:X:SLIM:LEFT 1MHZ`
                                               `CALC:MARK:X:SLIM:RIGH 10MHZ`
                                               `CALC:MARK:X:SLIM ON`

THRESHOLD

The *THRESHOLD* softkey defines the threshold line.

The threshold line represents a limit for the level range of the max. search at the lower end and that of the min. search at the upper end.

IEC/IEEE bus command: `CALC:THR -20dBm`
                                               `CALC:THR ON`

SEARCH LIMIT OFF

The *SEARCH LIMIT OFF* softkey disables all limits of the search range.

IEC/IEEE bus command: `CALC:MARK:X:SLIM OFF`
                                               `CALC:THR OFF`

PEAK EXCURSION   The *PEAK EXCURSION* softkey activates an entry box for selecting the minimum amount by which a signal level must decrease/increase before it is recognized by the *NEXT PEAK* and *NEXT MIN* search functions as a maximum or minimum.
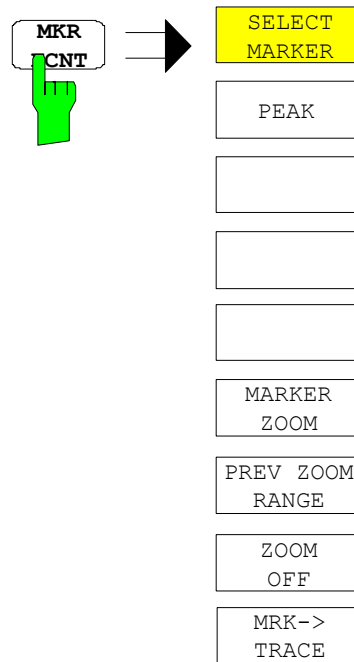
Input values from 0 to 80 dB are allowed, the resolution being 0.1 dB.

IEC/IEEE bus command: `CALC:MARK:PEXC 10dB`

For detailed explanation see softkey *PEAK EXCURSION* in *ANALYZER* mode

Marker Functions – MKR FCTN Key

PEAK EXCURSION

```
┌──────┐        ┌──────────┐
│ MKR  │   ━▶   │  SELECT  │
│ FCNT │        │  MARKER  │
└──────┘        └──────────┘
   👆
                ┌──────────┐
                │   PEAK   │
                └──────────┘

                ┌──────────┐
                │          │
                └──────────┘

                ┌──────────┐
                │          │
                └──────────┘

                ┌──────────┐
                │          │
                └──────────┘

                ┌──────────┐
                │  MARKER  │
                │   ZOOM   │
                └──────────┘
                ┌──────────┐
                │PREV ZOOM │
                │  RANGE   │
                └──────────┘
                ┌──────────┐
                │   ZOOM   │
                │   OFF    │
                └──────────┘
                ┌──────────┐
                │   MRK->  │
                │  TRACE   │
                └──────────┘
```

On calling the menu, the entry for the last active marker is activated (*PEAK EXCURSION* softkey); if no marker is activated, marker 1 is activated and a maximum search (*PEAK* softkey) is performed. The marker can be set to the desired trace by means of *MKR -> TRACE* softkey.

MARKER ZOOM

The *MARKER ZOOM* softkey zooms 10% of the diagram around the current marker. It opens at the same time a data entry field which allows to enter any frequency range which is then displayed

Pressing the softkey again expands the diagram such that only 3 measured values are represented.

IEC/IEEE bus command: `:CALC:MARK:FUNC:ZOOM <num_value>`

PREVIOUS ZOOM

The *PREVIOUS ZOOM* softkey sets again the previous frequency range

IEC/IEEE bus command: `--`

ZOOM OFF

The *ZOOM OFF* softkey switches off the zoomed representation.

IEC/IEEE bus command: `:DISP:TRAC:X:ZOOM OFF`

MKR→TRACE

The *MKR→TRACE* softkey places the marker on a new trace. The trace is selected via a data entry field. Only those traces can be selected which are visible on the screen in the same window.

IEC/IEEE bus command: `CALC:MARK1:TRAC 1`
                          `CALC:DELT:TRAC 1`

Selection and Setting of Traces – TRACE Key

The R&S ESU is capable of displaying up to three different traces at a time in a diagram. A trace consists of a maximum of 625 pixels on the horizontal axis (frequency or time). If more measured values than pixels are available, several measured values are combined in one pixel.

The traces are selected using the *SELECT TRACE* softkey in the menu of the *TRACE* key.

The traces can individually be activated for a measurement or frozen after completion of a measurement. Traces that are not activated are blanked.

The display mode can be selected for each trace. Traces can be overwritten in each measurement (CLEAR/WRITE mode), averaged over several measurements (AVERAGE mode), or a maximum or minimum value can be determined from several measurements and displayed (MAX HOLD or MIN HOLD).

Individual detectors can be selected for the various traces. The max peak detector and min peak detector display the maximum and minimum value of the level within a pixel. The rms detector displays the power (rms value) of the measured values within a pixel, the average detector the average value.

The quasi-peak detector yields the level weighted to CISPR 16.

Selection of Trace Function

The trace functions are subdivided as follows:

- Display mode of trace (CLEAR/WRITE, VIEW and BLANK)

- Evaluation of the trace as a whole (AVERAGE, MAX HOLD and MIN HOLD)

- Evaluation of individual pixels of a trace (MAX PEAK, MIN PEAK, QUASIPEAK, AVERAGE and RMS).
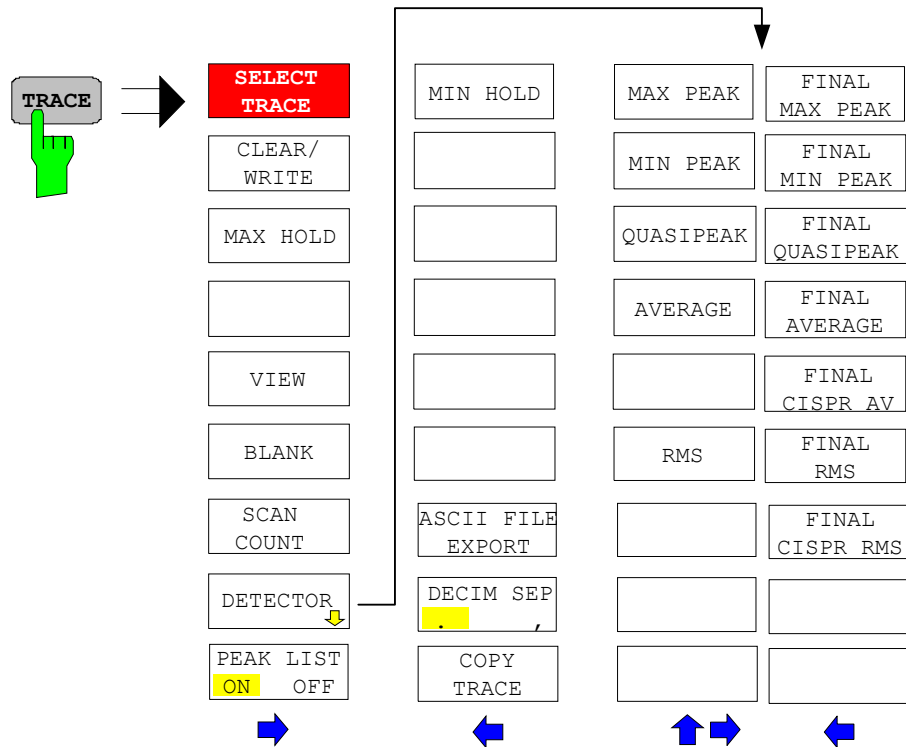
The *TRACE* key opens a menu offering the setting options for the selected trace.

In this menu, the mode of representing the measured data in the frequency or time domain in the 501 pixels of the display is determined. Upon start of the measurement, each trace can be displayed either completely new or based on the previous results.

Traces can be displayed, blanked and copied.

The measurement detector for the individual display modes can be selected directly by the user.

The default setting is trace 1 in the overwrite mode (*CLEAR / WRITE)* and detector *MAX PEAK* is selected, trace 2 is also in the overwrite mode (*CLEAR / WRITE)* and detector *AVERAGE* is selected, trace 3 is switched off (*BLANK*).

The *CLEAR/WRITE, MAX HOLD, MIN HOLD, AVERAGE, VIEW* and *BLANK* softkeys are mutually exclusive selection keys.

SELECT TRACE   The *SELECT TRACE* softkey activates the entry for the active trace (1, 2, 3).

                         IEC/IEEE bus command: -- (selected via numeric suffix of :
                                                  TRACe)

CLEAR/WRITE   The *CLEAR/WRITE* softkey activates the overwrite mode for the collected measured values, i.e. the trace is overwritten by each sweep.

                         Each time the *CLEAR/WRITE* softkey is actuated, R&S ESU clears the selected trace memory and starts the measurement anew.

                         IEC/IEEE bus command: DISP:WIND:TRAC:MODE WRIT

MAX HOLD   The *MAX HOLD* softkey activates the max peak detector.

R&S ESU saves the sweep result in the trace memory only if the new value is greater than the previous one.

his is especially useful with modulated or impulsive signals. The signal spectrum is filled up upon each scan until all signal components are detected in a kind of envelope.

Pressing the *MAX HOLD* softkey again clears the trace memory and restarts the max hold mode.

IEC/IEEE bus command: DISP:WIND:TRAC:MODE MAXH

VIEW   The *VIEW* softkey freezes the current contents of the trace memory and displays it.

If in the *VIEW* display mode the level display range (*GRID RANGE*) or the reference level (*GRID MIN LEVEL*) are changed, R&S ESU automatically adapts the measured data to the changed display range. This allows an amplitude zoom

to be made after the measurement in order to show details of the trace.

IEC/IEEE bus command: DISP:WIND:TRAC:MODE VIEW

BLANK   The *BLANK* softkey activates the blanking of the trace on the screen.

IEC/IEEE bus command: DISP:WIND:TRAC OFF

SCAN COUNT   The *SCAN COUNT* softkey activates the entry of the number of scan used in the SINGLE SCAN mode.

The allowed range of values is 0 to 30000. The default setting is 1.

IEC/IEEE bus command: SWE:COUN 10

DETECTOR   The *DETECTOR* softkey opens a submenu to select the detector.

The detector type may be indecently selected for each trace.

For description of detector types see section "Selection of Detector" on page 4.152.

MAX PEAK   The *MAX PEAK* softkey activates the max peak detector.

IEC/IEEE bus command: DET POS

MIN PEAK   The *MIN PEAK* softkey activates the min peak detector.

IEC/IEEE bus command: DET NEG

QUASIPEAK   The *QUASIPEAK* softkey selects the quasi-peak detector.

The IF bandwidth is adapted as a function of the frequency range. The coupling of the IF bandwidth to the frequency range can be cancelled using softkey *QP RBW UNCOUPLED*.

IEC/IEEE bus command: DET QPE

AVERAGE

The *AVERAGE* softkey activates the average detector.

IEC/IEEE bus command: `DET AVER`

RMS

The *RMS* softkey activates the rms detector.

IEC/IEEE bus command: `:DET RMS`

FINAL MAX PEAK

The *FINAL MAX PEAK* selects the max peak detector for the final measurement.

IEC/IEEE bus command: `:DET:FME POS`

FINAL MIN PEAK

The *FINAL MIN PEAK* selects the min peak detector for the final measurement.

IEC/IEEE bus command: `:DET:FME NEG`

FINAL QUASIPEAK

The *FINAL QUASIPEAK* selects the quasi peak detector for the final measurement.

IEC/IEEE bus command: `:DET:FME QPE`

FINAL AVERAGE

The *FINAL AVERAGE* selects the average detector for the final measurement.

IEC/IEEE bus command: `:DET:FME AVER`

FINAL CISPR AV

The *FINAL CISPR AV* selects the weighting average detector according to CISPR 16-1 for the final measurement.

IEC/IEEE bus command: `:DET:FME CAV`

FINAL RMS

The *FINAL RMS* selects the rms detector for the final measurement.

IEC/IEEE bus command: `:DET:FME RMS`

FINAL CISPR RMS

The *FINAL CISPR RMS* softkey selects the weighting rms detector according to CISPR 16-1-1 for the final measurement.

IEC/IEEE bus command: `:DET:FME CRMS`

PEAK LIST ON / OFF

The *PEAK LIST ON / OFF* softkey switches on and off the indication of the peak list or of the final measurement results. The single value is indicated as + or x. The assignment of symbol to trace is fixed.

RUN SCAN automatically switches *PEAK LIST* to *OFF* in order to prevent the indication of preceding final measurement results. *PEAK SEARCH* automatically sets *PEAK LIST* to *ON* (see "Data Reduction and Peak List" on page 4.32)

IEC/IEEE bus command: `DISP:TRAC:SYMB CROS | OFF`

MIN HOLD

The *MIN HOLD softkey* activates the min peak detector. R&S*ESU* saves for each scan the smallest of the previously stored/currently measured values in the trace memory.

This function is useful e.g. for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed by the min hold function whereas a CW signal is recognized by its constant level.

Pressing the *MIN HOLD* softkey again clears the trace memory and restarts the min hold function.

IEC/IEEE bus command: DISP:WIND:TRAC:MODE MINH

ASCII FILE EXPORT

The *ASCII FILE EXPORT* softkey stores the active trace in ASCII format, e.g. on a memory stick.

IEC/IEEE bus command: FORM ASC;
                            MMEM:STOR:TRAC 1,'TRACE.DAT'

The file consists of the header containing important scaling parameters, several data sections containing the scan settings and a data section containing the trace data.

The data of the file header consist of three columns, each separated by a semicolon:

parameter name; numeric value; basic unit

The data section for the scan ranges starts with the keyword "Scan <n>:", (<n> = number of scan range), followed by the scan data in one or several columns which are also separated by a semicolon.

The data section for the trace date starts with the keyword " Trace <n> " (<n> = number of stored trace), followed by the measured data in one or several columns which are also separated by a semicolon.

This format can be read in from spreadsheet calculation programs, e.g. MS-Excel. It is necessary to define ';' as a separator.

Note

Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using softkey *DECIM SEP*.

Table 4-1   Example – File header:

File contents	Description
Type;R&S ESU	Instrument model
Version;1.00;	Firmware version
Date;10.Nov 03;	Date of data set storage
Mode;Receiver;	Instrument mode
Start;150000.000000;Hz Stop;1000000000.000000;Hz	Start/stop of the display range. Unit: Hz
x-Axis;LOG;	Scaling of x-axis linear (LIN) or logarithmic (LOG)
Detector;AVERAGE;	Selected detector MAXPEAK, MINPEAK, AVERAGE, RMS, QUASIPEAK
Scan Count;1;	Scan count
Transducer;;	Transducer name (if switched on)

Table 4-2   Example – Data section of the file, Scan ranges

File contents	Description
Scan 1:	Settings for scan range 1
Start;150000.000000;Hz	Range 1 - start frequency in Hz
Stop;30000000.000000;Hz	Range 1 – stop frequency in Hz
Step; 4000.000000;Hz	Range 1 - step width
RBW;9000.000000;Hz	Range 1 - resolution bandwidth
Meas Time;0.001000;s	Range 1 - measurement time
Auto Ranging;OFF;	Range 1 - Auto ranging on - or off
RF Att;10.000000;dB	Range 1 - input attenuation
Auto Preamp;OFF;	Range 1 - Auto Preamp on or off
Preamp;0.000000;dB	Range 1 - preamplifier on (20dB) or off (0dB)
Scan 2:	Settings for scan range 2
Start;30000000.000000;Hz	Range 2 - start frequency in Hz
Stop;1000000000.000000;Hz	Range 2 – stop frequency in Hz
Step; 50000.000000;Hz	Range 2 - step width
RBW;120000.000000;Hz	Range 2 - resolution bandwidth
Meas Time;0.000100;s	Range 2 - measurement time
Auto Ranging;OFF;	Range 2 - Auto ranging on - or off
RF Att;10.000000;dB	Range 2 - input attenuation
Auto Preamp;OFF;	Range 2 - Auto Preamp on or off
Preamp;0.000000;dB	Range 2 - preamplifier on (20dB) or off (0dB)

Table 4-3   Example – Data section of the file, Trace

File contents	Description
Trace 1:	Selected trace
Trace Mode;CLR/WRITE;	Trace mode: CLR/WRITE, MAXHOLD
x-Unit;Hz;	Unit of x values: Hz for span > 0
y-Unit;dBµV;	Unit of y values: dB*/V/A/W depending on the selected unit
Values;26863;	Number of test points
150000.000000;15.604355; 154000.000000;13.236252; 158000.000000;11.907021; ...;...;	Measured values: <x value>, <y value>;

DECIM SEP

The *DECIM SEP* softkey selects the decimal separator between '.' (decimal point) and ',' (comma) with floating-point numerals for the function ASCII FILE EXPORT.

With the selection of the decimal separator different language versions of evaluation programs (e.g. MS-Excel) can be supported.

IEC/IEEE bus command: `FORM:DEXP:DSEP POIN`

COPY TRACE

The *COPY TRACE* softkey copies the screen contents of the current trace into another trace memory. The desired memory is selected by entering the number 1, 2 or 3.

Upon copying, the contents of the selected memory are overwritten and the new contents displayed in view mode.

IEC/IEEE bus command: `TRAC:COPY TRACE1,TRACE2`

IF Spectrum Analysis Mode

In IF spectrum analysis, the spectrum of the RF input signal is displayed in the vicinity of the receiver frequency. The center frequency of the displayed spectrum is always the current receive frequency.

The IF analysis provides a fast overview of the assignment of the spectrum adjacent to the measuring channel proper, or, with a large IF bandwidth, the spectral distribution of a modulated signal in the channel. Interference of the received useful signal can also be detected quickly, whether it is CW interference appearing as unmodulated carrier or pulse-like interference which is represented in the form of narrow horizontal lines on the screen.

The IF spectrum analysis is a very comfortable means for exact frequency tuning of the receiver and for identification of signals and of their bandwidth. The accuracy of the frequency axis corresponds to the reference used (internal or external). The frequency display range (span) can be selected between 1 kHz and 10 MHz in steps of 1, 2 and 5. With the bandwidths 10 Hz to 100 kHz in steps of 1, 3, 10 the frequency resolution can be matched to the span.
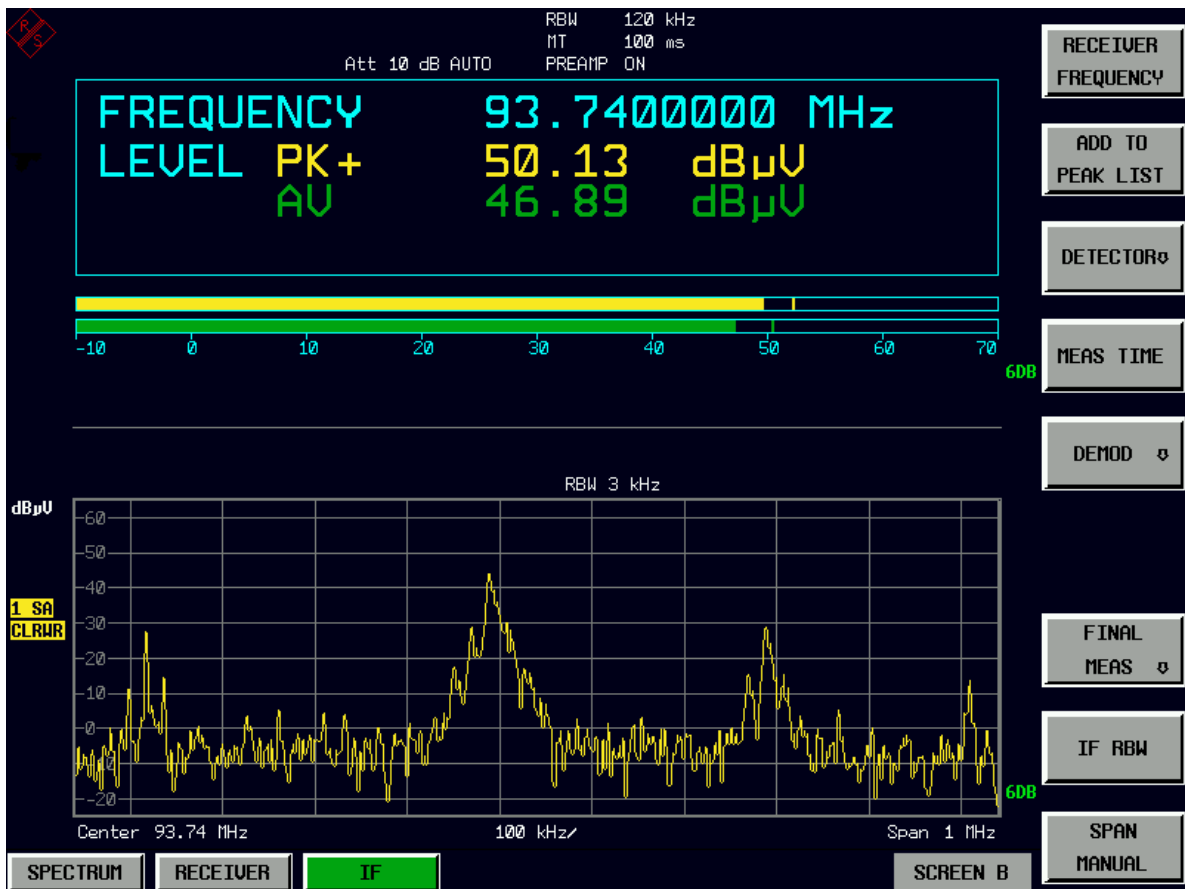
In contrast to normal spectrum analyzer operation, the measured values are determined using FFT from samples recorded from the A/D-converter. Thus the receiver stays tuned to the center frequency. It may continue to measure with the selected measurement time and display the signal level with the bar graph. E.g. the quasipeak level measured with one second measurement time may be displayed in the upper half of the display while in the lower half the spectrum may be refreshed every few milliseconds.

The measurement time of the bar graph may be longer than the measurement time of the IF analysis. If the measurement time of the bar graph is set to a smaller value then the measurement time of the IF analysis, the bar graph will as often be refreshed as the display of the IF analysis.
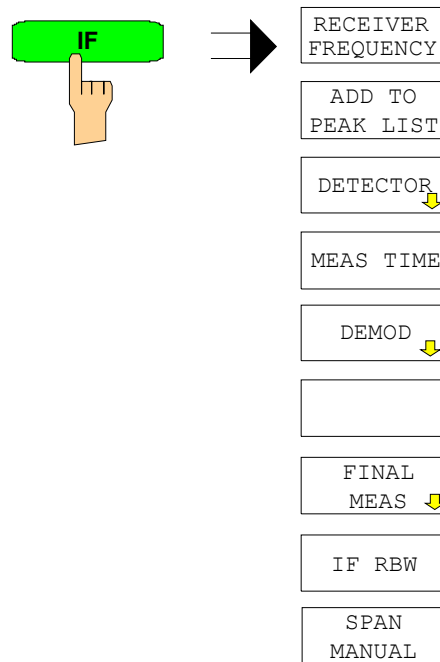
Table 4-4   Measurement time (data-recording time) for the possible span-RBW-combinations

	RBW								
Span	**10 Hz**	**30 Hz**	**100 Hz**	**300 Hz**	**1 kHz**	**3 kHz**	**10 kHz**	**30 kHz**	**100 kHz**
1 kHz	384 ms	128 ms							
2 kHz	384 ms	128 ms							
5 kHz	384 ms	128 ms							
10 kHz	384 ms	128 ms	38,4 ms						
20 kHz	384 ms	128 ms	38,4 ms						
50 kHz		128 ms	38,4 ms	12,8 ms					
100 kHz			38,4 ms	12,8 ms	3,84 ms				
200 kHz			38,4 ms	12,8 ms	3,84 ms				
500 kHz				12,8 ms	3,84 ms	1,28 ms			
1 MHz					3,84 ms	1,28 ms	384 µs		
2 MHz					3,84 ms	1,28 ms	384 µs		
5 MHz							384 µs	128µs	38,4 µs
10 MHz							384 µs	128µs	38,4 µs

The level display of the IF analysis is unweighted. It is independent of the selected detector for the bar graph measurement, e.g. average or quasi peak. This is indicated by the label SA (for sample detector) on the left side of the IF analysis display. A maximum of three traces can be displayed in parallel. The display mode – *CLEAR/WRITE*, *MAX HOLD*, *MIN HOLD*, *AVERAGE*, *VIEW* or *BLANK* – may be selected independent for each trace.

The IF display does switch on the 6 dB EMI resolution bandwidth filters for the bar graph measurement. 3 dB or channel filters are not possible in the IF analysis mode. The maximum span for the IF analysis is limited to ten times the selected resolution bandwidth for the bar graph measurement. This is due to the dynamic range of the bar graph measurement.

The IF analysis mode is selected using the *IF* hotkey (see also section "Mode Selection – Hotkey Bar" on page 4.10)

IF	→	RECEIVER FREQUENCY
		ADD TO PEAK LIST
		DETECTOR
		MEAS TIME
		DEMOD
		FINAL MEAS
		IF RBW
		SPAN MANUAL

The *IF* hotkey selects the IF analysis mode (IF spectrum analysis) and activates the menu for setting the main parameters.

For information on the following softkeys refer to the descriptions in section "Receiver Mode":

- "RECEIVER FREQUENCY" on page 4.14 (*FREQ* menu)
- "ADD TO PEAK LIST" on page 4.25 (*MKR* menu)
- "DETECTOR" on page 4.27 (*MEAS* menu)
- "MEAS TIME" on page 4.29 (*MEAS* menu)
- "DEMOD" on page 4.31 (*MEAS* menu)
- "FINAL MEAS" on page 4.34 (*MEAS* menu)

IEC/IEEE bus command: INST IFAN

IF RBW   The *IF RBW* softkey activates the manual entry mode for the resolution bandwidth.

For filter type *NORMAL (3dB)*, the bandwidth can be set from 10 Hz to 10 MHz in steps of 1/3/10. For filter type *NORMAL (6dB)*, the 6-dB bandwidth 200 Hz, 9 kHz, 120 kHz and 1 MHz can be set.

For numerical inputs, the values are always rounded to the next valid bandwidth. For rotary knob or the *UP/DOWN* key entries, the bandwidth is adjusted in steps either upwards or downwards.

IEC/IEEE bus command: BAND:IF 1 kHz

SPAN MANUAL

The *SPAN MANUAL* softkey activates the window for manually entering the frequency span. The center frequency is kept constant. The overall allowed range of span values is 1 kHz to 10 MHz.

It depends on the selected resolution bandwidth of the bar graph measurement: the span is limited to ten times the resolution bandwidth.

IEC/IEEE bus command: `FREQ:SPAN 1 MHz`

Level Display and RF Input Configuration – AMPT Key

The *AMPT* key is used to set the input attenuation, the preamplifier, the auto range function and the display unit. These functions are explained in detail in section "Receiver Mode" – "Level Display and RF Input Configuration – AMPT Key " on page 4.89.
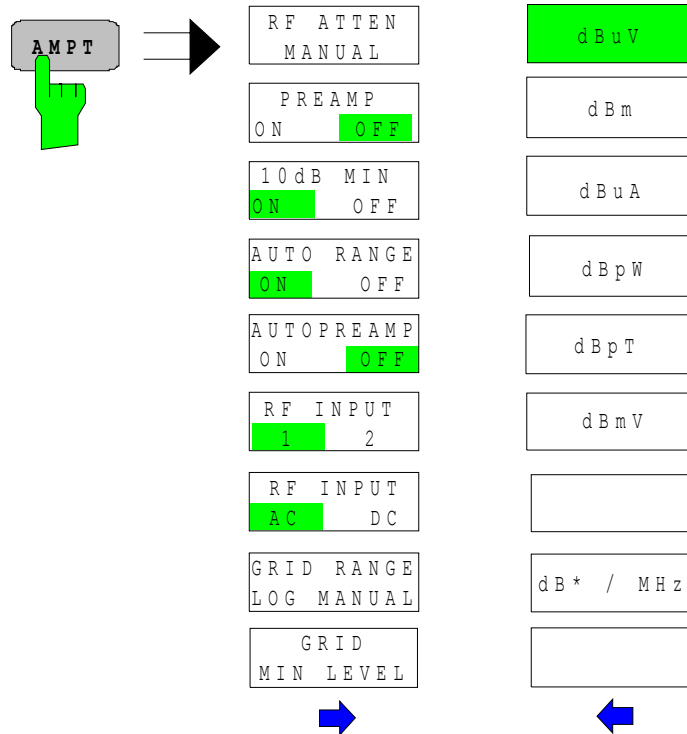
In addition, the level display range for the IF analysis display can be set.

The level axis of the IF analysis display is automatically set to display the full dynamic range of the IF analysis. The upper limit of the diagram is equal to the upper limit of the bar graph. The lower limit of the diagram depends on the selected resolution bandwidth of the IF analysis. Every time when a parameter is changed which affects the bar graph limits, e.g. the input attenuation, the IF analysis diagram is changed accordingly. With the softkeys *GRID RANGE LOG MANUAL* and *GRID MIN LEVEL* is it possible to select a user defined display range. As soon as a parameter is changed which affects the bar graph limits again, the display range is reset to the automatic settings.

GRID RANGE LOG MANUAL

The *GRID RANGE LOG MANUAL* softkey activates the entry of the level display range for the scan diagram.

The display ranges go from 10 to 200 dB in 10-dB steps. Invalid entries are rounded off to the nearest valid value.

IEC/IEEE bus command: DISP:WIND:TRAC:Y:SPAC LOG
                         DISP:WIND:TRAC:Y 120DB

GRID MIN LEVEL The *GRID MIN LEVEL* softkey activates the entry of the minimum level of the display range. Allowed values are:

$- 200 \leq$ GRID MIN LEVEL $\leq + 200$ dB - GRID RANGE

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LOG`
                                            `DISP:WIND:TRAC:Y:BOTT 0DBM`

Markers and Delta Markers – MKR Key

The markers are used for marking points on traces, reading out measurement results and for quickly selecting a display section. R&S ESU provides four markers. All markers can be used either as markers or delta markers.

The marker that can be moved by the user is defined in the following as the **active marker**.
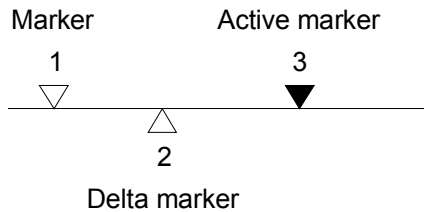
Fig. 4-9   Examples of marker display
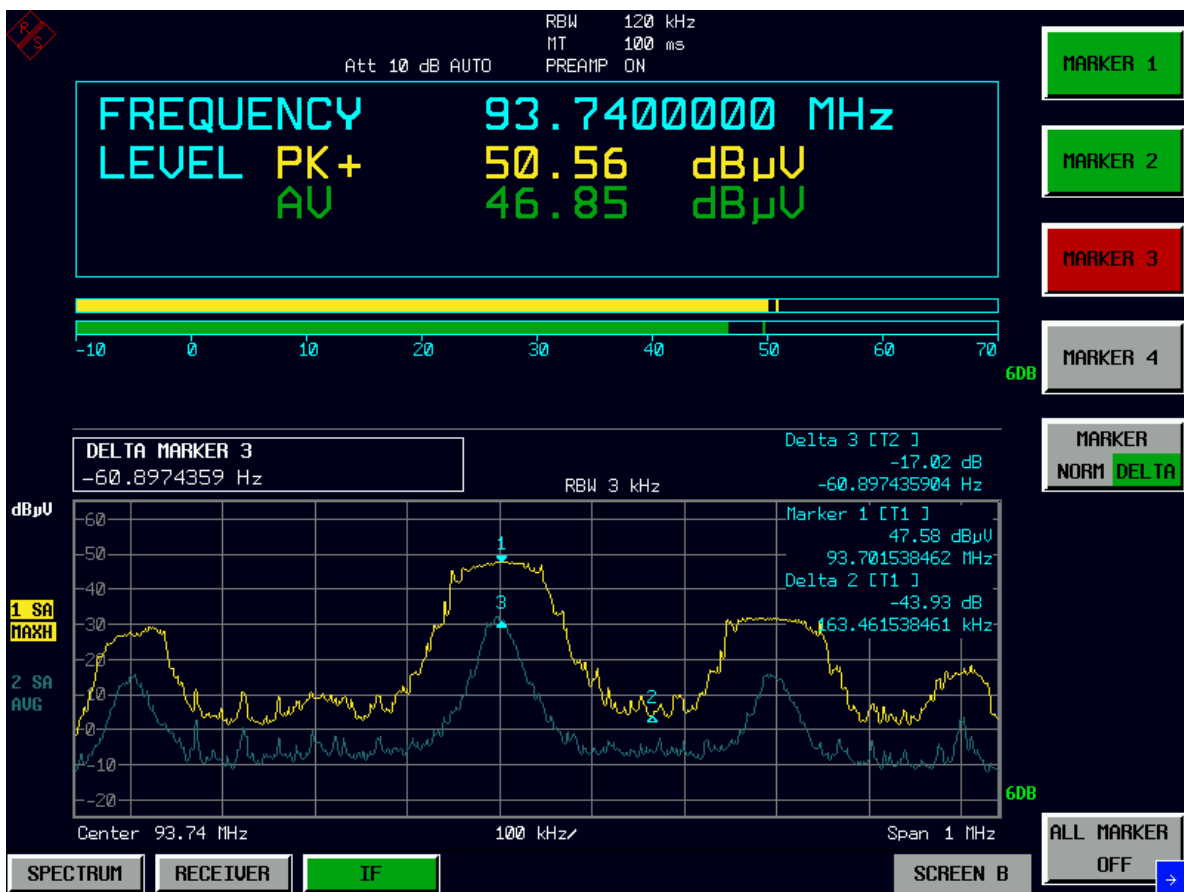
The measurement results of the active marker (also called **marker values**) are displayed in the marker field. The marker info field at the upper right of the display shows the marker location (here, frequency), the level and the currently selected trace [T1].

The *MKR* key calls a menu that contains all marker and delta marker standard functions. If no marker is active, *MARKER 1* will be enabled and a peak search on the trace carried out. Otherwise, the data entry for the marker activated last is opened.

```
 ┌──────┐         ┌──────────┐     ┌──────────┐
 │ SPAN │         │ MARKER 1 │     │ MKR->TRACE│
 └──────┘         └──────────┘     └──────────┘
 ┌──────┐         ┌──────────┐     ┌──────────┐
 │ MKR▸ │══▷      │ MARKER 2 │     │ LINK MKR1│
 └──────┘         └──────────┘     │ AND DELTA1│
                                   └──────────┘
                  ┌──────────┐     ┌──────────┐
                  │ MARKER 3 │     │          │
                  └──────────┘     └──────────┘
                  ┌──────────┐     ┌──────────┐
                  │ MARKER 4 │     │          │
                  └──────────┘     └──────────┘
                  ┌──────────┐     ┌──────────┐
                  │  MARKER  │     │          │
                  │NORM DELTA│     └──────────┘
                  └──────────┘
                  ┌──────────┐     ┌──────────┐
                  │          │     │          │
                  └──────────┘     └──────────┘
                  ┌──────────┐     ┌──────────┐
                  │          │     │          │
                  └──────────┘     └──────────┘
                  ┌──────────┐     ┌──────────┐
                  │          │     │          │
                  └──────────┘     └──────────┘
                  ┌──────────┐     ┌──────────┐
                  │ALL MARKER│     │          │
                  │   OFF    │     └──────────┘
                  └──────────┘
                      ⇨           ⇦
```
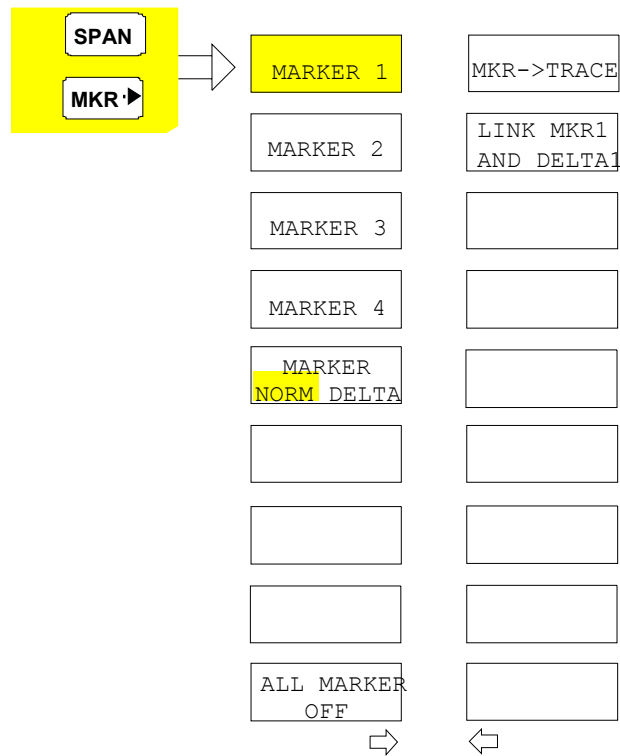
MARKER 1/2/3/4 The *MARKER 1/2/3/4* softkey selects the corresponding marker and activates it.

MARKER 1 is always the normal marker. After they have been switched on, *MARKERS 2/3/4* are delta markers that refer to *MARKER 1*. These markers can be converted into markers with absolute value display by means of the *MARKER NORM DELTA* softkey. When *MARKER 1* is the active marker, pressing the *MARKER NORM DELTA* softkey switches on an additional delta marker.

Pressing the *MARKER 1/2/3/4* softkey again switches off the selected marker.

Example:

[**PRESET**]	R&S ESU is set to the default setting.
[**MKR**]	On calling the menu, *MARKER 1* is switched on ('1' highlighted in the softkey) and positioned on the maximum value of the trace. It is a normal marker and the *MARKER NORMAL* softkey is highlighted.
[*MARKER 2*]	*MARKER 2* is switched on ('2' highlighted in the softkey). It is automatically defined as a delta marker on switching on so the *DELTA* is highlighted on softkey *MARKER NORM DELTA*. The frequency and level of *MARKER 2* with reference to *MARKER 1* are output in the marker info field.
[*MARKER NORM DELTA*]	The *MARKER NORM DELTA* softkey is highlighted. *MARKER 2* becomes a normal marker. The frequency and level of *MARKER 2* are output as absolute values in the marker info field.
[*MARKER 2*]	*MARKER 2* is switched off. *MARKER 1* is the active marker for entry. The frequency and level of *MARKER 1* are output in the marker info field.

IEC/IEEE bus command:
```
CALC:MARK ON;
CALC:MARK:X <value>;
CALC:MARK:Y?
CALC:DELT ON;
CALC:DELT:MODE ABS|REL
CALC:DELT:X <value>;
CALC:DELT:X:REL?
CALC:DELT:Y?
```

When several traces are being displayed, the marker is set to the maximum value (peak) of the active trace which has the lowest number (1 to 3). In case a marker is already located there, it will be set to the frequency of the next lowest level (next peak).

A marker can only be enabled when at least one trace in the corresponding window is visible.

If a trace is turned off, the corresponding markers and marker functions are also deactivated. If the trace is switched on again (*VIEW*, *CLR/WRITE*,..), the markers along with coupled functions will be restored to their original positions provided the markers have not been used on another trace.

MKR->TRACE   The *MKR->TRACE* softkey places the marker on a new trace. The trace is selected via a data entry field. Only those traces can be selected which are visible on the screen in the same window.

Example:

Three traces are presented on the screen. The marker is always on Trace 1 on switching on.

[*MKR ->TRACE*]

2 | ENTER   The marker jumps to trace 2 but remains on the previous frequency or time.
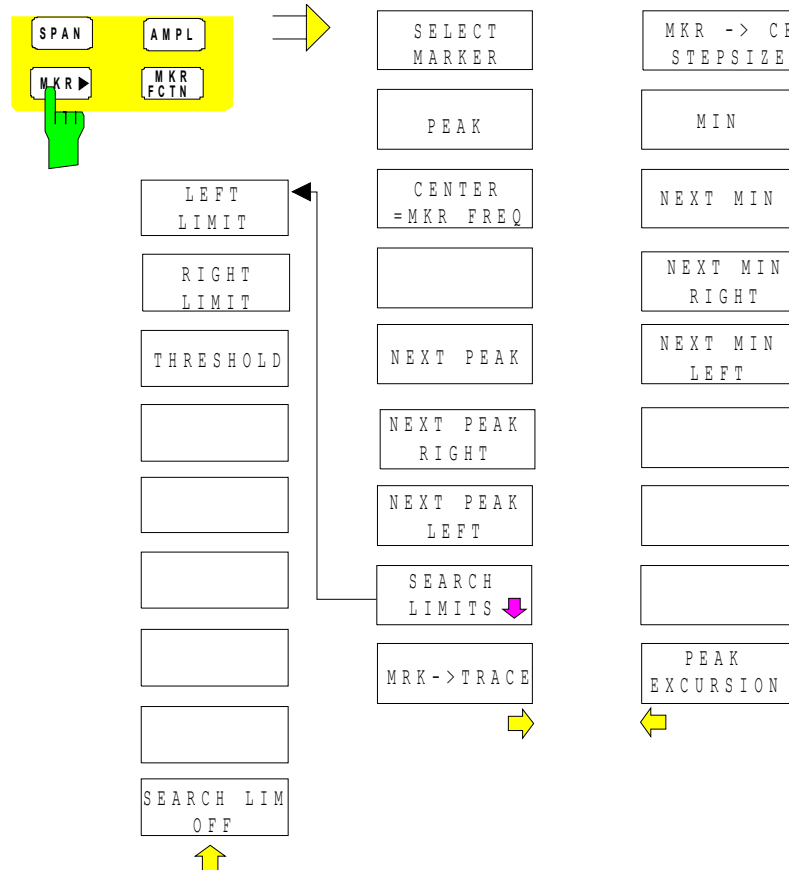
[*MKR ->TRACE*]

3 | ENTER   The marker jumps to trace 3.

IEC/IEEE bus command: `CALC:MARK1:TRAC 1`
                          `CALC:DELT:TRAC 1`

LINK MKR1 AND DELTA1

With the softkey *LINK MKR1 AND DELTA1* the delta marker1 can be linked to marker1, so if the x-axis value of the marker1 is changed the delta marker1 will follow on the same x-position. The link is default off, and can be switched on.

Example for setup:

1. *PRESET*
2. *TRACE | MAX HOLD*
3. *TRACE | SELECT TRACE | 2 | AVERAGE*
4. *MKR* (Switches marker1 on)
5. *MARKER NORM DELTA | DELTA* (Switches delta marker 1 on)
6. *MKR-> | MKR->TRACE | 2*
7. *LINK MKR1 AND DELTA1*

Now select the marker1 (by switching *MARKER1* from *DELTA* back to *NORM*) and when changing the x-axis value (by rotary knob or *UP/DOWN* keys), the delta marker1 will follow automatically.

The delta marker1 x-value can not be changed away from 0 as long as the link functionality is active.

IEC/IEEE bus command: `CALCulate<1|2>:DELTamarker<1...4>:`
                          `LINK ON | OFF`

   The suffix at `DELTamarker` can only be 1 or not present, because the functionality is only available for marker1.

ALL MARKER OFF

The *ALL MARKER OFF* softkey switches off all markers (reference and delta markers). It also switches off all functions and displays associated with the markers/delta markers.

Marker Functions – MKR FCTN Key

In spectrum analysis mode the *MKR FCTN* menu offers further measurements with the markers. In IF analysis the functionality is limited.

Select the spectrum analysis mode for the following functions:

- Measurement of noise density (*NOISE MEAS* softkey)

- Measurement of phase noise (*PHASE NOISE* softkey)

- Measurement of filter or signal bandwidth (*N DB DOWN* softkey)

- Activating of AF demodulation (*MARKER DEMOD* softkey)

On calling the menu, the entry for the last active marker is activated (*SELECT MARKER* softkey); if no marker is activated, marker 1 is activated and a maximum search (*PEAK* softkey) is performed. The marker can be set to the desired trace by means of the *MKR->TRACE* softkey.
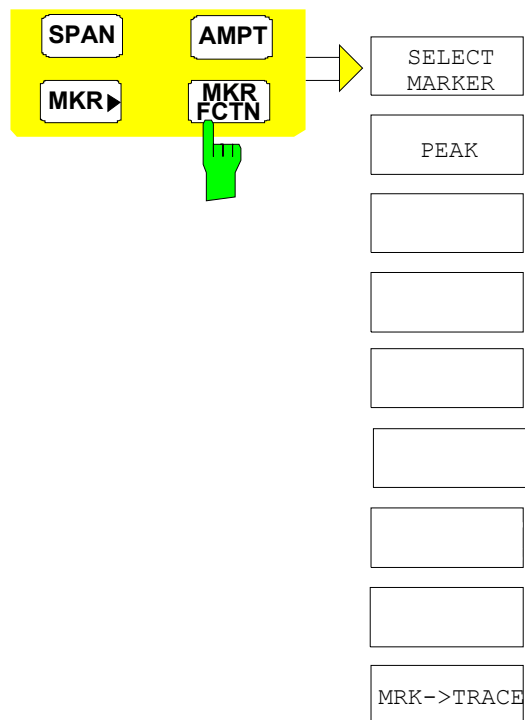
Activating the Markers

SELECT MARKER   The *SELECT MARKER* softkey activates the numerical selection of the marker in the data entry field. Delta marker 1 is selected by input of ' 0 '.

If the marker is switched off, then it is switched on and can be moved later on.

IEC/IEEE bus command: `CALC:MARK1 ON;`
`CALC:MARK1:X <value>;`
`CALC:MARK1:Y?`

PEAK   The *PEAK* softkey sets the active marker/delta marker to the peak of the trace.

IEC/IEEE bus command: `CALC:MARK1:MAX`
`CALC:DELT1:MAX`

Selecting the Trace

MKR->TRACE   The *MKR->TRACE* softkey sets the active marker to different traces. Only those traces can be selected which are visible on the screen in the same window.

The function of the softkey is identical to that of the softkey with the same name in the MKR-> menu.

Example:

Three traces are displayed on the screen. The marker is always on Trace 1 on switching on.

[*MKR->TRACE*]

1 | ENTER   The marker jumps to Trace 2, but remains at the previous frequency or time.

[*MKR->TRACE*]

3 | ENTER   The marker jumps to Trace 3.

IEC/IEEE bus command: `CALC:MARK:TRAC 2`

Change of Settings via Markers – MKR-> Key

The *MKR->* menu offers functions through which instrument parameters can be changed with the aid of the currently active marker. The functions can be used on markers and delta markers.

On opening the menu, the entry for the last active marker is activated; if no marker was enabled, *MARKER 1* is activated and a peak search is performed.

```
[SPAN]  [AMPL]           =>   SELECT          MKR -> CF
                              MARKER          STEPSIZE
[MKR►]  [MKR
         FCTN]                PEAK               MIN

          LEFT                CENTER          NEXT  MIN
          LIMIT              =MKR FREQ

          RIGHT                              NEXT MIN
          LIMIT                               RIGHT

        THRESHOLD           NEXT PEAK        NEXT MIN
                                              LEFT

                            NEXT PEAK
                             RIGHT

                            NEXT PEAK
                             LEFT

                             SEARCH
                             LIMITS ▼

                            MRK->TRACE         PEAK
                                            EXCURSION

        SEARCH LIM
          OFF
```

SELECT MARKER   The *SELECT MARKER* softkey activates the numerical selection of the marker in the data entry field. Delta marker 1 is selected by input of ' 0 '.

                    IEC/IEEE bus command: `CALC:MARK1 ON;`
                                                    `CALC:MARK1:X <value>;`
                                                      `CALC:MARK1:Y?`

PEAK   The *PEAK* softkey sets the active marker/delta marker to the peak of the trace.

                    If no marker is active when *MKR->* menu is called, *MARKER 1* is automatically switched on and the peak search is performed.

                    IEC/IEEE bus command: `CALC:MARK:MAX`
                                                    `CALC:DELT:MAX`

CENTER=MKR FREQ

The *CENTER=MKR FREQ* softkey sets the center frequency to the current marker or delta marker frequency.

A signal can thus be set to the center of the frequency display range, for example, so that it can then be examined in detail with a smaller span.

IEC/IEEE bus command:　　`CALC:MARK:FUNC:CENT`

Example:

A spectrum is displayed with a large span after PRESET. A signal off the center is to be examined in detail:

[**PRESET**]	R&S ESU is set to the default setting.
[**MKR->**]	*MARKER 1* is switched on and automatically jumps to the largest signal of the trace.
[*CENTER=MKR FREQ*]	The center frequency is set to the marker frequency. The span is adapted in such a way that the minimum frequency (= 0 Hz) or the maximum frequency is not exceeded.
[*SPAN*]	The span can, for example, be reduced using the rotary knob.

NEXT PEAK

The *NEXT PEAK* softkey sets the active marker/delta marker to the next lower maximum of the selected trace.

IEC/IEEE bus command:　　`CALC:MARK:MAX:NEXT`
　　　　　　　　　　　　　　`CALC:DELT:MAX:NEXT`

NEXT PEAK RIGHT

The *NEXT PEAK RIGHT* softkey sets the active marker/delta marker to the next lower maximum right of the current marker position on the selected trace.

IEC/IEEE bus command:　　`CALC:MARK:MAX:RIGH`
　　　　　　　　　　　　　　`CALC:DELT:MAX:RIGH`

NEXT PEAK LEFT

The *NEXT PEAK LEFT* softkey sets the active marker/delta marker to the next lower maximum left of the current marker position the selected trace.

IEC/IEEE bus command:　　`CALC:MARK:MAX:LEFT`
　　　　　　　　　　　　　　`CALC:DELT:MAX:LEFT`

SEARCH LIMITS

```
┌─────────┐      ┌──────────┐
│ SEARCH  │ ──>  │  LEFT    │
│ LIMITS  │      │  LIMIT   │
└─────────┘      └──────────┘

                 ┌──────────┐
                 │  RIGHT   │
                 │  LIMIT   │
                 └──────────┘

                 ┌──────────┐
                 │THRESHOLD │
                 └──────────┘

                 ┌──────────┐
                 │          │
                 └──────────┘

                 ┌──────────┐
                 │          │
                 └──────────┘

                 ┌──────────┐
                 │          │
                 └──────────┘

                 ┌──────────┐
                 │          │
                 └──────────┘

                 ┌──────────┐
                 │          │
                 └──────────┘

                 ┌──────────┐
                 │SEARCH LIM│
                 │   OFF    │
                 └──────────┘
```

The *SEARCH LIMITS* softkey limits the search range for maximum or minimum search. The softkey switches to a submenu in which the search range limits can be set in the x and y direction.

LEFT LIMIT
RIGHT LIMIT
The *LEFT LIMIT* and *RIGHT LIMIT* softkeys define the two vertical lines F1 and F2 in the frequency domain (span > 0) and T1 / T2 in the time domain (span = 0). The search is performed between these lines in the frequency and time domain.

If only *LEFT LIMIT* is enabled, line F1/T1 is the lower limit and the upper limit corresponds to the stop frequency. If *RIGHT LIMIT* is also enabled, it determines the upper limit.

IEC/IEEE bus command: CALC:MARK:X:SLIM:LEFT 1MHZ
                          CALC:MARK:X:SLIM:RIGH 10MHZ
                          CALC:MARK:X:SLIM ON

THRESHOLD
The *THRESHOLD* softkey defines the threshold line. The threshold line represents a limit for the level range of the max. search at the lower end and that of the min. search at the upper end.

IEC/IEEE bus command: CALC:THR –20dBm
                          CALC:THR ON

SEARCH LIMIT OFF
The *SEARCH LIMIT OFF* softkey disables all limits of the search range.

IEC/IEEE bus command: CALC:MARK:X:SLIM OFF
                          CALC:THR OFF

MKR->TRACE   The *MKR->TRACE* softkey sets the active marker to a new trace. If only one trace is available on the screen, the softkey does not appear. If several traces are available on the screen, only these are offered.

IEC/IEEE bus command: `CALC:MARK:TRAC 2`

Example:

Three traces are displayed on the screen. The marker is always on Trace 1 after switching on.

[*MKR->TRACE*]

2 | ENTER   The marker jumps to Trace 2 but remains at the previous frequency or time.

[*MKR->TRACE*]

3 | ENTER   The marker jumps to Trace 3.

MKR->CF STEPSIZE   The *MKR->CF STEPSIZE* softkey sets the step size for the center frequency variation to the current marker frequency, and also sets step size adaptation to *MANUAL. CF STEPSIZE* remains at this value until the center frequency entry mode in the *STEP* menu is switched from *MANUAL* to *AUTO* again.

The *MKR->CF STEPSIZE* function is, above all, useful in the measurement of harmonics with large dynamic range (narrow bandwidth and narrow span).

The softkey is not available in the time domain (span = 0 Hz).

IEC/IEEE bus command: `CALC:MARK:FUNC:CST`

Example:

The harmonics levels of a CW carrier are to be measured at 100 MHz.

[**PRESET**]	R&S ESU is set to the default setting.
[**CENTER**: 100 **MHz**]	R&S ESU sets the center frequency to 100 MHz. The span is set to 200 MHz.
[**SPAN**: 1 **MHz**]	The span is set to 1 MHz.
[**MKR->**]	MARKER 1 is switched on and set to the maximum value of the signal.
[**NEXT**]	R&S ESU switches to the submenu.
[*MKR->CF STEPSIZE*]	The step size of the center frequency setting equals the marker frequency (100 MHz).
[**CENTER**]	The center frequency entry mode is activated.
[**Right key**]	The center frequency is set to 200 MHz. The first harmonic of the test signal is displayed.
[**MKR->**: *PEAK*]	The marker is set to the harmonic and the level of the latter is output in the marker info field.

MIN   The *MIN* softkey sets the active marker/delta marker to the minimum of the selected trace.

IEC/IEEE bus command: `CALC:MARK:MIN`
                          `CALC:DELT:MIN`

NEXT MIN

The *NEXT MIN* softkey sets the active marker/delta marker to the next higher minimum of the selected trace. The search direction is defined in the *NEXT MODE* submenu (see above).

IEC/IEEE bus command: `CALC:MARK:MIN:NEXT`
                                            `CALC:DELT:MIN:NEXT`

NEXT MIN RIGHT

The *NEXT MIN RIGHT* softkey sets the active marker/delta marker to the next higher minimum right of the current marker position on the selected trace.

IEC/IEEE bus command: `CALC:MARK:MIN:RIGH`
                                            `CALC:DELT:MIN:RIGH`

NEXT MIN LEFT

The *NEXT MIN LEFT* softkey sets the active marker/delta marker to the next higher minimum left of the current marker position on the selected trace.

IEC/IEEE bus command: `CALC:MARK:MIN:LEFT`
                                            `CALC:DELT:MIN:LEFT`

PEAK EXCURSION

The *PEAK EXCURSION* softkey enables – for level measurements – the entry of a minimum level value by which a signal must rise or fall so that it will be identified as a maximum or a minimum by the *NEXT PEAK* and *NEXT MIN* search functions.

Valid entries are from 0 dB to 80 dB; the resolution is 0.1 dB.

IEC/IEEE bus command: `CALC:MARK:PEXC 10dB`

The default setting for the peak excursion is 6 dB. This value is sufficient for the *NEXT PEAK* and *NEXT MIN* functions since, in this mode, the next lower maximum or next higher minimum will always be detected.

If *NEXT PEAK LEFT* or *NEXT PEAK RIGHT* is selected, these functions search for the next relative maximum left or right of the current marker position irrespective of the current signal amplitude. *Relative maximum* is understood to mean a decrease of the signal amplitude by a defined value – i.e. the peak excursion – right and left of the amplitude peak.

The 6 dB level change set as a default value may be attained already by the inherent noise of the instrument. In such a case, the R&S ESU would identify noise peaks as maxima or minima. The value entered for the *PEAK EXCURSION* should therefore be higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

Example:

The following example illustrates the effect of different settings of the *PEAK EXCURSION*.
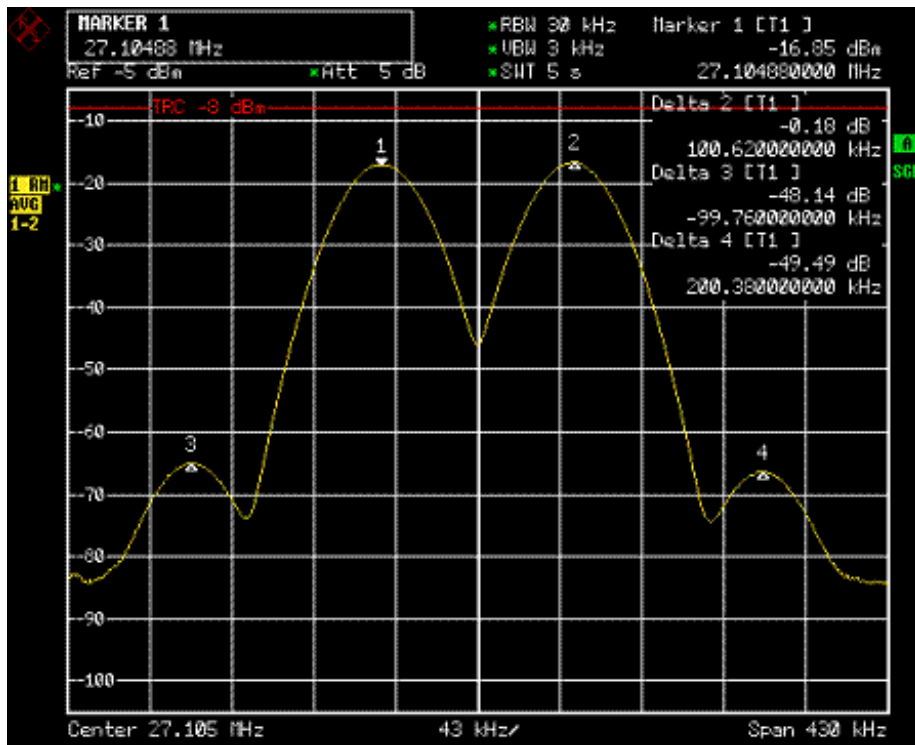
Fig. 4-10   Examples of level measurement with different settings of *PEAK EXCURSION*

The following table lists the signals as indicated by marker numbers in the diagram above, as well as the minimum of the amplitude decrease to both sides of the signal:

signal #	min. amplitude decrease to both sides of the signal
1	30 dB
2	29.85 dB
3	7 dB
4	7 dB

With **40 dB peak excursion**, *NEXT PEAK*, *NEXT PEAK RIGHT* and *NEXT PEAK LEFT* will not find any signal, as the signal level does not decrease by more than 30 dB to either side of any signal.

Order of signals detected:

PEAK: signal 1

NEXT PEAK: signal 1 (no further signal detected)

or

PEAK: signal 1
NEXT PEAK LEFT: signal 1 (no further signal detected)
NEXT PEAK RIGHT: signal 1 (no further signal detected)

With **20 dB peak excursion**, *NEXT PEAK* and *NEXT PEAK RIGHT* will also detect signal 2, as the signal level decreases at least by 29.85 dB to either side of this signal, which is now greater than the peak excursion.

Order of signals detected:

PEAK: Signal 1
NEXT PEAK: Signal 2
NEXT PEAK: Signal 2 (no further signal detected)

or

PEAK: Signal 1
NEXT PEAK LEFT: Signal 1 (no further signal detected)
NEXT PEAK RIGHT: Signal 2
NEXT PEAK RIGHT: Signal 2 (no further signal detected)

With **6 dB peak excursion**, all signals will be detected with *NEXT PEAK* and *NEXT PEAK RIGHT* / *NEXT PEAK LEFT*.

Order of signals detected:

PEAK: Signal 1
NEXT PEAK: Signal 2
NEXT PEAK: Signal 3
NEXT PEAK: Signal 4

or

PEAK: Signal 1
NEXT PEAK LEFT: Signal 3
NEXT PEAK RIGHT: Signal 1
NEXT PEAK RIGHT: Signal 2
NEXT PEAK RIGHT. Signal 4

Selection and Setting of Traces – *TRACE* Key

The R&S ESU is capable of displaying up to three different traces at a time in a diagram. A trace consists of a maximum of 625 pixels on the horizontal axis. If more measured values than pixels are available, several measured values are combined in one pixel.

The traces are selected using the *SELECT TRACE* softkey in the menu of the *TRACE* key.

The traces can individually be activated for a measurement or frozen after completion of a measurement. Traces that are not activated are blanked.

The display mode can be selected for each trace. Traces can be overwritten in each measurement (CLEAR/WRITE mode), averaged over several measurements (AVERAGE mode), or a maximum or minimum value can be determined from several measurements and displayed (MAX HOLD or MIN HOLD mode).

In IF analysis mode is only the sample detector for the traces available.
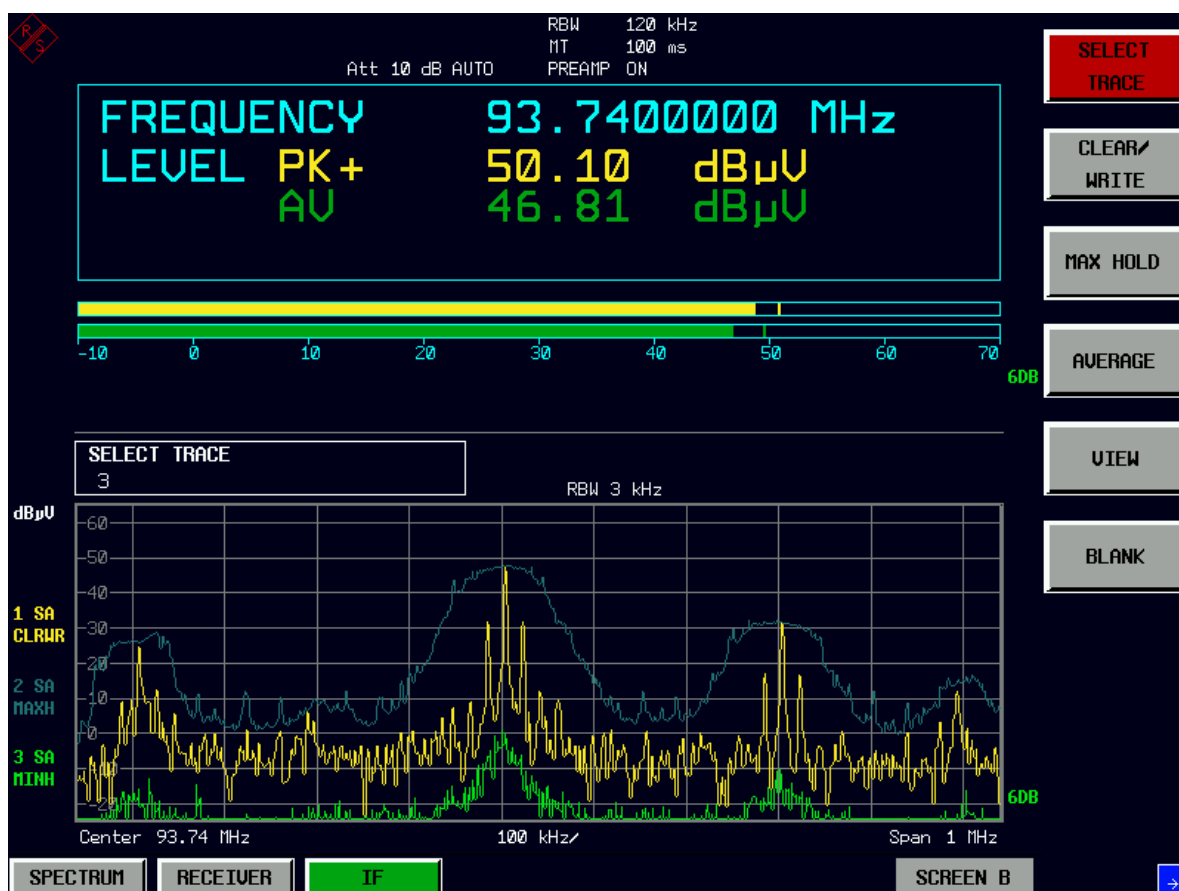
Selection of Trace Function

The trace functions are subdivided as follows:

• Display mode of trace (CLEAR/WRITE, VIEW, and BLANK)

• Evaluation of the trace as a whole (AVERAGE, MAX HOLD, and MIN HOLD)
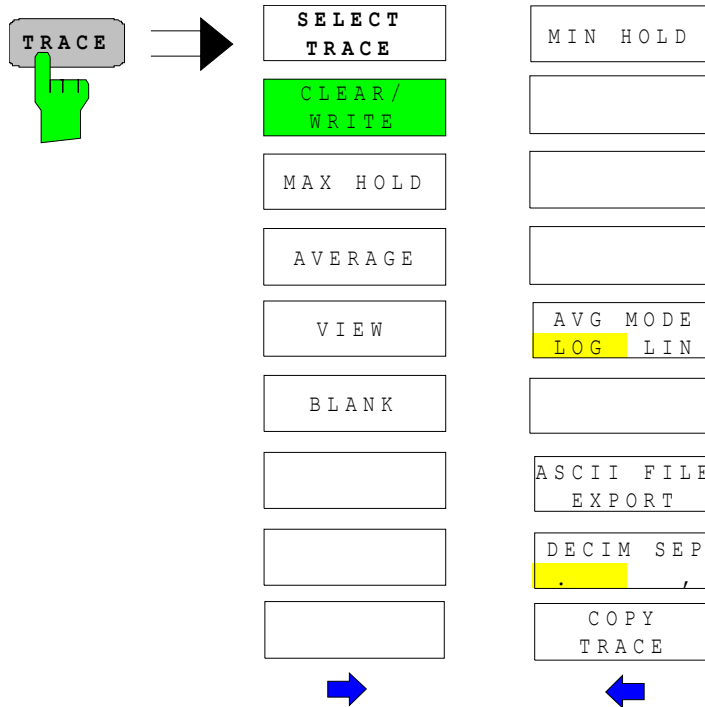
The *TRACE* key opens a menu offering the setting options for the selected trace.

In this menu, the mode of representing the measured data in the frequency or time domain in the 625 pixels of the display is determined. Upon start of the measurement, each trace can be displayed either completely new or based on the previous results.

Traces can be displayed, blanked and copied.

The default setting is trace 1 in the overwrite mode (CLEAR/WRITE mode), trace 2 and trace 3 are switched off (BLANK mode).

The *CLEAR/WRITE, MAX HOLD, MIN HOLD, AVERAGE, VIEW* and *BLANK* softkeys are mutually exclusive selection keys.

SELECT TRACE   The *SELECT TRACE* softkey activates the entry for the active trace (1, 2, 3).

IEC/IEEE bus command: `--` (selected via numeric suffix of TRACe)

CLEAR/WRITE   The *CLEAR/WRITE* softkey activates the overwrite mode for the collected measured values, i.e. the trace is overwritten by each sweep.

IEC/IEEE bus command: `DISP:WIND:TRAC:MODE WRIT`

MAX HOLD　　　　The *MAX HOLD* softkey activates the max hold mode for the trace display.

R&S ESU saves the sweep result in the trace memory only if the new value is greater than the previous one.

This is especially useful with modulated or impulsive signals. The signal spectrum is filled up upon each scan until all signal components are detected in a kind of envelope.

IEC/IEEE bus command:　　`DISP:WIND:TRAC:MODE MAXH`

AVERAGE　　　　The *AVERAGE* softkey activates the trace averaging function. The average is formed over several sweeps.

Depending on the setting of AVG MODE LOG / LIN, the logarithmic level values or the measured power/voltage values are averaged.

IEC/IEEE bus command:　　`DISP:WIND:TRAC:MODE AVER`

Description of averaging

Averaging is carried out over the pixels derived from the measurement samples. Several measured values may be combined in a pixel. This means that with linear level display the average is formed over linear amplitude values and with logarithmic level display over levels. For this reason the trace must be measured again when changing between *LIN* and *LOG* display mode. The settings *CONT/SINGLE SWEEP* and running averaging apply to the average display analogously.

A running average is calculated according to the following formula:

$$\text{TRACE} = \frac{9 * \text{TRACE} + \text{ meas. value}}{10}$$

Due to the weighting between the new measured value and the trace average, past values have practically no influence on the displayed trace after about ten sweeps. With this setting, signal noise is effectively reduced without need for restarting the averaging process after a change of the signal.

VIEW　　　　The *VIEW* softkey freezes the current contents of the trace memory and displays it.

If in the VIEW display mode the level display range (*GRID RANGE*) or the reference level (*GRID MIN LEVEL*) are changed, R&S ESU automatically adapts the measured data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

IEC/IEEE bus command:　　`DISP:WIND:TRAC:MODE VIEW`

BLANK　　　　The *BLANK* softkey activates the blanking of the trace on the screen.

IEC/IEEE bus command:　　`DISP:WIND:TRAC OFF`

MIN HOLD

The *MIN HOLD* softkey activates the min hold mode for the trace. R&S ESU saves for each scan the smallest of the previously stored/currently measured values in the trace memory.

This function is useful e.g. for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed by the min hold function whereas a CW signal is recognized by its constant level.

IEC/IEEE bus command: `DISP:WIND:TRAC:MODE MINH`

AVG MODE LOG/ LIN

The *AVG MODE LOG/LIN* softkey selects logarithmic or linear averaging for the logarithmic level display mode.

IEC/IEEE bus command: `CALC:MATH:AVER:MODE LIN`

With logarithmic averaging, the dB values of the display voltage are averaged. With linear averaging the level values in dB are converted into linear voltages or powers prior to averaging. Voltage or power values are averaged or offset against each other and reconverted into level values.

For stationary signals the two methods yield the same result.

Logarithmic averaging is recommended if sinewave signals are to be clearly visible against noise since with this type of averaging noise suppression is improved while the sinewave signals remain unchanged.

For noise or pseudo-noise signals the positive peak amplitudes are decreased in logarithmic averaging due the characteristic involved and the negative peak values are increased relative to the average value. If the distorted amplitude distribution is averaged, a value is obtained that is smaller than the actual average value. The difference is -2.5 dB.

Probability distribution

This low average value is usually corrected in noise power measurements by a 2.5 dB factor. Therefore the R&S ESU offers the selection of linear averaging. The trace data are delogarithmized prior to averaging, then averaged and logarithmized again for display on the screen. The average value is always correctly displayed irrespective of the signal characteristic.

ASCII FILE EXPORT   The *ASCII FILE EXPORT* softkey stores the active trace in ASCII format, e.g. on a memory stick.

IEC/IEEE bus command: `FORM ASC;`
`MMEM:STOR:TRAC 1,'TRACE.DAT'`

The file consists of the header containing important scaling parameters, several data sections containing the scan settings and a data section containing the trace data.

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit

The data section for the scan ranges starts with the keyword "Scan <n>:", (<n> = number of scan range), followed by the scan data in one or several columns which are also separated by a semicolon.

The data section for the trace date starts with the keyword " Trace <n> " (<n> = number of stored trace), followed by the measured data in one or several columns which are also separated by a semicolon.

This format can be read in from spreadsheet calculation programs, e.g. MS-Excel. It is necessary to define ';' as a separator.

Note

Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using softkey DECIM SEP.

Example - File header:

File contents	Description
Type;ESU8;	Instrument model
Version;1.00;	Firmware version
Date;01.Jul 2005;	Date of data set storage
Mode;IF;	Instrument mode
Center Freq;10000000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Span;100000;Hz	Frequency range
x-Axis;LIN;	Scaling of x axis linear (LIN)
Start;9950000;Hz	Start/stop of the display range.
Stop;10050000;Hz	
Ref.Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Ref Position;100;%	Position of reference level referred to diagram limits (0% = lower edge)
y-Axis;LOG;	Scaling of y axis: logarithmic (LOG)
Level Range;100;dB	Display range in y direction. Unit: dB with x axis LOG,
RF Att;20;dB	Input attenuation
RBW;100000;Hz	Resolution bandwidth
VBW;30000;Hz	Video bandwidth
SWT;0.005;s	Sweep time
Trace Mode;AVERAGE;	Display mode of trace: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD
Detector;SAMPLE;	Detector set: always SAMPLE
Sweep Count;0;	Number of sweeps set, always 0

Example - Data section of the file

File contents	Description
Trace 1:;;	Selected trace
x-Unit;Hz;	Unit of x values: always Hz
y-Unit;dBm;	Unit of y values
Values; 625;	Number of test points
	Measured values:
10000;-10.3	\<x value\>, \<y1\>
10180;-11.5	
10360;-12.0	
...;...	

DECIM SEP The *DECIM SEP* softkey selects the decimal separator between '.' (decimal point) and ',' (comma) with floating-point numerals for the function *ASCII FILE EXPORT*.

With the selection of the decimal separator different language versions of evaluation programs (e.g. MS Excel) can be supported.

IEC/IEEE bus command: `FORM:DEXP:DSEP POIN`

COPY TRACE   The *COPY TRACE* softkey copies the screen contents of the current trace into another trace memory. The desired memory is selected by entering the number 1, 2 or 3.

Upon copying, the contents of the selected memory are overwritten and the new contents displayed in view mode.

IEC/IEEE bus command: `TRAC:COPY TRACE1,TRACE2`

Spectrum Analysis Mode

The spectrum analysis mode is activated by pressing the *SPECTRUM* hotkey (see also section "Mode Selection – Hotkey Bar" on page 4.10)

SPECTRUM

The *SPECTRUM* hotkey selects the spectrum analysis mode.

The functions provided correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the test signal over the selected frequency range with the selected resolution and sweep time, or, for a fixed frequency, displays the waveform of the video signal.

Note

If two displays (screen A and screen B) are opened after switch-on of signal analysis, the analyzer mode is only set for the display activated for entry (marked at the top right corner of diagram). For the other display, the previous settings remain valid.

Data acquisition and display of measured values is sequential: first in the upper and then in the lower display.

Frequency and Span Selection – FREQ

The *FREQ* key is used to specify the frequency axis of the active display window. The frequency axis can be defined either by the start and stop frequency or by the center frequency and the span (*SPAN* key). With two windows (SPLIT SCREEN) displayed at the same time, the input data always refer to the window selected in the *SYSTEM-DISPLAY* menu.

After pressing one of the *CENTER*, *START* or *STOP* softkeys, the value of the corresponding parameter can be defined in an input window.

```
                        Span <> 0        Span = 0

FREQ  →    CENTER    →    0.1 * SPAN      0.1 * RBW    →    TRACK
                                                           ON   OFF
           CF-              0.5 * SPAN      0.5 * RBW          TRACK
           STEPSIZE                                           BW

                           x * SPAN        x * RBW            TRACK
                                                              THRESHOLD

           START           = CENTER        = CENTER          SELECT
                                                             TRACE

           STOP            = MARKER        = MARKER


                           MANUAL          MANUAL


           FREQUENCY
           OFFSET

           SIGNAL
           TRACK
```
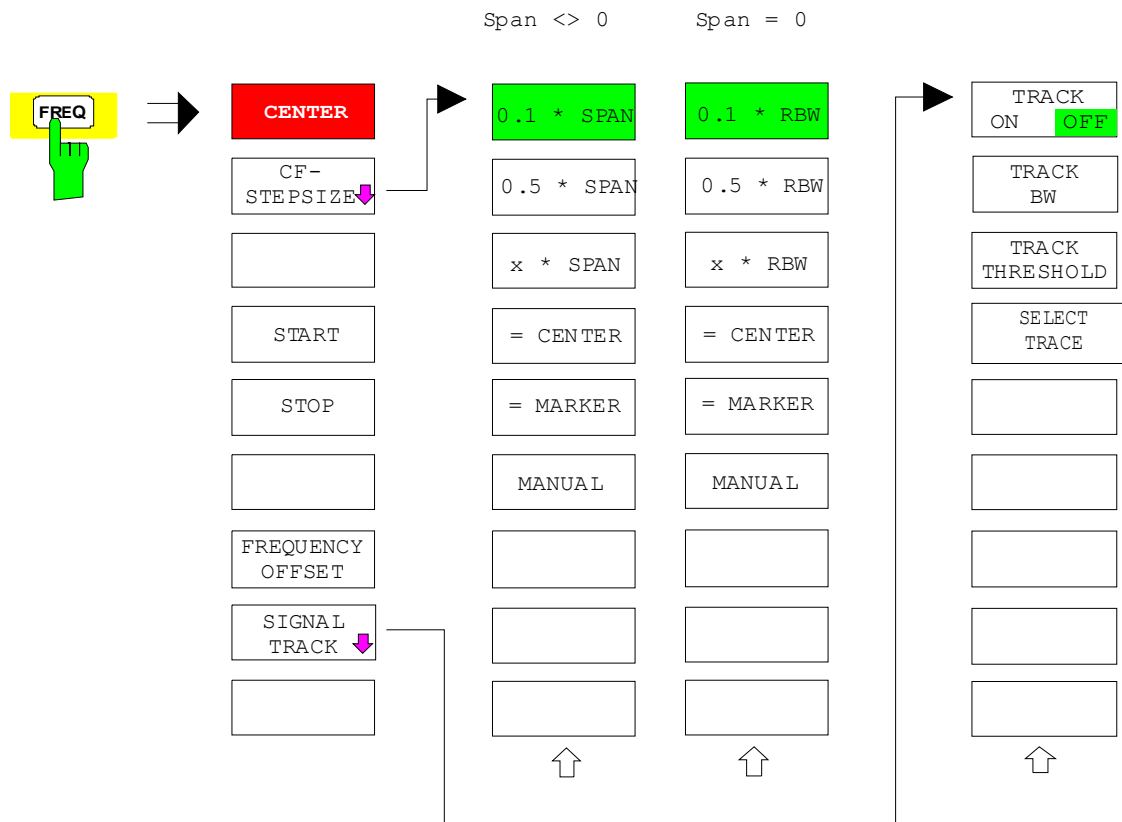
CENTER

The *CENTER* softkey opens the window for manually entering the center frequency.

The allowed range of values for the center frequency is:

- for the frequency domain (span >0):

    $\text{minspan} / 2 \leq f_{center} \leq f_{max} - \text{minspan} / 2$

- and for the time domain (span = 0):

    $0\ \text{Hz} \leq f_{center} \leq f_{max}$

f_{center} center frequency

minspan   smallest selectable span > 0 Hz (10 Hz)

f_{max} max. frequency

IEC/IEEE bus command: `FREQ:CENT 100MHz`

CF STEPSIZE   The *CF STEPSIZE* softkey opens a submenu for setting the step size of the center frequency. The step size can be coupled to the span (frequency domain) or the resolution bandwidth (time domain) or it can be manually set to a fixed value. The softkeys are mutually exclusive selection keys.

The softkeys are presented according to the selected domain (frequency or time).

Softkeys in frequency domain:

0.1 * SPAN   The *0.1 * SPAN* softkey sets the step size for the center frequency entry to 10% of the span.

IEC/IEEE bus command: `FREQ:CENT:STEP:LINK SPAN`
`FREQ:CENT:STEP:LINK:FACT 10PCT`

0.5 * SPAN   The *0.5 * SPAN* softkey sets the step size for the center frequency entry to 50% of the span.

IEC/IEEE bus command: `FREQ:CENT:STEP:LINK SPAN`
`FREQ:CENT:STEP:LINK:FACT 50PCT`

X * SPAN   The *X * SPAN* softkey allows the factor defining the center frequency step size to be entered as % of the span.

IEC/IEEE bus command: `FREQ:CENT:STEP:LINK SPAN`
`FREQ:CENT:STEP:LINK:FACT 20PCT`

= CENTER   The *= CENTER* softkey sets the step size coupling to MANUAL and the step size to the value of the center frequency. This function is especially useful during measurements of the signal harmonic content because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

IEC/IEEE bus command: `--`

= MARKER   The *= MARKER* softkey sets the step size coupling to MANUAL and the step size to the value of the marker. This function is especially useful during measurements of the signal harmonic content at the marker position because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

IEC/IEEE bus command: `--`

MANUAL   The *MANUAL* softkey activates the window for entering a fixed step size.

IEC/IEEE bus command: `FREQ:CENT:STEP 120MHz`

Softkeys in time domain:

0.1 * RBW
The *0.1 * RBW* softkey sets the step size for the center frequency entry to 10% of the resolution bandwidth.

*AUTO 0.1 * RBW* corresponds to the default setting.

IEC/IEEE bus command: `FREQ:CENT:STEP:LINK RBW`
`FREQ:CENT:STEP:LINK:FACT 10PCT`

0.5 * RBW
The *0.5 * RBW* softkey sets the step size for the center frequency entry to 50% of the resolution bandwidth.

IEC/IEEE bus command: `FREQ:CENT:STEP:LINK RBW`
`FREQ:CENT:STEP:LINK:FACT 50PCT`

X * RBW
The *X * RBW* softkey allows the factor defining the center frequency step size to be entered as % of the resolution bandwidth.

Values between 1 and 100% in steps of 1% are allowed. The default setting is 10%.

IEC/IEEE bus command: `FREQ:CENT:STEP:LINK RBW`
`FREQ:CENT:STEP:LINK:FACT 20PCT`

= CENTER
The = *CENTER* softkey sets the step size coupling to MANUAL and the step size to the value of the center frequency. This function is especially useful during measurements of the signal harmonic content because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

IEC/IEEE bus command: `--`

= MARKER
The = *MARKER* softkey sets the step size coupling to MANUAL and the step size to the value of the marker. This function is especially useful during measurements of the signal harmonic content at the marker position because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

IEC/IEEE bus command: `--`

MANUAL
The *MANUAL* softkey activates the window for entering a fixed step size.

IEC/IEEE bus command: `FREQ:CENT:STEP 120MHz`

START
The *START* softkey activates the window for manually entering the start frequency.

The allowed range of values for the start frequency is:

$0 \text{ Hz} \leq f_{start} \leq f_{max} - minspan$

f_{start} start frequency

minspan   smallest selectable span (10 Hz)

f_{max} max. frequency

IEC/IEEE bus command: `FREQ:STAR 20MHz`

STOP   The *STOP* softkey activates the window for entering the stop frequency.

                            The allowed range of values for the stop frequency is:

                            $minspan \leq f_{stop} \leq f_{max}$

                            f_{stop} stop frequency

                            minspan   smallest selectable span (10 Hz)

                            f_{max} max. frequency

                            IEC/IEEE bus command: `FREQ:STOP 2000MHz`

FREQUENCY   The *FREQUENCY OFFSET* softkey activates the window for entering an
OFFSET   arithmetical frequency offset which is added to the frequency axis labelling. The
                            allowed range of values for the offset is -100 GHz to 100 GHz. The default
                            setting is 0 Hz.

                            IEC/IEEE bus command: `FREQ:OFFS 10 MHz`

SIGNAL TRACK   The *SIGNAL TRACK* softkey switches on the tracking of a signal near the
                            center frequency. The signal is tracked as long it is in the search bandwidth
                            around the center frequency defined with *TRACK BW* and above the level
                            threshold defined with *TRACK THRESHOLD*.

                            For that purpose, the maximum signal is searched (*PEAK SEARCH)* on the
                            screen and the center frequency set to this signal (*MARKER ->CENTER*) after
                            each frequency sweep within the search bandwidth.

                            If the signal falls below the level threshold or jumps out of the search bandwidth
                            around the center frequency, the center frequency is not varied until a signal is
                            in the search bandwidth above the level threshold. This can be achieved by
                            manually modifying the center frequency, for example.

                            On switching on, the softkey is highlighted and the search bandwidth and the
                            threshold value are marked on the diagram by two vertical lines and one
                            horizontal line. All these lines are allocated the designation TRK.

                            At the same time a submenu is opened in which the search bandwidth, the
                            threshold value and the trace can be modified for the maximum search.

                            The softkey is only available in the frequency domain (span >0).

                            IEC/IEEE bus command: `CALC:MARK:FUNC:STR OFF`

        TRACK ON/OFF   The *TRACK ON/OFF* softkey switches on and off signal tracking.

                            IEC/IEEE bus command: `CALC:MARK:FUNC:STR OFF`

            TRACK BW   The *TRACK BW* softkey defines the search bandwidth for signal tracking. The
                            frequency range is symmetrical with respect to the center frequency.

                            IEC/IEEE bus command: `CALC:MARK:FUNC:STR:BAND 10KHZ`

    TRACK THRESHOLD   The *TRACK THRESHOLD* softkey defines the threshold value for signal
                            detection. The value is always entered as an absolute level value.

                            IEC/IEEE bus command: `CALC:MARK:FUNC:STR:THR -70DBM`

SELECT TRACE   The *SELECT TRACE* softkey selects the trace on which signal tracking is to be performed.

IEC/IEEE bus command: `CALC:MARK:FUNC:STR:TRAC 1`

Setting the Frequency Span – SPAN

The *SPAN* key opens a menu which offers various options for setting the span.

The entry of the span (*SPAN MANUAL* softkey) is automatically active for span > 0 Hz.

For span = 0 Hz the entry for sweep time (*SWEEPTIME MANUAL*) is automatically active.

With two windows (*SPLIT SCREEN)* displayed at the same time, the input data always refer to the window selected with the *SCREEN A/B* hotkey.
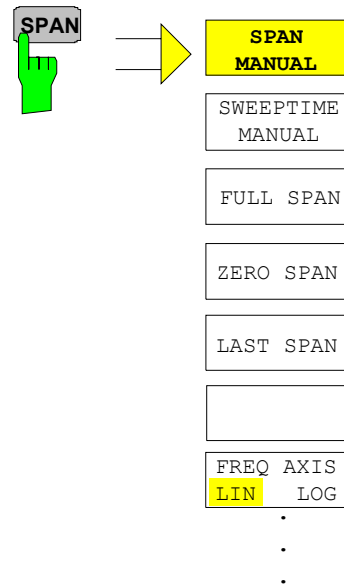
SPAN

SPAN MANUAL

SWEEPTIME MANUAL

FULL SPAN

ZERO SPAN

LAST SPAN

FREQ AXIS LIN LOG

.
.
.

SPAN MANUAL   The *SPAN MANUAL* softkey activates the window for manually entering the frequency span. The center frequency is kept constant.

The allowed range of span values is

- for the time domain (span = 0): 0 Hz

- and for the frequency domain (span >0): minspan $\leq f_{span} \leq f_{max}$

f_{span} frequency span

minspan   smallest selectable span (10 Hz)

f_{max} max. frequency

IEC/IEEE bus command: FREQ:SPAN 2GHz

SWEEPTIME MANUAL   The *SWEEPTIME MANUAL* softkey activates the window for entering the sweep time manually with Span = 0 Hz. The softkey is not available for Span > 0 Hz.

IEC/IEEE bus command: SWE:TIME 10s

FULL SPAN   The *FULL SPAN* softkey sets the span to the full frequency range of ESU.

IEC/IEEE bus command: FREQ:SPAN:FULL

ZERO SPAN   The *ZERO SPAN* softkey sets the span to 0 Hz. The x axis becomes the time
                       axis with the grid lines corresponding to 1/10 of the current sweep time (SWT).

                       IEC/IEEE bus command: `FREQ:SPAN 0Hz`

LAST SPAN   After changing the span setting the *LAST SPAN* softkey activates the previous
                       setting. With this function a fast change between overview measurement (*FULL
                       SPAN*) and detailed measurement (manually set center frequency and span) is
                       possible.

                       Note

                       Only values > 0 Hz are restored, i.e. a transition between
                       time and frequency domain is not possible.

                       IEC/IEEE bus command: `--`

FREQ AXIS LIN/   The *FREQ AXIS LIN/LOG* softkey switches between linear and logarithmic
LOG   scaling of the frequency axis. Switch over is only possible if the stop/start
                       frequency ratio is ≥10.

                       The default state is LIN.

                       The logarithmic frequency axis is only available in spectrum mode and it is not
                       available in zero span mode, in external mixer mode, with frequency offset or if
                       the ratio stop frequency / start frequency is below 1.4.

                       IEC/IEEE bus command: `DISP:WIND<1|2>:TRAC:X:SPAC LIN`

Level Display Setting and RF Input Configuration – AMPT

The *AMPT* key is used to set the reference level, the maximum level and the display range of the active window as well as the input impedance and the input attenuation of the RF input.

The *AMPT* key opens a menu for setting the reference level and the input attenuation of the active window. The data entry for the reference level (*REF LEVEL* softkey) is opened automatically.

Further settings regarding level display and attenuation can be made in this menu.

REF LEVEL	
RANGE LOG MANUAL	
RANGE LINEAR ⇩	RANGE LINEAR %
	RANGE LINEAR dB
UNIT ⇩	dBm
	dBmV
	dBμV
	dBμA
	dBμW
	VOLT
	AMPERE
	WATT
RF INPUT AC/DC	
RF ATTEN MANUAL	
RF ATTEN AUTO	
10 dB MIN ON/OFF	
RF INPUT 1/2	
Side menu	
REF LEVEL POSITION	
REF LEVEL OFFSET	
GRID ABS/REL	
RF INPUT 50 W / 75 W	

REF LEVEL

The *REF LEVEL* softkey allows the reference level to be input in the currently active unit (dBm, dBμV, etc.)

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RLEV –60dBm`

RANGE LOG MANUAL

The *RANGE LOG MANUAL* softkey activates the manual entry of the level display range. Display ranges from 10 to 200 dB are allowed in 10 dB steps. Inputs which are not allowed are rounded to the next valid value.

The default setting is 100 dB.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LOG`
                                       `DISP:WIND:TRAC:Y 120DB`

RANGE LINEAR

The *RANGE LINEAR* softkey selects linear scaling for the level display range of the analyzer. In addition, it opens a submenu for selecting % or dB for the scaling.

When linear scaling is selected, the % scaling is first activated (see also *RANGE LINEAR dB* softkey).

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LIN`

RANGE LINEAR %

The *RANGE LINEAR %* softkey selects linear scaling in % for the level display range, i.e. the horizontal lines are labelled in %. The grid is divided in decadic steps. Markers are displayed in the selected unit; delta markers are displayed in % referenced to the voltage value at the position of marker 1.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LIN`

RANGE LINEAR dB

The *RANGE LINEAR dB* softkey selects linear scaling in dB for the level display range, i.e. the horizontal lines are labelled in dB.

Markers are displayed in the selected unit; delta markers are displayed in dB referenced to the power value at the position of marker 1.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LDB`

UNIT
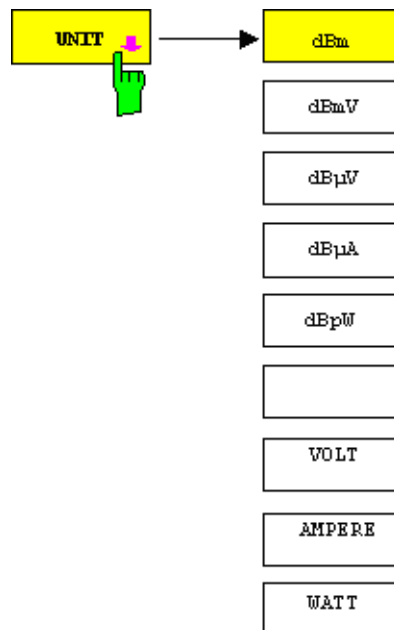
The *UNIT* softkey opens a submenu allowing to select the unit for the level axis.

The default setting is dBm.

In general, the analyzer measures the signal voltage at the RF input. The level display is calibrated in rms values of an unmodulated sinewave signal. In the default state, the level is displayed at a power of 1 mW (= dBm). Via the known input resistance of 50 Ω or 75W, conversion to other units is possible. The units dBm, dBmV, dBµV, dBµA, dBpW, V, A and W are directly convertible.

IEC/IEEE bus command: `CALC:UNIT:POW DBM`

RF INPUT AC/DC   The *RF INPUT AC/DC* softkey toggles the RF input of the analyzer between AC and DC coupling.

IEC/IEEE bus command: `INP:COUP AC`

RF ATTEN MANUAL   The *RF ATTEN MANUAL* softkey allows the attenuation to be entered irrespective of the reference level.

The attenuation can be set in 5 dB steps between 0 and 75 dB.

Other entries will be rounded to the next lower integer value.

If the defined reference level cannot be set for the given RF attenuation, the reference level will be adjusted accordingly and the warning "Limit reached" will be output.

> **Note**
>
> The value 0 dB cannot be switched on unless the *10 dB MIN ON/OFF* softkey is set to *OFF*.

IEC/IEEE bus command: `INP:ATT 40 DB`

RF ATTEN AUTO   The *RF ATTEN AUTO* softkey sets the RF attenuation automatically as a function of the selected reference level.

This ensures that the optimum RF attenuation desired by the user is always used.

RF ATTEN AUTO is the default setting.

IEC/IEEE bus command: `INP:ATT:AUTO ON`

10 dB MIN ON/OFF   The *10 dB MIN ON/OFF* softkey determines whether or not the 0 dB position of the attenuator is used when the attenuation is set manually or automatically.

The default setting is *ON*. This means the ESU always leaves at least 10 dB RF attenuation on in order to protect the input mixer.

The 0 dB position cannot be switched on manually. This prevents that 0 dB are set by mistake especially for measurements on objects with high signal voltage.

IEC/IEEE bus command: `INP:ATT:PROT ON`

RF INPUT 1/2   The RF INPUT 1/2 softkey selects the RF input.

Input 1 is the default setting. Alternatively, the pulse-resistant input 2 can be used in a frequency range up to 1 GHz.

REF LEVEL POSITION

The *REF LEVEL POSITION* softkey allows the reference level position to be entered.

The setting range is from -200 to +200%, 0% corresponding to the lower and 100% to the upper limit of the diagram.

IEC/IEEE bus command: `DISP:WIND:TRAC:RPOS 100PCT`

REF LEVEL OFFSET

The *REF LEVEL OFFSET* softkey allows the arithmetic level offset to be entered. This offset is added to the measured level irrespective of the selected unit. The scaling of the Y axis is changed accordingly.

The setting range is ±200 dB in 0.1 dB steps.

IEC/IEEE bus command: `DISP:WIND:TRAC:RLEV:OFFS –10dB`

GRID ABS/REL

The *GRID ABS/REL* softkey switches between absolute and relative scaling of the level axis.

GRID ABS is the default setting.

ABS   The labelling of the level lines refers to the absolute value of the reference level.

REL   The upper line of the grid is always at 0 dB.
The scaling is in dB whereas the reference level is always in the set unit (dBm, dBmV,..).

For setting *RANGE LINEAR* (linear scaling, labelling of axes in %) the softkey is not displayed since the unit % itself implies a relative scale.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:MODE ABS`

RF INPUT 50 Ω / 75 Ω

The *RF INPUT 50 Ω / 75 Ω* softkey switches the input impedance of the instrument between 50 Ω (= default setting) and 75 Ω.

The setting 75 Ω should be used if the input impedance (50 Ω) is transformed to 75 Ω using the corresponding adapter unit of type RAZ (= 25 Ω in series to the input impedance of the analyzer). The correction value used for the adoption is 1.76 dB = 10 log (75Ω / 50Ω).

All levels specified in this operating manual refer to the default setting of the instrument (50 Ω).

IEC/IEEE bus command: `INP:IMP 50OHM`

Setting the Bandwidths and Sweep Time – BW

The *BW* key calls a menu for setting the resolution bandwidth (*RBW*), video bandwidth (*VBW*) and sweep time (*SWT*) for the frequency sweep. The parameters may be coupled dependent on the span (stop minus start frequency) or freely set by the user. When working with a split screen display, the settings always refer to the active window.

The ESU offers resolution bandwidths from 10 Hz to 10 MHz in 1, 2, 3, 5, 10 steps.

Resolution bandwidths up to 120 kHz are realized using digital bandpasses with Gaussian characteristics. As far as the attenuation characteristic is concerned they behave like analog filters but have a much higher measurement speed than comparable analog filters. This is due to the fact that the transient response can be compensated as a result of an accurately defined filter behavior.

Bandwidths above 120 kHz are realized using decoupled 5-circuit LC filters.

As an alternative to the analog filters, FFT filters are available for the bandwidths between 1 Hz and 30 kHz. When working with bandwidths up to 30 kHz, the FFT algorithm offers considerably higher measurement speeds with all the other settings remaining the same. The reason is that with analog filters the sweep time required for a particular span is proportional to $(Span/RBW^2)$. When using the FFT algorithm, however, the sweep time is proportional to $(Span/RBW)$.

The video bandwidths are available in 1, 2, 3, 5, 10 steps between 1 Hz and 10 MHz. They can be set in accordance with the resolution bandwidth.

The video filters serve for smoothing the displayed trace. Video bandwidths that are small compared to the resolution bandwidth average out noise peaks and pulsed signals, so that only the signal average is displayed. If pulsed signals are to be measured, it is recommended to use a video bandwidth that is large compared to the resolution bandwidth (VBW $\geq$ 10 × RBW) for the amplitudes of pulses to be measured correctly.

Note

For analog and digital filters, the ESU has overload reserves of different magnitude above the reference level. Due to the LO breakthrough the overload display OVLD responds with digital filters with RBW < 100 kHz, as soon as the start frequency is selected <6 * resolution bandwidth, for RBW = 100 kHz, as soon as the start frequency is below 3 MHz.

BW	SWEEP		RES BW MANUAL		MAIN PLL BANDWIDTH		RBW / VBW SINE [1/3]
M__S	TRIG		VIDEO BW MANUAL		FFT FILTER MODE		RBW / VBW PULSE[0.1]
			SWEEPTIME MANUAL		VBW MODE LIN LOG		RBW / VBW NOISE [10]
			RES BW AUTO				RBW / VBW MANUAL
			VIDEO BW AUTO				
			SWEEPTIME AUTO				SPAN /RBW AUTO [50]
			COUPLING RATIO				SPAN /RBW MANUAL
			DEFAULT COUPLING				
			FILTER TYPE				
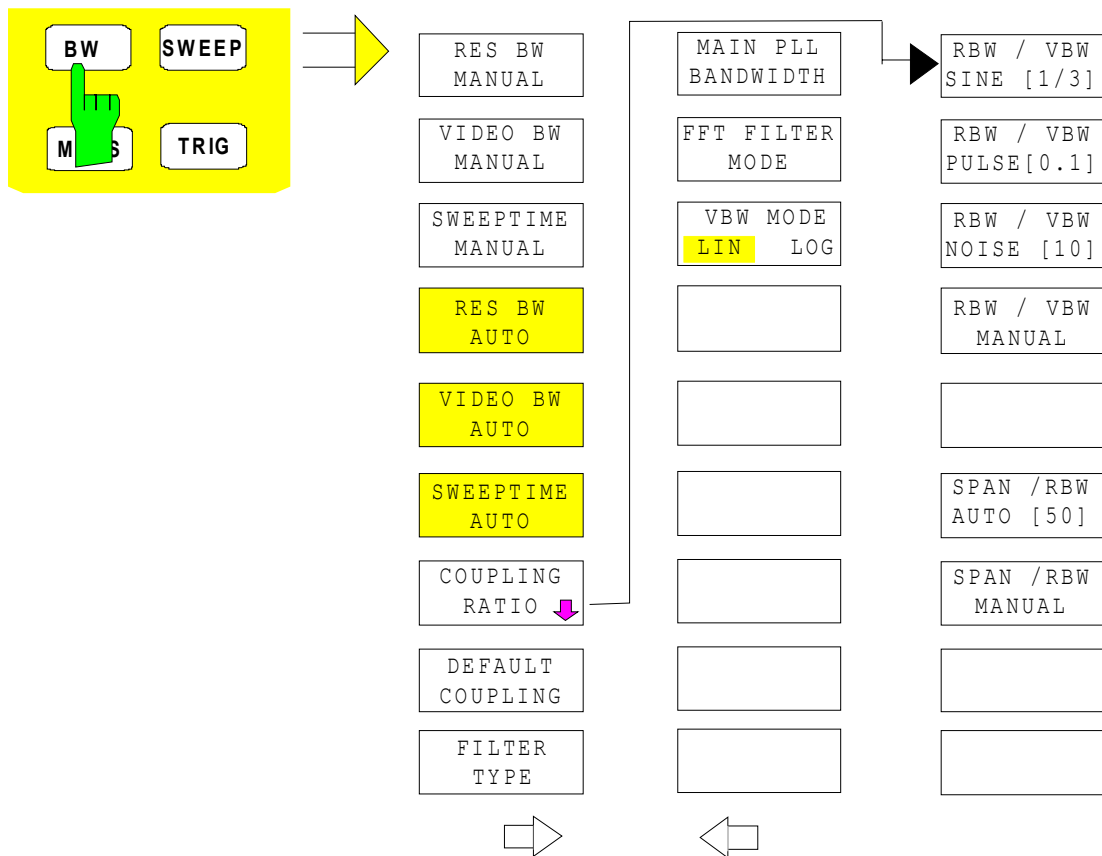
The *BW* key opens a menu for setting the resolution bandwidth, the video bandwidth, the sweep time and their couplings.

The *…BW AUTO* softkeys are used to couple the functions. The coupling ratios are selected by means of the *COUPLING RATIO* softkey.

The *…BW MANUAL* softkeys allow a parameter to be entered. This parameter is not coupled to the other parameters.

> **Note**
>
> With the *…BW AUTO* softkeys the resolution bandwidth, the video bandwidth and the sweep time can be entered separately for the frequency domain (span > 0 Hz) and the time domain (span = 0 Hz).
>
> But with *…BW MANUAL* softkeys the selected values apply to both the frequency and time domain.

RES BW MANUAL   The *RES BW MANUAL* softkey activates the manual data entry for the resolution bandwidth.

The resolution bandwidth can be selected in 1/2/3/5/10 steps in the range between 10 Hz and 10 MHz. The nominal resolution bandwidth is the 3 dB bandwidth.

When FFT filters are used, the lower limit of the bandwidth is 1 Hz. FFT filters may be used with bandwidths up to 30 kHz.

For numeric inputs, the values are always rounded to the nearest possible bandwidth. For rotary knob or UP/DOWN key inputs, the bandwidth is adjusted in steps either upwards or downwards.

For filter type CHANNEL or RRC the bandwidth is selected from the list of available channel filters given at the end of this section. For data entry, the cursor keys ⊘ and ⊙ scroll through this list.

The manual input mode of the resolution bandwidth is indicated by a green asterisk (*) on the display.

IEC/IEEE bus command: `BAND:AUTO OFF;`
                         `BAND 1MHz`

VIDEO BW   The *VIDEO BW MANUAL* softkey activates the manual data entry for the video
MANUAL   bandwidth.

The video bandwidth can be selected in 1/2/3/5/10 steps in the range between 1 Hz and 10 MHz.

For numeric inputs, the values are always rounded to the nearest possible allowed bandwidth. For rotary knob or UP/DOWN key inputs, the bandwidth is adjusted in steps either downwards or upwards.

The manual input mode of the video bandwidth is indicated by a green asterisk (*) on the display.

IEC/IEEE bus command: `BAND:VID:AUTO OFF;`
                         `BAND:VID 10 kHz`

SWEEP TIME   The *SWEEPTIME MANUAL* softkey activates the manual data entry for the
MANUAL   sweep time. At the same time, the coupling of the sweep time is cancelled. Other couplings (*VIDEO BW, RES BW*) remain effective.

In the frequency domain (span > 0 Hz) and for resolution bandwidths above 1 kHz, the allowed sweep times for spans > 3.2 kHz range from 2.5 ms through to 16000 s. With spans below 3.2 kHz, the maximum allowed sweep time is reduced to 5 s * span/Hz.

If FFT filters are used, the sweep time is fixed by the span and the bandwidth and therefore cannot be set.

In time domain (span = 0 Hz), the range of sweep times is 1 µs to 16000 s is selectable in steps of max. 5% of the sweep time. For numeric inputs, rounding is made to the nearest possible sweep time. For rotary knob or UP/DOWN key inputs, the sweep time is adjusted in steps either downwards or upwards.

The manual input mode of the sweep time is indicated by a green asterisk (*) on the display. If the selected sweep time is too short for the selected bandwidth and span, level measurement errors will occur. This happens because the available settling time for the resolution or video filters is too short. In this case, the ESU outputs *UNCAL* on the display and marks the indicated sweep time with a red asterisk (*).

IEC/IEEE bus command: `SWE:TIME:AUTO OFF;`
                                       `SWE:TIME 10s`

RES BW AUTO

The *RES BW AUTO* softkey couples the resolution bandwidth to the selected span. Changing the span causes automatic adjustment of the resolution bandwidth.

Automatic coupling of resolution bandwidth to span is always recommended when a favorable setting of the resolution bandwidth in relation to the selected span is desired for the measurement under request.

The coupling ratio is set in the *COUPLING RATIO* submenu.

The *RES BW AUTO* softkey is only available in the frequency domain (span > 0 Hz). The softkey is blanked in the time domain.

IEC/IEEE bus command: `BAND:AUTO ON`

VIDEO BW AUTO

The *VIDEO BW AUTO* softkey couples the video bandwidth to the resolution bandwidth. If the resolution bandwidth is changed, the video bandwidth is automatically adjusted.

The coupling of the video bandwidth is always recommended when the minimum sweep time is required for a selected resolution bandwidth. Narrower video bandwidths require longer sweep times due to the longer settling time. Wider bandwidths reduce the signal/noise ratio.

The coupling ratio is set in the *COUPLING RATIO* submenu.

The coupling of the video bandwidth to the resolution filter is also permitted for the time domain display (span = 0).

IEC/IEEE bus command: `BAND:VID:AUTO ON`

SWEEPTIME AUTO

The *SWEEPTIME AUTO* softkey couples the sweep time to the span, video bandwidth (VBW) and resolution bandwidth (RBW). The sweep time is automatically adjusted on any change in span, resolution bandwidth or video bandwidth.

The softkey is only available in the frequency domain (span >0 Hz). It is blanked in the time domain.

The ESU always selects the shortest sweep time possible without falsifying the signal. The maximum level error compared to using a longer sweep time is < 0.1 dB. If additional bandwidth and level errors are to be avoided, the sweep time is to be set to three times the time offered in coupled mode.

IEC/IEEE bus command: `SWE:TIME:AUTO ON`

COUPLING RATIO

COUPLING RATIO → RBW / VBW SINE [1/3]

RBW / VBW PULSE [.1]

RBW / VBW NOISE [10]

RBW / VBW MANUAL

SPAN / RBW AUTO [50]

SPAN / RBW MANUAL
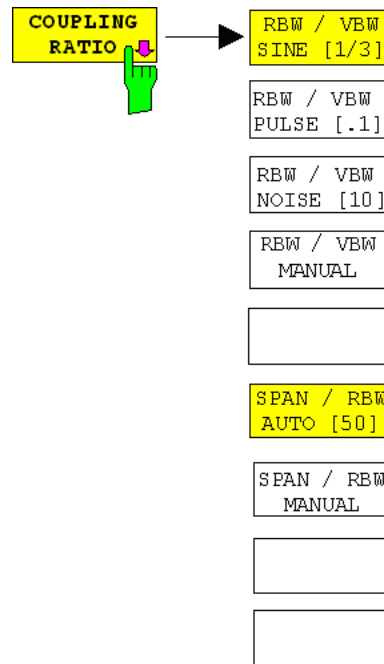
The *COUPLING RATIO* softkey opens a submenu for selection of the coupling ratios.

When the default setting is active, i.e. the *COUPLING RATIO* softkey is deactivated (not highlighted), the ratio span/resolution bandwidth (SPAN/RBW) is 50 (this corresponds to SPAN / RBW AUTO [50]) and the ratio resolution bandwidth/video bandwidth (RBW/VBW) is 0.33 (this corresponds to RBW / VBW SINE [1/3]).

If the ratio RBW/VBW or SPAN/RBW is different from the default setting, the *COUPLING RATIO* softkey is highlighted.

The softkeys *RBW/VBW...* are selection keys. Only one softkey can be enabled at any one time. The softkeys are only effective for the *VBW AUTO* selection in the main menu.

The softkeys *SPAN/RBW...* are also selection keys. They are only effective for the *RBW AUTO* selection in the main menu.

RBW/VBW SINE [1/3]   The *RBW/VBW SINE [1/3]* softkey sets the following coupling ratio:

video bandwidth = 3 × resolution bandwidth.

This is the default setting for the coupling ratio resolution bandwidth/video bandwidth.

This is the coupling ratio recommended if sinusoidal signals are to be measured.

IEC/IEEE bus command: `BAND:VID:RAT 3`

This setting is only effective for the *VBW AUTO* selection in the main menu.

RBW/VBW PULSE [.1]	The *RBW/VBW PULSE [.1]* softkey sets the following coupling ratio: video bandwidth = 10 × resolution bandwidth or

video bandwidth = 10 MHz (= max. VBW).

This coupling ratio is recommended whenever the amplitudes of pulsed signals are to be measured correctly. The IF filter is exclusively responsible for pulse shaping. No additional evaluation is performed by the video filter.

IEC/IEEE bus command: `BAND:VID:RAT 10`

This setting is only effective for the *VBW AUTO* selection in the main menu.

RBW/VBW NOISE [10]	The *RBW/VBW NOISE [10]* softkey sets the following coupling ratio: video bandwidth = resolution bandwidth/10

At this coupling ratio, noise and pulsed signals are suppressed in the video domain. For noise signals, the average value is displayed.

IEC/IEEE bus command: `BAND:VID:RAT 0.1`

This setting is only effective for the *VBW AUTO* selection in the main menu.

RBW/VBW MANUAL	The *RBW/VBW MANUAL* softkey activates the manual input of the coupling ratio.

The resolution bandwidth/video bandwidth ratio can be set in the range 0.001 to 1000.

IEC/IEEE bus command: `BAND:VID:RAT 10`

This setting is only effective for the *VBW AUTO* selection in the main menu.

SPAN/RBW AUTO [50]	The *SPAN/RBW AUTO [50]* softkey sets the following coupling ratio: resolution bandwidth = span/50

This coupling ratio is the default setting of the ESU

IEC/IEEE bus command: `BAND:RAT 0.02`

This setting is only effective for the *RBW AUTO* selection in the main menu.

SPAN/RBW MANUAL	The *SPAN/RBW MANUAL* softkey activates the manual input of the coupling ratio.

The span / resolution bandwidth ratio can be set in the range
1 to 10000.

IEC/IEEE bus command: `BAND:RAT 0.1`

This setting is only effective for the *RBW AUTO* selection in the main menu.

DEFAULT COUPLING   The *DEFAULT COUPLING* softkey sets all coupled functions to the default state (*AUTO)*. In addition, the ratio *RBW/VBW* is set to *SINE [1/3]* and the ratio *SPAN/RBW* to 50 in the *COUPLING RATIO* submenu (default setting, *COUPLING RATIO* softkey not highlighted).

IEC/IEEE bus command: `BAND:AUTO ON`
`BAND:VID:AUTO ON`
`SWE:TIME:AUTO ON`

FILTER TYPE   The *FILTER TYPE* softkey opens the selection list for different filter types. In the range up to 30 kHz digital band filters with Gaussian characteristic and filtering with FFT algorithm can be selected.

Filter Types

- EMI (6dB): The resolution bandwidths are implemented by Gaussian filters with the set 6 dB bandwidth and correspond approximately to the pulse bandwidth. For bandwidths up to 1 MHz, digital bandpass filters are used.

- FFT: An FFT is performed. For that purpose, the filtered IF signal is digitized and then transformed into the spectral domain via FFT. The transformation range depends on the selected filter bandwidths and can be set between 4 kHz to 50 kHz. If the span is larger than the transformation range, several transformations are performed and the results are appended to each other in the spectral domain.

  If the span is smaller than the transformation range, the measurement results are interpolated when the number of measurement points provided by the FFT is smaller than the number of display points in x-direction (625). A flattop window serves as a window in the time domain so that high amplitude accuracy as well as good selection are achieved.

  Compared to bandpasses, FFT filters lead to significantly reduced sweep times. For a span of 50 kHz and a bandwidth of 100 Hz, for instance, the sweep time is reduced from 5 s to 40 ms. FFT filters are particularly suitable for stationary signals (sinusoidal signals or signals that are continuously modulated in time). For burst signals (TDMA) or pulsed signals, normal filters are preferable.

Note

As soon as the FFT filters are active (RBW ≤ 30 kHz) the sweep time display field (SWT) is replaced by the acquisition time (AQT) display field.

FFT is a block transformation so the result depends on the time relation between the data set to be transformed and the burst or pulsed signal. A gated sweep measurement for TDMA signals is therefore not provided if FFT filters are used.

When the tracking generator (option FSU-B9) is used as signal source for the DUT, filtering with the FFT algorithm is not useful. The selection FFT is thus not available if the tracking generator is switched on.

When the preselection is active, the FFT filter is not available.

Additionally, a number of especially steep-edged channel filters are available for power measurement.

A distinction is made between the following filter types:

- CHANNEL = general, steep-edged channel filters
- RRC = filters with root-raised cosine characteristic
  (RRC = Root Raised Cosine)

When selecting these filter types, the automatic coupling of the resolution bandwidth to the span is not available. The filters are selected via the *RES BW* softkey.

A list of all available channel filters with their associated applications can be found at the end of this section.

IEC/IEEE bus command: `BAND:TYPE NORM | FFT | CFIL | RRC | P5`

List of Available Channel Filters

The channel filters included in the following table are can be activated via the *FILTER TYPE* softkey and are then available as resolution filters.

Note

For filters of type RRC (Root Raised Cosine), the filter bandwidth indicated describes the sampling rate of the filter.

For all other filters (CFILter) the filter bandwidth is the 3 dB bandwidth.

Filter Bandwidth	Filter Type	Application
100 Hz	CFILter	
200 Hz	CFILter	A0
300 Hz	CFILter	
500 Hz	CFILter	
1 kHz	CFILter	
3 kHz	CFILter	
3.4 kHz	CFILter	
4 kHz	CFILter	DAB, Satellite
8.5 kHz	CFILter	ETS300 113 (12.5 kHz channels)
10 kHz	CFILter	
12.5 kHz	CFILter	CDMAone
14 kHz	CFILter	ETS300 113 (20 kHz channels)
16 kHz	CFILter	ETS300 113 (25 kHz channels)
18 kHz, $\alpha=0.35$	RRC	TETRA
21 kHz	CFILter	PDC
24.3 kHz, $\alpha=0.35$	RRC	IS 136
30 kHz	CFILter	CDPD, CDMAone
100 kHz	CFILter	
150 kHz	CFILter	FM Radio
192 kHz	CFILter	
300 kHz	CFILter	J.83 (8-VSB DVB, USA)
500 kHz	CFILter	
1.0 MHz	CFILter	CDMAone
1.2288 MHz	CFILter	CDMAone
1.5 MHz	CFILter	DAB
5.6 MHz	CFILter	DVB-T (Japan)
6 MHz	CFILter	J.83 (8VSB DVB, USA)
6.4 MHz	CFILter	DVB-T

MAIN PLL BANDWIDTH	The *MAIN PLL BANDWIDTH* softkey defines the bandwidth of the main PLL of the analyzer synthesizer and thus influences the phase noise of the analyzer. Three bandwidth settings are possible (High / Medium / Low); if AUTO is selected, the bandwidth is set automatically (default).

IEC/IEEE bus command: `BAND:PLL AUTO`

FFT FILTER MODE   The softkey *FFT FILTER MODE* allows to specify between the following three options for FFT filters:

WIDE: The FFT filters with the greater partial span (this is the span which is covered with one FFT analysis) are used always.

AUTO: The firmware decides whether to use wide or narrow filters to achieve the best performance of the measurement.

NARROW: The FFT filters with the smaller partial span are used, this allows measurements near a carrier with reduced reference level, because of a more narrow analog prefilter.

IEC/IEEE bus command: `[SENSe1]:BWIDth:FFT:MODE WIDE | AUTO`
                                               `| NARRow`

VBW MODE LIN/ LOG   The *VBW MODE LIN/LOG* softkey determines the position of the video filter in the signal path for resolution bandwidths $\leq$ 100 kHz:

• If LINear is selected, the video filter will be in front of the logarithmic amplifier (default).

• If LOGarithmic is selected, the video filter will be behind the logarithmic amplifier.

The essential difference between the two operating modes relates to the settling in the case of falling signal edges:

With LINear, the falling signal edge will be "flatter" than with LOGarithmic.

This is due to the conversion from linear power to logarithmic level units: a reduction of the linear power by 50% reduces the logarithmic signal level by only 3 dB.

IEC/IEEE bus command: `BAND:VID:TYPE LIN`

Sweep Settings – SWEEP

The SWEEP key serves for configuring the sweep mode.

The *SWEEP* key calls a menu in which the sweep mode is defined. In split-screen mode, the entries made are valid for the active window only.

The *CONTINUOUS SWEEP, SINGLE SWEEP* and *SGL SWEEP DISP OFF* softkeys are mutually exclusive selection keys.

BW **SWEEP**	**CONTINUOUS SWEEP**
MEAS **T G**	**SINGLE SWEEP**
	CONTINUE SGL SWEEP
	SWEEPTIME MANUAL
	SWEEPTIME AUTO
	SWEEP COUNT
	SWEEP POINTS
	SGL SWEEP DISP OFF
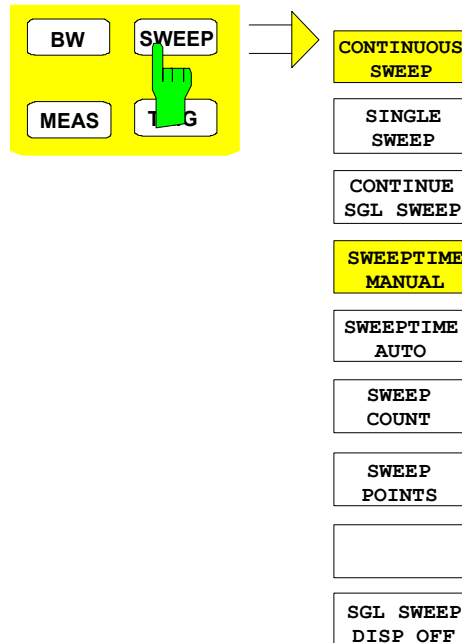
CONTINUOUS SWEEP   The *CONTINUOUS SWEEP* softkey activates the continuous sweep mode, which means that the sweep takes place continuously according to the trigger mode set.

When working in the split-screen mode and with different settings in the two windows, screen A is swept first, followed by screen B. When the softkey is pressed, the sweep is restarted.

CONTINUOUS SWEEP is the default setting of ESU.

IEC/IEEE bus command: `INIT:CONT ON`

SINGLE SWEEP   The *SINGLE SWEEP* softkey starts n sweeps after triggering. The number of sweeps is determined by the *SWEEP COUNT* softkey.

When working in the split-screen mode, the frequency ranges of the two windows are swept one after the other.

If a trace is swept using *TRACE AVERAGE* or *MAXHOLD,* the value set via the *SWEEP COUNT* softkey determines the number of sweeps. If 0 has been entered, one sweep is performed.

IEC/IEEE bus command: `INIT:CONT OFF`

CONTINUE SGL SWEEP	The *CONTINUE SGL SWEEP* softkey repeats the number of sweeps set under *SWEEP COUNT*, however without first deleting the trace.

This is particularly of interest when using the functions *TRACE AVERAGE* and *MAXHOLD*, if previously recorded measurement results are to be taken into consideration for averaging / maximum search.

If *SGL SWEEP DISP OFF* is active, the screen is switched off also during repeated sweeps.

IEC/IEEE bus command: `INIT:CONM`

SWEEPTIME MANUAL

The *SWEEPTIME MANUAL* softkey activates the window for entering the sweep time manually (see also *BW* menu).

IEC/IEEE bus command: `SWE:TIME 10s`

SWEEPTIME AUTO

The *SWEEPTIME AUTO* softkey activates the automatic selection of the sweep time as a function of the bandwidth of the resolution and video filters (see also *BW* menu).

IEC/IEEE bus command: `SWE:TIME:AUTO ON`

SWEEP COUNT

The *SWEEP COUNT* softkey activates the window for the entry of the number of sweeps to be performed by ESU after a single sweep has been started. If Trace Average, Max Hold or Min Hold is activated, this also determines the number of averaging or maximum search procedures.

Example

[**TRACE1**: *MAX HOLD*]
[**SWEEP**: *SWEEP COUNT*: {10} **ENTER**]
[*SINGLE SWEEP*]

ESU performs the Max Hold function over 10 sweeps.

The permissible range for the sweep count is 0 to 32767. For sweep count = 0 or 1, one sweep is performed. For trace averaging in the continuous-sweep mode, ESU performs running averaging over 10 sweeps if sweep count = 0; if sweep count = 1, no averaging is performed.

The sweep count is valid for all the traces in a diagram.

> **Note**
>
> The number of sweeps set in the *TRACE* menu is the same as that in the *SWEEP* menu.
>
> If SINGLE SWEEP is selected, the measurement stops after the selected number of sweeps has been performed.

IEC/IEEE bus command: `SWE:COUN 64`

SWEEP POINTS   The *SWEEP POINTS* softkey selects the number of measurement samples acquired during a sweep.

The following numbers of points per sweep are available: 155, 313, 625 (default), 1251, 2501, 5001, 10001, 20001, 40001
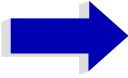
Note

The autopeak detector will be disabled while the number of points per sweep is ≠ 625.

IEC/IEEE bus command: `SWE:POIN 625`

SGL SWEEP   The *SGL SWEEP DISP OFF* softkey deactivates the display while a single
DISP OFF   sweep is being performed. Once the sweep has been completed, the trace is shown.

IEC/IEEE bus command: `INIT:DISP OFF;:INIT`

Triggering the Sweep – TRIG

The *TRIG* key opens a menu for selection of the various trigger sources, trigger polarity and external gate function. The active trigger mode is indicated by highlighting the corresponding softkey.

For video trigger, a trigger threshold can be entered, which is represented in the diagram as a horizontal line.

To indicate that a trigger mode other than *FREE RUN* has been set, the enhancement label **TRG** is displayed on the screen. If two windows are displayed, TRG appears next to the appropriate window.

TRIG				
FREE RUN				GATE MODE LEVEL EDGE
VIDEO				POLARITY POS NEG
EXTERN				GATE DELAY
IF POWER				GATE LENGTH
TRIGGER OFFSET	DELAY COMP ON OFF			SWEEPTIME
POLARITY POS NEG				
GATED TRIGGER				
GATE SETTINGS				
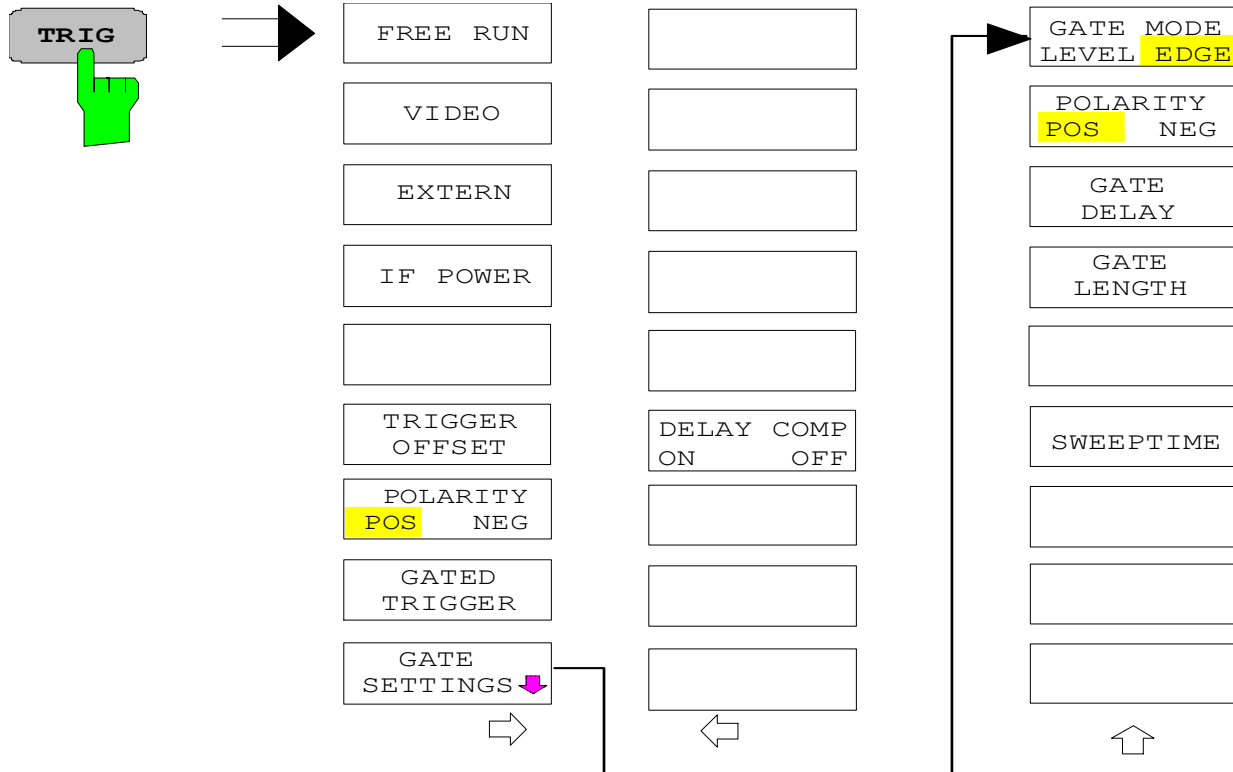
FREE RUN   The *FREE RUN* softkey activates the free-run sweep mode, i.e. start of a sweep is not triggered. Once a measurement is completed, another is started immediately.

FREE RUN is the default setting of ESU.

IEC/IEEE bus command: `TRIG:SOUR  IMM`

VIDEO   The *VIDEO* softkey activates triggering through the displayed voltage.

For the video triggering mode, a horizontal trigger line is shown in the diagram. It may be used to set the trigger threshold between 0% and 100% of the overall diagram height.

IEC/IEEE bus command: `TRIG:SOUR  VID`
                         `TRIG:LEV:VID 50 PCT`

EXTERN

The *EXTERN* softkey activates triggering via a TTL signal at the input connector *EXT TRIGGER/GATE* on the rear panel.

The external trigger level can be adjusted in the range from 0.5 V to 3.5 V. The default value is 1.4 V.

IEC/IEEE bus command: `TRIG:SOUR EXT <numeric_value>`
                         `SWE:EGAT:SOUR EXT`

IF POWER

The *IF POWER* softkey activates triggering of the measurement via signals which are outside the measurement channel.

For this purpose, the ESU uses a level detector at the second intermediate frequency. can be selected in a range between –30 dBm and -10 dBm at the input mixer. The resulting trigger level at the RF input is calculated via the following formula:

$$Mixerlevel_{min} + RFAtt - \Pr eampGain \ \leq \ Input\,Signal \ \leq \ Mixerlevel_{max} + RFAtt - \Pr eampGain$$

The bandwidth at the intermediate frequency is 10 MHz. The ESU is triggered as soon as the trigger threshold is exceeded within a 5 MHz range around the selected frequency (= start frequency in the frequency sweep).

Thus, the measurement of spurious emissions, e.g. for pulsed carriers, is possible even when the carrier lies outside the selected frequency span.

IEC/IEEE bus command: `TRIG:SOUR  IFP`
                         `SWE:EGAT:SOUR  IFP`

TRIGGER OFFSET

The *TRIGGER OFFSET* softkey activates the window for entering the time offset between the trigger signal and the start of the sweep.

Triggering is delayed by the entered time with respect to the trigger signal (time entered > 0) or is started earlier (time entered < 0). The time may be entered in multiples of 125 ns in the range -100 s to 100 s (default 0 s).

Note

A negative offset (pretrigger) can be set in the time domain only (SPAN = 0 Hz) provided GATED TRIGGER is not active in that domain.

The maximum allowed range and the maximum resolution of the pretrigger is limited by the set sweep time:

max. range = - 499/500 × sweep time
max. resolution = sweep time/500.

Pretriggering is not possible when the rms or the average detector is activated

As a common input signal is used for both trigger and gate when selecting *EXTERN* and *IF POWER,* changes to the gate delay will affect the trigger delay *(TRIGGER OFFSET)* as well.

IEC/IEEE bus command: `TRIG:HOLD  10US`

POLARITY POS/ NEG

The *POLARITY POS/NEG* softkey selects the polarity of the trigger source.

The sweep starts after a positive or negative edge of the trigger signal. The selected setting is highlighted.

The selection is valid for all trigger modes with the exception of *FREE RUN*; in the gate mode, it also applies to the gate polarity.

The default setting is *POLARITY POS*.

IEC/IEEE bus command: `TRIG:SLOP  POS`

By using a gate in sweep mode and stopping the measurement while the gate signal is inactive, the spectrum for pulsed RF carriers can be displayed without the superposition of frequency components generated during switching. Similarly, the spectrum can also be examined for an inactive carrier. The sweep can be controlled by an external gate or by the internal power trigger.
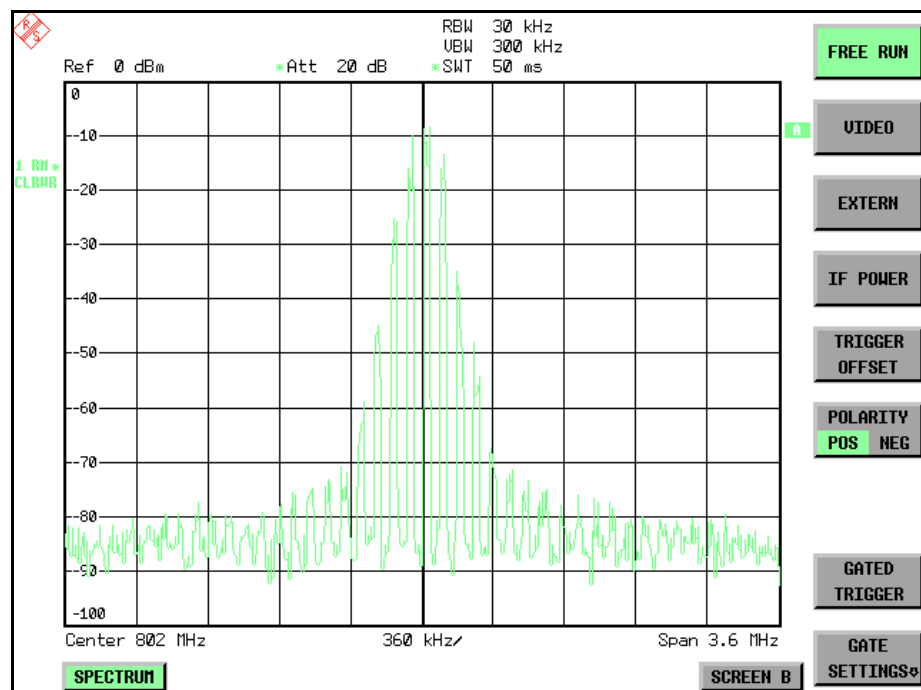
Fig. 4-11   Pulsed signal GATE OFF
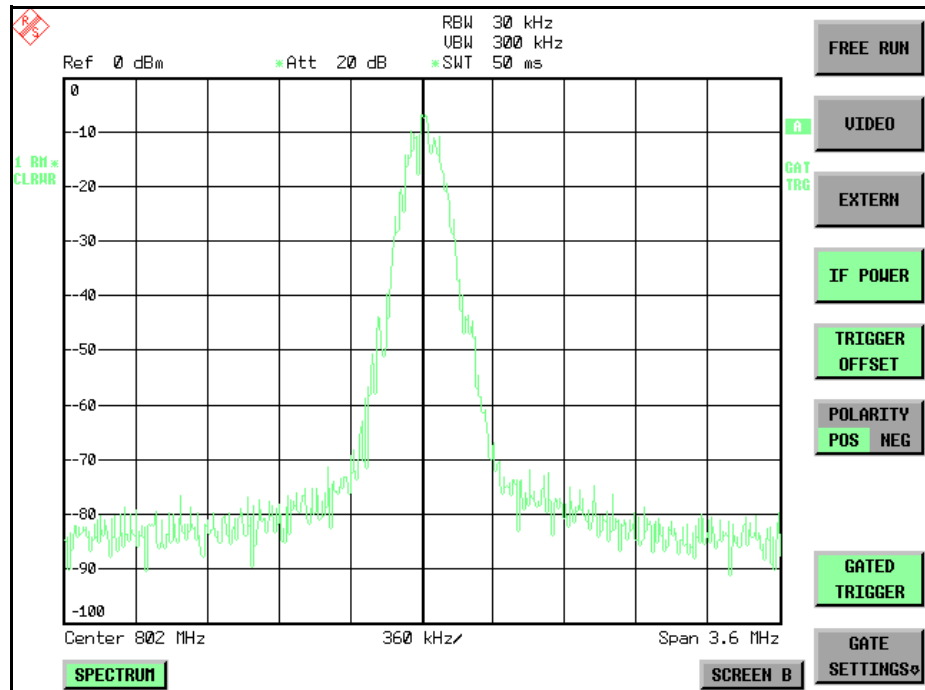
Fig. 4-12   TDMA signal with GATE ON

The gated-sweep mode is activated by the *GATED TRIGGER* softkey. The setting of the mode takes place in the *GATE SETTINGS* submenu.

GATED TRIGGER   The *GATED TRIGGER* softkey switches the sweep mode with gate on and off.

When gate is switched on, a gate signal applied to the rear panel connector *EXT TRIGGER/GATE* or the internal IF power detector controls the sweep of the analyzer. This selection is made via the *EXTERN* and *IF POWER* softkeys for trigger and gate.

The length of the gate signal defines when the sweep is to be interrupted. Here a differentiation is made between edge-triggered and level-triggered modes: in case of edge triggering the gate length can be set via the *GATE LENGTH* softkey, while in case of level triggering the gate length depends on the length of the gate signal.
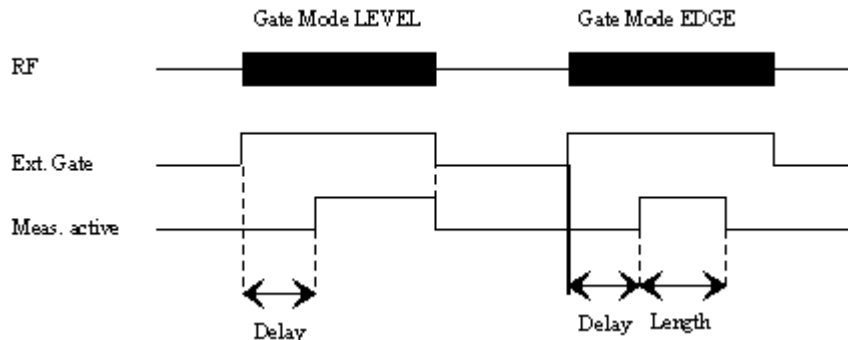
Fig. 4-13   Timing diagram for GATE, GATE DELAY and GATE LENGTH

This softkey requires the *EXTERN* or *IF POWER* trigger mode. If a different mode is active, IF POWER is automatically selected.

Gated-sweep operation is also possible in the time domain. This enables - e.g. in burst signals - level variations of individual slots to be displayed versus time.

To indicate that a gate is used for the sweep, the enhancement label **GAT** is displayed on the screen. This label appears to the right of the window for which the gate is configured.

IEC/IEEE bus command: `SWE:EGAT  ON`
                          `SWE:EGAT:SOUR  IFP`
                          or:
                          `SWE:EGAT:SOUR  EXT`

GATE SETTINGS

```
┌──────────┐         ┌──────────────┐
│   GATE   │    →    │  GATE MODE   │
│ SETTINGS │         │ LEVEL  EDGE  │
└──────────┘         └──────────────┘

                     ┌──────────────┐
                     │  POLARITY    │
                     │ POS    NEG   │
                     └──────────────┘

                     ┌──────────────┐
                     │    GATE      │
                     │    DELAY     │
                     └──────────────┘

                     ┌──────────────┐
                     │    GATE      │
                     │   LENGTH     │
                     └──────────────┘

                     ┌──────────────┐
                     │              │
                     └──────────────┘

                     ┌──────────────┐
                     │  SWEEPTIME   │
                     └──────────────┘

                     ┌──────────────┐
                     │              │
                     └──────────────┘

                     ┌──────────────┐
                     │              │
                     └──────────────┘

                     ┌──────────────┐
                     │              │
                     └──────────────┘
                           ⇧
```
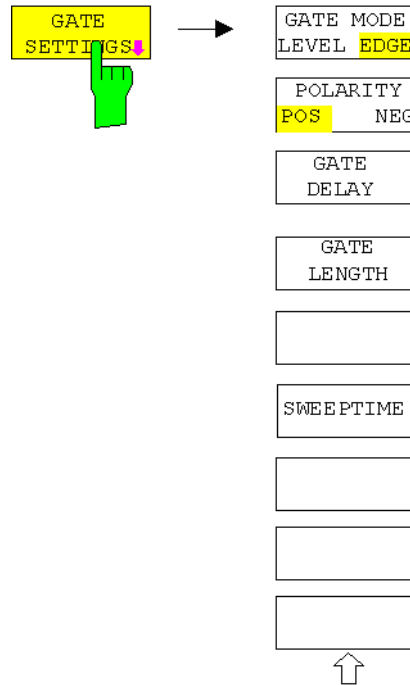
The *GATE SETTINGS* softkey calls a submenu for making all the settings required for gated-sweep operation.

At the same time, a transition is made to the time domain (span = 0) and the time parameters *GATE DELAY* and *GATE LENGTH* are represented as vertical lines. This allows the required gate time parameters to be set easily.

For highly accurate setting of gate delay and gate length, the x axis can be altered using the *SWEEPTIME* softkey in a way that the signal range concerned (e.g. one full burst) is displayed.

Then the sampling time and duration can be set by *GATE DELAY* and *GATE LENGTH* in a way that the desired portion of the signal is shown.

When quitting the submenu, the program will return to the frequency domain provided it was active before. The original span is restored so the desired measurement can now be performed with the accurately set gate.

IEC/IEEE bus command: `--`

GATE MODE LEVEL/
EDGE

The *GATE MODE LEVEL/EDGE* softkey selects the trigger mode. Gated sweep is possible in the level-triggered as well as in the edge-triggered mode.

If level triggering is selected, the *GATE LENGTH* softkey becomes inactive and cannot be operated.

IEC/IEEE bus command: `SWE:EGAT:TYPE  EDGE`

POLARITY POS/NEG

The *POLARITY POS/NEG* softkey controls the polarity of the *EXT TRIGGER/ GATE* control line.

In case of level triggering the sweep is stopped by *POLARITY POS* and a logic '0' signal; the signal '1' will restart the sweep after the *GATE DELAY* time has elapsed.

In case of edge triggering the sweep is continued on a ´0´ to ´1´ transition for the duration of *GATE LENGTH* after a delay (*GATE DELAY)* has elapsed.

Changing the polarity automatically implies a transition of the trigger-edge polarity (*POLARITY* softkey in the higher menu).

IEC/IEEE bus command: `SWE:EGAT:POL  POS`

GATE DELAY

The *GATE DELAY* softkey activates the window for setting the delay time between the gate signal and the continuation of the sweep.

This may be useful for taking into account a delay between the gate signal and the stabilization of an RF carrier for example.

As gate delay, values between 125 ns and 100 s may be set. The position of the delay on the time axis in relation to the sweep is indicated by the line labelled **GD**.

As there is a common input signal for trigger and gate if *EXTERN* or *IF POWER* is selected, changes to the gate delay will affect the trigger delay (*TRIGGER OFFSET*) as well.

IEC/IEEE bus command: `SWE:EGAT:HOLD  1US`

GATE LENGTH

The *GATE LENGTH* softkey activates the window for setting the sweep duration of ESU in the edge-triggered mode.

Values between 125 ns and 100 s may be set for the gate length. The length of the gate in relation to the sweep is indicated by the line labelled **GL.**

This softkey is only available if *GATE MODE EDGE* (edge triggering) has been selected.

IEC/IEEE bus command: `SWE:EGAT:LENG  100US`

SWEEP TIME

The *SWEEP TIME* softkey enables the user to change the time axis to obtain a higher resolution for positioning gate delay and gate length.

When this is to be done, the sweep time temporarily changes; the original value is restored when the menu is quit.

IEC/IEEE bus command: `--`

Measurement example

The modulation spectrum of a GSM or PCS1900 signal is to be measured using the gated-sweep function. The signal is generated by a Signal Generator SME03 whose RF output is directly connected to the RF input of ESU.

Settings on SME03:

FREQ:	802 MHz
Level:	0 dBm: Return
Digital Mod:	Select: GMSK: Select
Source:	Select: PRBS: Select: Return
Level Attenuation:	Select: 60 dB: Return

The SME03 supplies a GMSK-modulated TDMA signal (GSM).

Settings on ESU:

Conventions:

[KEY]	Menu called by this key. All information between the brackets refers to this menu.
{Number}	Numeric value to be entered for the parameter on hand.
SOFTKEY	Softkey to be used for making a selection or entering a value.

[PRESET]	
[FREQ:	*CENTER* {802} **MHz]**
[SPAN	{3.6} **MHz]**
[AMPT:	*REF LEVEL* {0} **dBm**: *RF ATTEN MANUAL*: {10} **dB]**
[BW:	*RES BW MANUAL*: {30} **kHz]**
[TRACE:	*TRACE 1 DETECTOR*: *RMS***]**
[SWEEP:	*SWEEPTIME MANUAL*: {50} **ms]**
[TRIG:	*EXTERN* *GATED TRIGGER;* *GATE SETTINGS*: *GATE MODE EDGE; POLARITY POS* *SWEEPTIME MANUAL* {1} **ms**: *GATE DELAY* {300} **µs**: *GATE LENGTH*: {250} **µs]**

The following figure shows the screen display for setting gate parameters. The vertical lines for gate delay (GD) and gate length (GL) can be adjusted to the burst signal by entering numeric values or by means of the rotary knob.
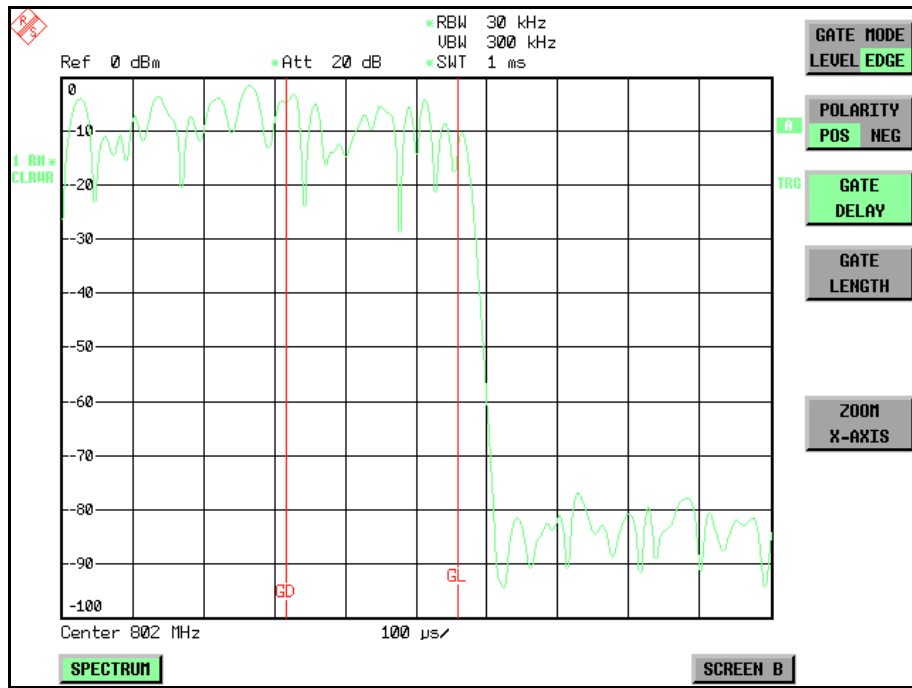
Fig. 4-14   Setting GATE DELAY and GATE LENGTH in time domain by means of lines GD and GL

On quitting the *GATE SETTINGS* menu, ESU returns to the previous screen.

DELAY COMP ON/ OFF
The *DELAY COMP ON/OFF* softkey enables the filter group delay compensation for the external trigger. If a bursted signal is analyzed in zero span and the delay compensation is on, a change of the RBW will not change the rising slope of the signal.

Default is *OFF*.

IEC/IEEE bus command: `TRIG:HOLD:ADJ:AUTO ON|OFF`

Selection and Setting of Traces – TRACE

The traces are selected using the *SELECT TRACE* softkey in the menu of the *TRACE* key.

The traces can individually be activated for a measurement or frozen after completion of a measurement. Traces that are not activated are blanked.

The display mode can be selected for each trace. Traces can be overwritten in each measurement (CLEAR/WRITE mode), averaged over several measurements (AVERAGE mode), or a maximum or minimum value can be determined from several measurements and displayed (MAX HOLD or MIN HOLD).

Individual detectors can be selected for the various traces. The autopeak detector displays maximum and minimum values connected by a vertical line. The max peak detector and min peak detector display the maximum and minimum value of the level within a pixel. The sample detector displays the instantaneous value of the level at a pixel. The rms detector displays the power (rms value) of the measured values within a pixel, the average detector the average value.

Selection of Trace Functions

The trace functions are subdivided as follows:

- Display mode of trace (CLEAR/WRITE, VIEW and BLANK)

- Evaluation of the trace as a whole (AVERAGE, MAX HOLD and MIN HOLD)

- Evaluation of individual pixels of a trace (AUTOPEAK, MAX PEAK, MIN PEAK, SAMPLE, RMS, AVERAGE and QUASIPEAK)

The *TRACE* key opens a menu offering the setting options for the selected trace.

Traces can be displayed, blanked and copied. Traces can also be corrected with the aid of mathematical functions.

The measurement detector for the individual display modes can be selected directly by the user or set automatically by ESU.

The default setting is trace 1 in the overwrite mode (*CLEAR / WRITE)*, the other traces 2 and 3 are switched off (*BLANK*).

The *CLEAR/WRITE, MAX HOLD, MIN HOLD, AVERAGE, VIEW* and *BLANK* softkeys are mutually exclusive selection keys.
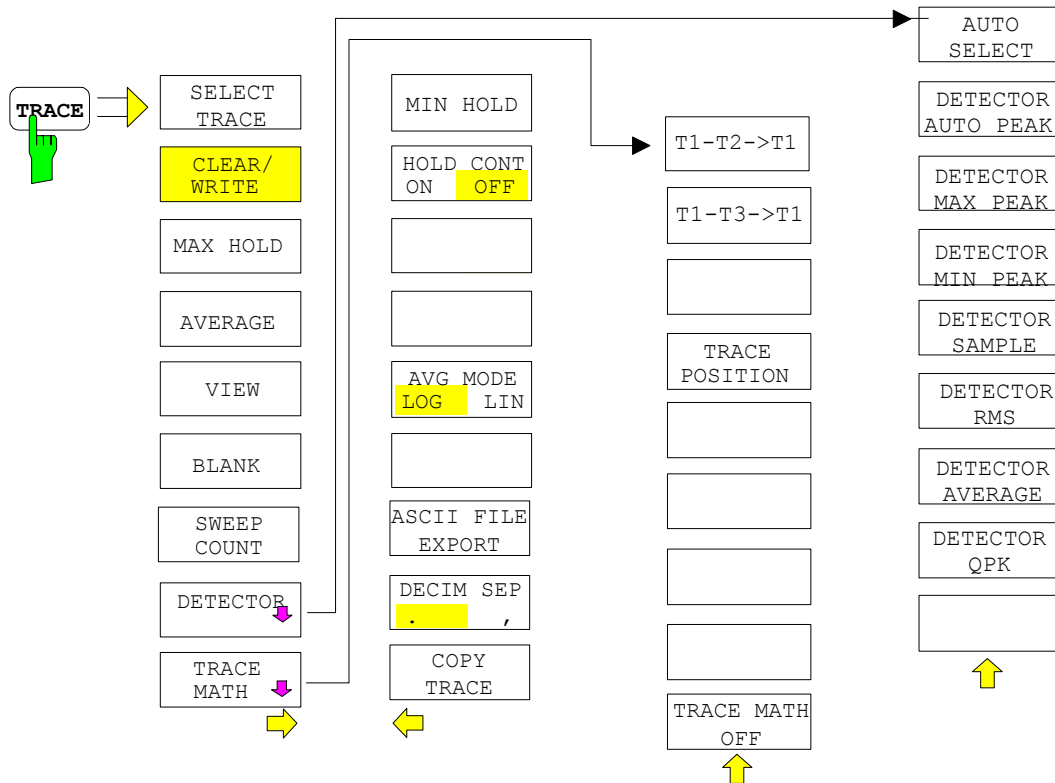
SELECT TRACE   The *SELECT TRACE* softkey activates the entry for the active trace (1, 2, 3).

                         IEC/IEEE bus command: -- (selected via numeric suffix of: TRACe)

CLEAR/WRITE   The *CLEAR/WRITE* softkey activates the overwrite mode for the collected measured values, i.e. the trace is overwritten by each sweep.

                         In the *CLEAR/WRITE* display mode all the available detectors can be selected. In the default mode the autopeak detector (setting *AUTO*) is selected.

                         Each time the *CLEAR/WRITE* softkey is actuated, ESU clears the selected trace memory and starts the measurement anew.

                         IEC/IEEE bus command: DISP:WIND:TRAC:MODE WRIT

MAX HOLD   The *MAX HOLD* softkey activates the max peak detector.

                         ESU saves the sweep result in the trace memory only if the new value is greater than the previous one.

                         The detector is automatically set to *MAX PEAK*. The maximum value of a signal can thus be determined over several sweeps.

                         This is especially useful with modulated or impulsive signals. The signal spectrum is filled up upon each sweep until all signal components are detected in a kind of envelope.

                         Pressing the *MAX HOLD* softkey again clears the trace memory and restarts the max hold mode.

                         IEC/IEEE bus command: DISP:WIND:TRAC:MODE MAXH

AVERAGE The *AVERAGE* softkey activates the trace averaging function. The average is formed over several sweeps. Averaging can be performed with any of the detectors available. If the detector is automatically selected by ESU, the sample detector is used.

Depending on the setting of AVG MODE LOG / LIN, the logarithmic level values or the measured power/voltage values are averaged.

Averaging is restarted every time the *AVERAGE* softkey is pressed. The trace memory is always cleared.

IEC/IEEE bus command: `DISP:WIND:TRAC:MODE AVER`

Description of averaging

Averaging is carried out over the pixels derived from the measurement samples. Several measured values may be combined in a pixel. This means that with linear level display the average is formed over linear amplitude values and with logarithmic level display over levels. For this reason the trace must be measured again when changing between *LIN* and *LOG* display mode. The settings *CONT/SINGLE SWEEP* and running averaging apply to the average display analogously.

There are two methods for calculating the average. For a sweep count = 0, a running average is calculated according to the following formula:

$$TRACE = \frac{9 * TRACE + \text{meas. value}}{10}$$

Due to the weighting between the new measured value and the trace average, past values have practically no influence on the displayed trace after about ten sweeps. With this setting, signal noise is effectively reduced without need for restarting the averaging process after a change of the signal.

If the sweep count is >1, averaging takes place over the selected number of sweeps. In this case the displayed trace is determined during averaging according to the following formula:

$$Trace_n = \frac{1}{n} \left[\sum_{i=1}^{n-1} (T_i) + \text{meas. value}_n \right]$$

where n is the number of the current sweep (n = 2 ... SWEEP COUNT). No averaging is carried out for the first sweep but the measured value is stored in the trace memory. With increasing n, the displayed trace is increasingly smoothed since there are more single sweeps for averaging.

After the selected number of sweeps the average trace is saved in the trace memory. Until this number of sweeps is reached, a preliminary average is displayed.

After completion of averaging, i.e. when the averaging length defined by *SWEEP COUNT* is attained, a running averaging is continued with *CONTINUOUS SWEEP* according to the following formula:

$$\text{Trace} = \frac{(N-1) \cdot \text{Trace}_{old} + \text{meas. value}}{N}$$

where

Trace   = new trace

Trace$_{old}$ = old trace

N   = SWEEP COUNT

The display "Sweep N of N" does not change any more until a new start is triggered.

In the *SINGLE SWEEP* mode, the number of sweeps is triggered with *SWEEP START*. The sweeps are stopped when the selected number of sweeps is attained. The number of the current sweep and the total number of sweeps are shown on the display: "Sweep 3 of 200".

VIEW

The *VIEW* softkey freezes the current contents of the trace memory and displays it.

If a trace is frozen by *VIEW*, the instrument settings can be changed without the displayed trace being modified (exception: level display range and reference level, see below). The fact that the trace and the current instrument setting do not agree any more is indicated by an enhancement label "*" at the right edge of the grid.

If in the *VIEW* display mode the level display range (*RANGE*) or the reference level (*REF LEVEL*) are changed, ESU automatically adapts the measured data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

IEC/IEEE bus command: `DISP:WIND:TRAC:MODE VIEW`

BLANK

The *BLANK* softkey activates the blanking of the trace on the screen.

IEC/IEEE bus command: `DISP:WIND:TRAC OFF`

SWEEP COUNT

The *SWEEP COUNT* softkey activates the entry of the number of sweeps used for averaging. The allowed range of values is 0 to 30000 and the following should be observed:

•   Sweep Count = 0 means running averaging

•   Sweep Count = 1 means no averaging being carried out

•   Sweep Count > 1 means averaging over the selected number of sweeps; in the continuous sweep mode averaging is performed until the set number of sweeps is attained and is then continued as running averaging.

The default setting is running averaging (Sweep Count = 0). The number of sweeps used for averaging is the same for all active traces in the selected diagram.

Note

The setting of the sweep count in the *TRACE* menu is equivalent to the setting in the *SWEEP* menu.

IEC/IEEE bus command: `SWE:COUN 64`

DETECTOR   See following section "Selection of Detector" on page 4.152.

TRACE MATH   See following section "Mathematical Functions for Traces" on page 4.157.

MIN HOLD   The *MIN HOLD* softkey activates the min peak detector. ESU saves for each sweep the smallest of the previously stored/currently measured values in the trace memory. The detector is automatically set to *MIN PEAK*. In this way, the minimum value of a signal can be determined over several sweeps.

This function is useful e.g. for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed by the min hold function whereas a CW signal is recognized by its constant level.

Pressing the *MIN HOLD* softkey again clears the trace memory and restarts the min hold function.

IEC/IEEE bus command: `DISP:WIND:TRAC:MODE MINH`

HOLD CONT   The *HOLD CONT* softkey defines whether the traces in min hold and max hold mode are reset after some specific parameter changes.

• OFF: The traces are reset after some definite parameter changes (default)

• ON: This mechanism is switched off.

In general, parameter changes require a restart of the measurement before results are evaluated (e.g. with markers). For those changes that are known to require a new measurement (e.g. modification of the span), the trace is automatically reset so that erroneous evaluations of previous results are avoided.

This mechanism can be switched off for those exceptional cases where the described behavior is unwelcome.

IEC/IEEE bus command: `DISPlay[:WINDow<1|2>]:TRACe<1..4>:`
                        `MODE:HCON ON|OFF`

AVG MODE LOG/ LIN

The *AVG MODE LOG/LIN* softkey selects logarithmic or linear averaging for the logarithmic level display mode.

At the same time the difference calculation is switched between linear and logarithmic in submenu *TRACE MATH*.

IEC/IEEE bus command: `CALC:MATH:AVER:MODE LIN`

With logarithmic averaging, the dB values of the display voltage are averaged or substracted from each other with trace mathematical functions. With linear averaging the level values in dB are converted into linear voltages or powers prior to averaging. Voltage or power values are averaged or offset against each other and reconverted into level values.

For stationary signals the two methods yield the same result.

Logarithmic averaging is recommended if sinewave signals are to be clearly visible against noise since with this type of averaging noise suppression is improved while the sinewave signals remain unchanged.

For noise or pseudo-noise signals the positive peak amplitudes are decreased in logarithmic averaging due the characteristic involved and the negative peak values are increased relative to the average value. If the distorted amplitude distribution is averaged, a value is obtained that is smaller than the actual average value. The difference is -2.5 dB.

Probability distribution

This low average value is usually corrected in noise power measurements by a 2.5 dB factor. Therefore the ESU offers the selection of linear averaging. The trace data are delogarithmized prior to averaging, then averaged and logarithmized again for display on the screen. The average value is always correctly displayed irrespective of the signal characteristic.

ASCII FILE EXPORT　　The *ASCII FILE EXPORT* softkey stores the active trace in ASCII format, e.g. on a memory stick.

　　　　　　　　　　　　　　IEC/IEEE bus command:　　`FORM ASC;`
　　　　　　　　　　　　　　　　　　　　　　　　　　　　`MMEM:STOR:TRAC 1,'TRACE.DAT'`

The file consists of the header containing important scaling parameters and a data section containing the trace data.

The data of the file header consist of three columns, each separated by a semicolon:

　　parameter name; numeric value; basic unit

The data section starts with the key word " Trace <n> " (<n> = number of stored trace), followed by the measured data in one or several columns (depending on measurement) which are also separated by a semicolon.

This format can be read in from spreadsheet calculation programs, e.g. MS-Excel. It is necessary to define ';' as a separator.

Note

Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using the *DECIM SEP* softkey.

Example - file header

File contents	Description
Type; ESU8;	Instrument model
Version;1.00;	Firmware version
Date;01.Jul 1999;	Date of data set storage
Mode;Spectrum;	Instrument mode
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Span;90000;Hz	Frequency range (0 Hz with zero span and statistics measurements)
x-Axis;LIN;	Scaling of x axis linear (LIN) or logarithmic (LOG)
Start;10000;Hz Stop;100000;Hz	Start/stop of the display range. Unit: Hz for span > 0, s for span = 0, dBm/dB for statistics measurements
Ref.Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Ref Position;75;%	Position of reference level referred to diagram limits (0% = lower edge)
y-Axis;LOG;	Scaling of y axis linear (LIN) or logarithmic (LOG)
Level Range;100;dB	Display range in y direction. Unit: dB with x axis LOG, % with x axis LIN
RF Att;20;dB	Input attenuation
RBW;100000;Hz	Resolution bandwidth
VBW;30000;Hz	Video bandwidth
SWT;0.005;s	Sweep time
Trace Mode;AVERAGE;	Display mode of trace: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD
Detector;SAMPLE;	Detector set: AUTOPEAK,MAXPEAK,MINPEAK,AVERAGE, RMS,SAMPLE,QUASIPEAK
Sweep Count;20;	Number of sweeps set

Example - data section of the file

File contents	Description
Trace 1:;;	Selected trace
x-Unit;Hz;	Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements
y-Unit;dBm;	Unit of y values: dB*/V/A/Ω depending on the selected unit with y axis LOG or % with y axis LIN
Values; 625;	Number of test points
10000;-10.3;-15.7 10180;-11.5;-16.9 10360;-12.0;-17.4 ...;...;	Measured values: <x value>, <y1>, <y2> <y2> being available only with detector AUTOPEAK and containing in this case the smallest of the two measured values for a test point.

DECIM SEP

The *DECIM SEP* softkey selects the decimal separator between '.' (decimal point) and ',' (comma) with floating-point numerals for the function ASCII FILE EXPORT.

With the selection of the decimal separator different language versions of evaluation programs (e.g. MS-Excel) can be supported.

IEC/IEEE bus command: `FORM:DEXP:DSEP POIN`

COPY TRACE

The *COPY TRACE* softkey copies the screen contents of the current trace into another trace memory. The desired memory is selected by entering the number 1, 2 or 3.

Upon copying, the contents of the selected memory is overwritten and the new contents displayed in view mode.

IEC/IEEE bus command: `TRAC:COPY TRACE1,TRACE2`

Selection of Detector

The detectors of the ESU are implemented as pure digital devices. The detectors available are the peak detectors which determine the maximum and/ or the minimum value from a number of samples, the rms detector which measures the power within a pixel, the average, the quasipeak and the sample detector. The sample detector routes through the sampled data without any modification or performs a data reduction by suppressing measured values that cannot be displayed.

The peak detectors compare the current level value with the maximum or minimum level from the previously sampled data. When the number of samples defined by the instrument setting is reached, the samples are combined in the displayed pixels. Each of the 625 pixels of the display thus represents 1/625 of the sweep range and contains all single measurements (frequency samples) in this subrange in compressed form. For each trace display mode an optimized detector is selected automatically. Since peak detectors and sample detector are connected in parallel, a single sweep is sufficient for collecting all detector values for 3 traces.

Peak detectors (*MAX PEAK* and *MIN PEAK*)

Peak detectors are implemented by digital comparators. They determine the largest of all positive (max peak) or the smallest of all negative (min peak) peak values of the levels measured at the individual frequencies which are displayed in one of the 625 pixels. This procedure is repeated for each pixel so that for wide frequency spans and despite the limited resolution of the display a large number of measurements can be taken into consideration for the display of the spectrum.

Autopeak detector

The *AUTOPEAK* detector combines the two peak detectors. The max peak detector and the min peak detector simultaneously determine the maximum and the minimum level within a displayed test point and display it as a single measured value. The maximum and minimum levels within a frequency point are connected by a vertical line.

Sample detector

The *SAMPLE* detector routes through the sampled data without any further evaluation and either displays them directly or, for reasons of speed in case of short sweep times, first writes them into a memory and processes them subsequently.

There is no data reduction, i.e. no summing up of measured values of neighboring frequencies or time samples. If during a frequency sweep more measured values are obtained than can be displayed, measured values will be lost. This means that discrete signals might be lost.

The sample detector therefore can only be recommended for a span-to-resolution bandwidth ratio of up to approx. 250 in order to ensure that no signal will be suppressed (example: span 1 MHz, -> min. bandwidth 5 kHz).

RMS detector

The RMS detector forms the rms value of the measured values within a pixel.

To this effect, ESU uses the linear voltage after envelope detection. The sampled linear values are squared, summed and the sum is divided by the number of samples (= root mean square). For logarithmic display the logarithm is formed from the square sum. For linear display the root mean square value is displayed. Each pixel thus corresponds to the power of the measured values summed up in the pixel.

The rms detector supplies the power of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or impulsive signal). Correction factors as needed for other detectors for measuring the power of the different signal classes are not required.

Average detector

The average detector forms the average value of the measured values within a pixel.

To this effect, ESU uses the linear voltage after envelope detection. The sampled linear values are summed up and the sum is divided by the number of samples (= linear average value). For logarithmic display the logarithm is formed from the average value. For linear display the average value is displayed. Each pixel thus corresponds to the average of the measured values summed up in the pixel.

The average detector supplies the average value of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or impulsive signal).

Quasipeak detector

The quasipeak detector resembles the behavior of an analog voltmeter by evaluating the measured values in a pixel.

The quasipeak detector is especially designed for the requirements of EMC measurements and is used for evaluating pulse-shaped spurious.

Note

During a frequency sweep, ESU increments the 1st local oscillator in steps that are smaller than approximately 1/10 of the bandwidth. This is to ensure that the signal level is correctly measured. For narrow bandwidths and wide frequency spans a very large number of measured values is thus obtained. The number of frequency steps, however, always is a multiple of 625 (= number of pixels that can be displayed). With the sample detector selected, only every n^{th} value is displayed. The value of n depends on the number of measured values, i.e. on the frequency span, the resolution bandwidth and the measurement rate.

DETECTOR

```
  DETECTOR  ⟶          AUTO
                     SELECT

                     DETECTOR
                     AUTOPEAK

                     DETECTOR
                     MAX PEAK

                     DETECTOR
                     MIN PEAK

                     DETECTOR
                     SAMPLE

                     DETECTOR
                     RMS

                     DETECTOR
                     AVERAGE

                     DETECTOR
                     QPK

                        ⇧
```
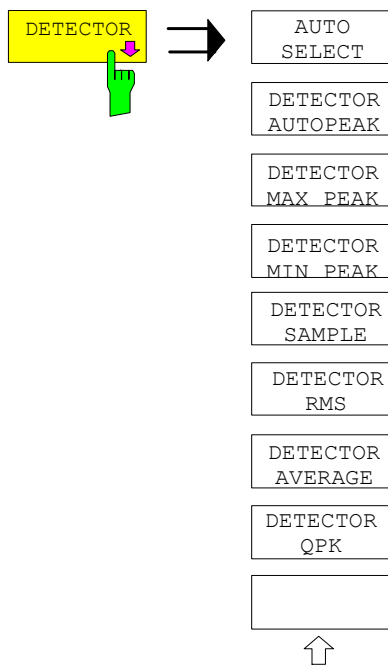
The *DETECTOR* softkey opens a submenu for selecting the detector for the selected trace. The softkey is highlighted if the detector is not selected with *AUTO SELECT*.

The detector can be selected independently for each trace. The *AUTO SELECT* mode selects the optimum detector for each display mode of the trace (Clear/Write, Max Hold or Min Hold).

The softkeys for the detectors are mutually exclusive selection keys.

AUTO SELECT   The *AUTO SELECT* softkey (= default setting) selects the optimum detector for the set display mode of the trace (Clear/Write, Max Hold and Min Hold) and the selected filter mode (bandpass/FFT).

Trace display	Detector (bandpass)	Detector (FFT)
Clear/Write	Auto Peak	Max Peak
Average	Sample	Sample
Max Hold	Max Peak	Max Peak
Min Hold	Min Peak	Max Peak

The detector activated for the specific trace is identified in the respective trace display field as follows:

Detector

Auto Peak	AP
Max Peak	PK
Min Peak	MI
Average	AV
RMS	RM
Sample	SA
Quasipeak	QP

IEC/IEEE bus command: `DET:AUTO ON`

DETECTOR AUTOPEAK

The *DETECTOR AUTOPEAK* softkey activates the autopeak detector.

IEC/IEEE bus command: `DET APE`

DETECTOR MAX PEAK

The *DETECTOR MAX PEAK* softkey activates the max peak detector. It is recommended for measurement of impulsive signals.

IEC/IEEE bus command: `DET POS`

DETECTOR MIN PEAK

The *DETECTOR MIN PEAK* softkey activates the min peak detector. Weak sinewave signals become clearly visible in noise using this detector. In case of a composite signal made up of sinewave and impulsive signals, the impulsive signals are suppressed.

IEC/IEEE bus command: `DET NEG`

DETECTOR SAMPLE

The *DETECTOR SAMPLE* softkey activates the sample detector.

It is used for measuring uncorrelated signals such as noise. The power can be determined with the aid of fixed correction factors for evaluation and the logarithmic function.

IEC/IEEE bus command: `DET SAMP`

DETECTOR RMS

The *DETECTOR RMS* softkey activates the rms detector.

The rms detector supplies the power of the signal independent of the waveform. For this effect the root mean square of all sampled level values is formed during the sweep of a pixel. The sweep time thus determines the number of averaged values and with increasing sweep time better averaging is obtained. The rms detector is thus an alternative for averaging over several sweeps (see TRACE AVERAGE).

Since the video bandwidth must be at least 10 times the resolution bandwidth (RBW) to ensure that video filtering does not invalidate the rms values of the signal, this ratio is set automatically upon activating the detector.

IEC/IEEE bus command: `DET RMS`

DETECTOR AVERAGE
The *DETECTOR AVERAGE* softkey activates the average detector.

In contrast to the rms detector, the average detector supplies the linear average of all sampled level values during the sweep of a pixel.

The same relations as for the rms detector apply (see above).

IEC/IEEE bus command: `DET AVER`

DETECTOR QPK
The *DETECTOR QPK* softkey activates the quasipeak detector.

This detector evaluates the sampled level values during the sweep of a pixel like an analog voltmeter.

On switching the quasipeak detector on the video bandwidth is automatically set to 10*RBW so as to exclude the influence of the video filter on the signal evaluation.

IEC/IEEE bus command: `DET QPE`

Mathematical Functions for Traces

TRACE MATH
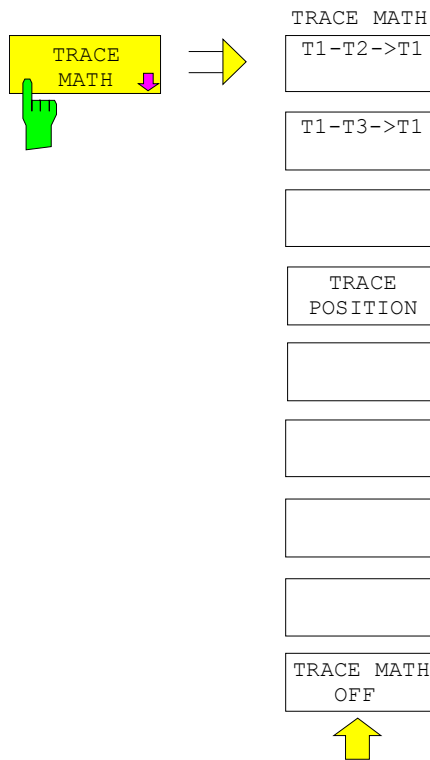
The *TRACE MATH* softkey opens a submenu in which the difference between the selected trace to trace 1 is calculated. The softkey is highlighted if a math function is activated.

T1-T2->T1   The *T1-T2* and *T1-T3* softkeys subtract the corresponding traces. The result
T1-T3->T1   displayed is referred to the zero point defined by *TRACE POSITION*.

To indicate that the trace has been obtained by subtraction, the difference "1 - 2" or "1 - 3" is indicated on the trace info of trace 1 and in the *TRACE* main menu the *TRACE MATH* softkey is highlighted.

IEC/IEEE bus command: `CALC:MATH (TRACE1-TRACE2)`
                          `CALC:MATH (TRACE1-TRACE3)`

TRACE POSITION   The *TRACE POSITION* softkey activates the entry of the trace position for 0 difference. The position is stated in % of the diagram height.

The range of values extends from -100% to +200%

IEC/IEEE bus command: `DISP:MATH:POS 50PCT`

TRACE MATH OFF   The *TRACE MATH OFF* softkey switches the math function off.

IEC/IEEE bus command: `CALC:MATH:STAT OFF`

Recording the Correction Data – CAL

The ESU obtains its high measurement accuracy through its inbuilt self-alignment method.

The correction data and characteristics required for the alignment are determined by comparison of the results at different settings with the known characteristics of the high-precision calibration signal source of ESU at 128 MHz. The correction data are then available in the instrument as a file and can be displayed by means of the *CAL RESULTS* softkey.

For service purposes the use of correction data can be deactivated by means of the *CAL CORR ON/OFF* softkey. If the correction data recording is aborted, the last complete correction data set is restored.

> **Note**
>
> The term "Calibration" formerly used for the integrated self alignment was often mistaken for the "true" calibration of the instrument at the test set in production and in service. It is therefore no longer used although it appears in the abbreviated form in the name of keys ("CAL...").

The *CAL* key opens a menu with the available functions for recording, displaying and activating the data for self alignment.
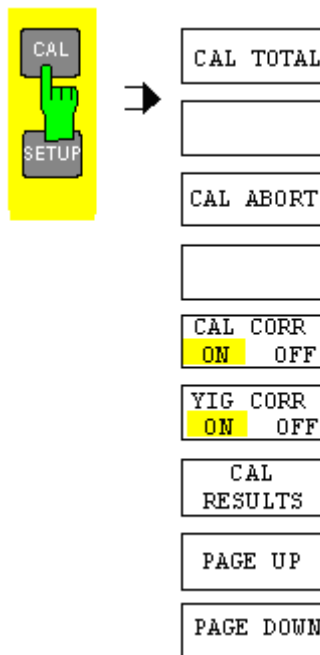
CAL TOTAL   The *CAL TOTAL* softkey starts the recording of correction data of the instrument.

If the correction data recording has failed or if the correction values are deactivated (*CAL CORR = OFF* softkey), the status field indicates

UNCAL

IEC/IEEE bus command: `*CAL?`

CAL ABORT   The *CAL ABORT* softkey interrupts the recording of correction data and restores the last complete correction data set.

IEC/IEEE bus command: `CAL:ABOR`

CAL CORR ON/OFF   The *CAL CORR ON/OFF* softkey switches the calibration data on/off.

- ON: The status message depends upon the results of the total calibration.

- OFF: The message *UNCAL* appears in the status line.

IEC/IEEE bus command: `CAL:STAT ON`

YIG CORR ON/OFF   The *YIG CORR ON/OFF* softkey switches on or off the automatic, cyclic correction of the temperature-dependent frequency drift of the YIG filter.

When switched to ON (default setting), it is checked once per minute whether a frequency correction for the YIG filter is required. Frequency correction is performed if the temperature has changed by more than 5K relative to the last instance of correction.

> **Note**
>
> If the instrument is operated in a temperature-controlled environment, the cyclic frequency drift correction can – for time-critical applications – be switched off after an operating period of $\geq$ 30 minutes.

IEC/IEEE bus command: `:[SENSe<1|2>:]CORRection:YIG:`
                       `TEMPerature:AUTO ON | OFF`

CAL RESULTS   The *CAL RESULTS* softkey calls the *CALIBRATION RESULTS* table, which shows the correction data found during calibration.

The *CALIBRATION RESULTS* table contains the following information:

- date and time of last record of correction values

- overall results of correction value record

- list of found correction values according to function/module

The results have the following meaning:

PASSED   calibration successful without any restrictions

CHECK   deviation of correction value larger than expected, correction could however be performed

FAILED   deviations of correction value too large, no correction was possible. The found correction data are not valid.

ABORTED   calibration aborted

```
                    CALIBRATION RESULTS
Total Calibration Status: PASSED
Rohde&Schwarz,ESU-40,100002/040,3.83
Date (dd/mm/yyyy): 17/02/2006 Time: 10:49:03
Runtime: 05:39


Linear detector offset [%]
                                  1.11


LC center frequencies
LC-cycle              DAC [%]    Error[kHz]
        0             67.49        4.81        PASSED
        1             69.58        3.21        PASSED
        2             67.95        4.81        PASSED
        3             68.81       -4.81        PASSED
        4             68.69        0.00        PASSED


Bandwidths and center frequency offsets
RBW                   DAC [%]    E [RBW %]
```

IEC/IEEE bus command: `CAL:RES?`

PAGE UP /
PAGE DOWN   The softkeys *PAGE UP* and *PAGE DOWN* scroll one page forward or backward in the *CALIBRATION RESULTS* table. They have no function when the table is closed.

IEC/IEEE bus command: `--`

Markers and Delta Markers – MKR

The markers are used for marking points on traces, reading out measurement results and for quickly selecting a display section. ESU provides four markers per display window. All markers can be used either as markers or delta markers. The availability of marker functions depends on whether the measurement is performed in the frequency, time or level domain.

The marker that can be moved by the user is defined in the following as the **active marker**.

Fig. 4-15   Examples of marker display

Temporary markers are used in addition to the markers and delta markers to evaluate the measurement results. They disappear when the associated function is deactivated.

The measurement results of the active marker (also called **marker values**) are displayed in the marker field. The marker info field at the upper right of the display shows the marker location (here, frequency), the level and the currently selected trace [T1].

```
MARKER 1   [T1]
   -27.5 dBm
  123.4567 MHz
```

The *MKR* key calls a menu that contains all marker and delta marker standard functions. If no marker is active, *MARKER 1* will be enabled and a peak search on the trace carried out. Otherwise, the data entry for the marker activated last is opened.

```
                                                                    ┌────────────┐
                                                                    │  REF FIXED │
┌─────────────────────────────┐   ┌────────────┐                   ├────────────┤
│ ┌──────┐      ┌──────┐       │   │   MARKER   │                   │  REF FXD   │
│ │ FREQ │      │ SPAN │       │   ├────────────┤                   │ ON    OFF  │
│ └──────┘      └──────┘       │   │ MARKER 1   │                   ├────────────┤
│ ┌──────┐      ┌──────┐       │   ├────────────┤                   │ REF POINT  │
│ │ MKR  │      │ MKR▶ │       │   │ MARKER 2   │                   │   LEVEL    │
│ └──────┘      └──────┘       │   ├────────────┤                   ├────────────┤
│                              │   │ MARKER 3   │                   │ REF POINT  │
└─────────────────────────────┘   ├────────────┤                   │ LVL OFFSET │
                                   │ MARKER 4   │                   ├────────────┤
                                   ├────────────┤   ┌────────────┐  │ REF POINT  │
                                   │   MARKER   │   │   MARKER   │  │ FREQUENCY  │
                                   │ NORM DELTA │   ├────────────┤  ├────────────┤
                                   ├────────────┤   │ MKR->TRACE │  │ REF POINT  │
                                   │  SIGNAL    │   ├────────────┤  │   TIME     │
                                   │  COUNT     │   │ LINK MKR1  │  ├────────────┤
                                   ├────────────┤   │ AND DELTA1 │  │  PEAK      │
                                   │ REFERENCE  │   ├────────────┤  │  SEARCH    │
                                   │ FIXED      │   │            │  ├────────────┤
                                   ├────────────┤   ├────────────┤  │            │
                                   │  MARKER    │   │ CNT RESOL  │  │            │
                                   │  ZOOM      │   │  10 kHz    │  ├────────────┤
                                   ├────────────┤   ├────────────┤  │            │
                                   │ ALL MARKER │   │ CNT RESOL  │  │            │
                                   │   OFF      │   │  1 kHz     │  ├────────────┤
                                   └────────────┘   ├────────────┤  │            │
                                                    │ CNT RESOL  │  │            │
                                                    │  100 Hz    │  └────────────┘
                                                    ├────────────┤
                                                    │ CNT RESOL  │
                                                    │  10 Hz     │
                                                    ├────────────┤
                                                    │ CNT RESOL  │
                                                    │  1 Hz      │
                                                    ├────────────┤
                                                    │ CNT RESOL  │
                                                    │  0.1 Hz    │
                                                    └────────────┘
```
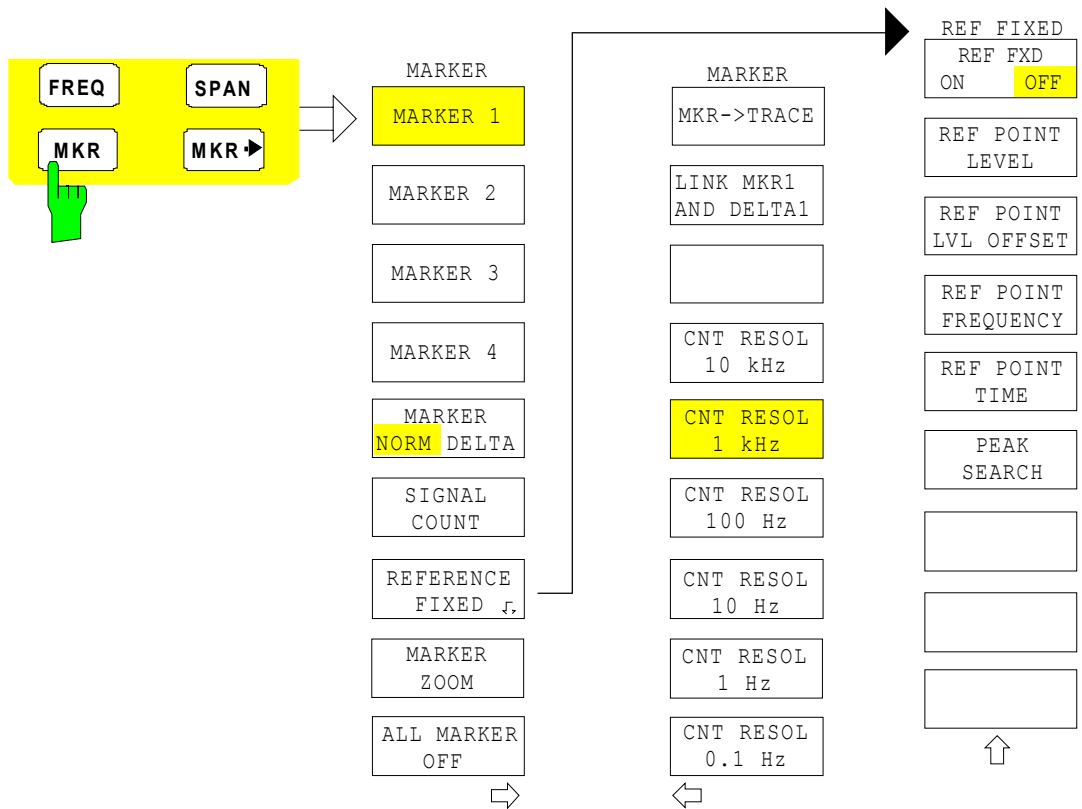
MARKER 1/2/3/4
MARKER NORM
DELTA

The *MARKER 1/2/3/4.*softkey selects the corresponding marker and activates it.

MARKER 1 is always the normal marker. After they have been switched on, *MARKERS 2 to 4* are delta markers that refer to *MARKER 1*. These markers can be converted into markers with absolute value display by means of the *MARKER NORM DELTA* softkey. When *MARKER 1* is the active marker, pressing the *MARKER NORM DELTA* softkey switches on an additional delta marker.

Pressing the *MARKER 1 to 4* softkey again switches off the selected marker.

Example

[**PRESET**] ESU is set to the default setting.

[**MKR**] On calling the menu, *MARKER 1* is switched on ('1' highlighted in the softkey) and positioned on the maximum value of the trace. It is a normal marker and the *MARKER NORMAL* softkey is highlighted.

[*MARKER 2*] *MARKER 2* is switched on ('2' highlighted in the softkey). It is automatically defined as a delta marker on switching on so the *DELTA* is highlighted on softkey *MARKER NORM DELTA*. The frequency and level of *MARKER 2* with reference to *MARKER 1* are output in the marker info field.

[*MARKER NORM DELTA*] The *MARKER NORM DELTA* softkey is highlighted. *MARKER 2* becomes a normal marker. The frequency and level of *MARKER 2* are output as absolute values in the marker info field.

[*MARKER 2*] *MARKER 2* is switched off. *MARKER 1* is the active marker for entry. The frequency and level of *MARKER 1* are output in the marker info field.

IEC/IEEE bus command:
```
CALC:MARK ON;
CALC:MARK:X <value>;
CALC:MARK:Y?

CALC:DELT ON;
CALC:DELT:MODE ABS|REL
CALC:DELT:X <value>;
CALC:DELT:X:REL?
CALC:DELT:Y?
```

When several traces are being displayed, the marker is set to the maximum value (peak) of the active trace which has the lowest number (1 to 3). In case a marker is already located there, it will be set to the frequency of the next lowest level (next peak).

When the split-screen display mode is active, the marker will be placed in the active window. A marker can only be enabled when at least one trace in the corresponding window is visible.

If a trace is turned off, the corresponding markers and marker functions are also deactivated. If the trace is switched on again (*VIEW*, *CLR/WRITE*;..), the markers along with coupled functions will be restored to their original positions provided the markers have not been used on another trace.

MKR->TRACE   The *MKR->TRACE* softkey places the marker on a new trace. The trace is selected via a data entry field. Only those traces can be selected which are visible on the screen in the same window.

Example

Three traces are presented on the screen. The marker is always on Trace 1 on switching on.

[*MKR ->TRACE*] "2"<ENTER>   The marker jumps to Trace 2 but remains on the previous frequency or time.

[*MKR ->TRACE*] "3"<ENTER>   The marker jumps to Trace 3. '

IEC/IEEE bus command: `CALC:MARK1:TRAC 1`
                         `CALC:DELT:TRAC 1`

LINK MKR1 AND DELTA1   With the softkey *LINK MKR1 AND DELTA1* the delta marker1 can be linked to marker1, so if the x-axis value of the marker1 is changed the delta marker1 will follow on the same x-position. The link is default off, and can be switched on.

Example for setup

- PRESET
- TRACE | MAX HOLD
- TRACE | SELECT TRACE | 2 | AVERAGE
- MKR (Switches marker1 on)
- MARKER NORM DELTA | DELTA (Delta Marker 1 ON)
- MKR-> | MKR->TRACE | 2
- LINK MKR1 AND DELTA1

Now select the Marker1 (by switching MARKER1 from DELTA back to NORM) and when changing the x-axis value (by knob wheel or UP/DOWN keys) the delta marker1 will follow automatically.

The delta marker1 x-value can not be changed away from 0 as long as the link functionality is active.

IEC/IEEE bus command: `CALCulate<1|2>:DELTamarker<1...4>:`
                         `LINK ON | OFF`

The suffix at `DELTamarker` can only be 1 or not present, because the functionality is only available for marker1.

Frequency Measurement with the Frequency Counter

In order to accurately determine the frequency of a signal, ESU is equipped with a frequency counter which measures the frequency of the RF signal at the intermediate frequency. Using the measured IF, ESU calculates the frequency of the RF input signal by applying the known frequency conversion factors.

The frequency measurement error depends only upon the accuracy of the frequency standard used (external or internal reference). Although ESU always operates synchronously irrespective of the set span, the frequency counter delivers a more exact result than a measurement performed with a marker. This is due to the following:

- The marker measures only the position of the pixel on the trace and infers the frequency of the signal from this value. The trace, however, contains only a limited number of pixels. Depending upon the selected span, each pixel may contain many measurement values, which therefore limits the frequency resolution.

- The resolution with which the frequency can be measured is proportional to the measurement time. For this reason, the bandwidth is normally made as wide as possible and the sweep time as short as possible. This results in a loss of frequency resolution.

For the measurement with the frequency counter, the sweep is stopped at the reference marker, the frequency is counted with the desired resolution and then the sweep is allowed to continue.
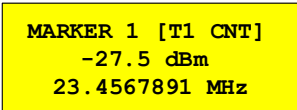
SIGNAL COUNT The *SIGNAL COUNT* softkey switches the frequency counter on/off.

The frequency is counted at the position of the reference marker (*MARKER 1*). The sweep stops at the reference marker until the frequency counter has delivered a result. The time required for a frequency measurement depends on the selected frequency resolution. The resolution is set in the side menu.

If no marker is enabled when the *SIGNAL COUNT* softkey is pressed, MARKER 1 is switched on and set at the largest signal.

In addition, the *SIGNAL COUNT* function is displayed in the marker info field on the screen with [Tx CNT].

```
MARKER 1 [T1 CNT]
   -27.5 dBm
 23.4567891 MHz
```

Switching the *SIGNAL COUNT* function off is accomplished by pressing the softkey again.

IEC/IEEE bus command: CALC:MARK1:COUN ON;
                      CALC:MARK:COUN:FREQ?

MARKER

| CNT RESOL |
| 10 kHz |

| CNT RESOL |
| 1 kHz |

| CNT RESOL |
| 100 Hz |

| CNT RESOL |
| 10 Hz |

| CNT RESOL |
| 1 Hz |

| CNT RESOL |
| 0.1 Hz |

The resolution of the frequency counter is set in the *NEXT* menu of the *MARKER* menu. ESU offers counter resolutions between 0.1 Hz and 10 kHz.

The *CNT RESOL ...* softkeys select the counter resolution. They are selection switches, i.e. only one of the can be active at any one time.

The marker stop time, i.e. the frequency measurement time, depends on the selected resolution.

IEC/IEEE bus command: `CALC:MARK1:COUN:RES <value>`

Measurement example

The frequency of a CW signal is to be determined by means of the frequency counter with a resolution of 10 Hz.

[**PRESET**]	ESU is set to the default setting.
[**MARKER**]	*MARKER 1* is switched on and set to the maximum value of the displayed spectrum.
[*SIGNAL COUNT*]	The frequency counter is switched on. ESU counts the frequency of the signal at the marker position with a resolution of 1 kHz. The counted frequency is indicated in the marker info field.
[*NEXT*]	Changes to the submenu for setting the counter resolution.
[*CNT RESOL 10 Hz*]	The frequency counter resolution is increased to 10 Hz.

REFERENCE FIXED

| REF FXD ON/OFF |
| REF POINT LEVEL |
| REF POINT LVL OFFSET |
| REF POINT FREQUENCY |
| REF POINT TIME |
| REF POINT x-LEVEL |

The *REFERENCE FIXED* softkey defines the level and the frequency or time of *MARKER 1* as a reference for one or several delta markers. The measured values for one or several markers displayed in the marker info field are derived from this reference point instead of the current values of the reference marker (*MARKER 1*).

On actuating the softkey, reference fixed is switched on and thus, the level value and the frequency, time or x-level value of *MARKER 1* immediately become the reference point.

Additionally, the *REFERENCE FIXED* softkey opens the submenu where it is possible to determine manually a reference point with level and frequency, time or x-axis level, to define a level offset or deactivate the reference point.

The *REFERENCE FIXED* function is useful for the measurement of the harmonic suppression at small span (fundamental not represented).

REF FXD ON/OFF	The *REF FXD ON/OFF* softkey switches on or off the relative measurement to a fixed reference value (*REFERENCE POINT*) independent of the trace.

IEC/IEEE bus command: `CALC:DELT2:FUNC:FIX ON`

REF POINT LEVEL	The *REF POINT LEVEL* softkey enters a reference level independent of the reference marker level. All relative level values of the delta markers refer to this reference level.

IEC/IEEE bus command: `CALC:DELT2:FUNC:FIX:RPO:Y -10dBm`

REF POINT LVL OFFSET	The *REF POINT LVL OFFSET* softkey specifies a level offset relevant to the reference level. The relative level values of the delta markers refer to the reference point level plus the level offset.

The level offset is set to 0 dB on enabling the *REFERENCE FIXED* or *PHASE NOISE* function.

IEC/IEEE bus command: `CALC:DELT2:FUNC:FIX:RPO:Y:OFFS 0dB`

REF POINT FREQUENCY	With the *REF POINT FREQUENCY* softkey a reference frequency can be manually activated for the delta markers when the *REFERENCE FIXED* or *PHASE NOISE* function is used.

IEC/IEEE bus command: `CALC:DELT2:FUNC:FIX:RPO:X 10.7MHz`

REF POINT TIME	The *REF POINT TIME* softkey activates the entry box for the input of a reference time for the *REFERENCE FIXED* function in the time domain (span = 0 Hz).

IEC/IEEE bus command: `CALC:DELT2:FUNC:FIX:RPO:X 5MS`

For phase noise measurement, input of reference time is not possible.

REF POINT x-LEVEL	The *REF POINT x-LEVEL* softkey activates the entry box for the input of a reference level on the x-axis for the *REFERENCE FIXED* function when the power sweep is active.

IEC/IEEE bus command: `CALC:DELT2:FUNC:FIX:RPO:X -5DBM`

Measurement example

Small-span harmonics measurement to increase sensitivity

CW signal (e.g. 100 MHz, 0 dBm) with harmonics at the RF input of ESU.

[**PRESET**]	ESU is set to the default setting.
[**CENTER**: 100 **MHz**]	The center frequency of ESU is set to 100 MHz.
[**SPAN**: 1 **MHz**]	The span is set to 1 MHz.
[**AMPL**: 3 **dBm**]	The reference level is set to 3 dBm (3 dB above the expected RF level).
[**MKR**]	*MARKER 1* is switched on ('1' highlighted in the softkey) and set to the signal peak.
[*MARKER 2*]	*MARKER 2* is switched on and automatically defined as the delta marker (*DELTA* is highlighted on *MARKER NORM DELTA* softkey).
[*REFERENCE FIXED*]	The frequency and level of *MARKER 1* are a reference for the delta marker.
[**CENTER**: 200 **MHz**]	The center frequency is set to 200 MHz (= frequency of the 2nd harmonic). The reference level may have to be reduced to see the 2nd harmonic from the noise. This does not affect the reference level set with *REFERENCE FIXED*.
[**MKR->**: *PEAK*]	The delta marker jumps to the 2nd harmonic of the signal. The level spacing of the harmonic to the fundamental is displayed in the marker info field.

MARKER ZOOM   The *MARKER ZOOM* softkey expands the area around MARKER 1. With the zoom function, more details of the spectrum can be seen. The desired display range can be defined in an entry window.

The following sweep is stopped at the position of the reference marker. The frequency of the signal is counted and the measured frequency becomes the new center frequency. The zoomed display range is then configured and the new settings are used by ESU for further measurements.

As long as switching to the new frequency display range has not yet taken place, pressing the softkey will abort the procedure.

If *MARKER 1* is not active when the softkey is pressed, it is automatically activated and set to the highest peak in the window.

If an instrument setting is changed after selection of *MARKER ZOOM*, the function is aborted.

The *MARKER ZOOM* softkey is only available in the frequency domain (span > 0).

IEC/IEEE bus command: `CALC:MARK1:FUNC:ZOOM 1kHz`

ALL MARKER OFF   The *ALL MARKER OFF* softkey switches off all markers (reference and delta markers). It also switches off all functions and displays associated with the markers/delta markers.

IEC/IEEE bus command: `CALC:MARK:AOFF`

Marker Functions – MKR FCTN

The *MKR FCTN* menu offers further measurements with the markers:

– Measurement of noise density (*NOISE MEAS* softkey)

– Measurement of phase noise (*PHASE NOISE* softkey)

– Measurement of filter or signal bandwidth (*N DB DOWN* softkey)

– Activating of AF demodulation (*MARKER DEMOD* softkey)

On calling the menu, the entry for the last active marker is activated (*SELECT MARKER* softkey); if no marker is activated, marker 1 is activated and a maximum search (*PEAK* softkey) is performed. The marker can be set to the desired trace by means of *MKR -> TRACE* softkey.

SELECT MARKER	
PEAK	
NOISE MEAS	
PHASE NOISE ⇩	PH NOISE ON/OFF
	REF POINT LEVEL
	REF POINT LVL OFFSET
	REF POINT FREQUENCY
	PEAK SEARCH
N dB DOWN	
PEAK LIST ⇩	NEW SEARCH
	SORT MODE FREQ/LEVEL
	PEAK EXCURSION
	LEFT LIMIT / RIGHT LIMIT
	THRESHOLD
	PEAK LIST OFF
MARKER DEMOD ⇩	MKR DEMOD ON/OFF
	AM FM
	SQUELCH
	MKR STOP TIME
	CONT DEMOD
MKR->TRACE	

Activating the Markers

SELECT MARKER   The *SELECT MARKER* softkey activates the numerical selection of the marker
                           in the data entry field. Delta marker 1 is selected by input of ' 0 '.

                           If the marker is switched off, then it is switched on and can be moved later on.

                           IEC/IEEE bus command: `CALC:MARK1 ON;`
                                                     `CALC:MARK1:X <value>;`
                                                     `CALC:MARK1:Y?`

PEAK   The *PEAK* softkey sets the active marker/delta marker to the peak of the trace.

                           IEC/IEEE bus command: `CALC:MARK1:MAX`
                                                     `CALC:DELT1:MAX`

Measurement of Noise Density

NOISE MEAS   The *NOISE MEAS* softkey switches the noise measurement for the active
                           marker on or off. The corresponding marker becomes the *NORMAL* marker.

                           During noise measurement, the noise power density is measured at the position
                           of the marker. In the time domain mode, all points of the trace are used to
                           determine the noise power density. When measurements are performed in the
                           frequency domain, two points to the right and left of the marker are used for the
                           measurement to obtain a stable result.

                           The noise power density is indicated in the marker field. With a logarithmic
                           amplitude units (dBm, dBmV, dBmµV, dBµA) the noise power density is output
                           in dBm/Hz i.e. as level in 1 Hz bandwidth with reference to 1 mW. With linear
                           amplitude units (V, A, Ω) the noise voltage density is evaluated in µV/√Hz, the
                           noise current density in µA/√Hz or the noise power density in µW/Hz.

                           The following settings have to be made to ensure that the power density
                           measurement yields correct values:

                           Detector: Sample or RMS

                           Video bandwidth: $\leq$ 0.1 × resolution bandwidth with sample detector
                                                  (corresponds to RBW / VBW NOISE)

                                                  $\geq$ 3 × resolution bandwidth with RMS detector
                                                  (corresponds to RBW / VBW SINE)

                           In the default setting, the ESU uses the sample detector for the noise function.

                           With the sample detector, the trace can additionally be set to AVERAGE to
                           stabilize the measured values. With RMS detector used, trace averaging must
                           not be used since in this case it produces too low noise levels which cannot be
                           corrected. Instead, the sweep time can be increased to obtain stable
                           measurement results.

The ESU uses the following correction factors to evaluate the noise density from the marker level:

• Since the noise power is indicated with reference to 1 Hz bandwidth, the bandwidth correction value is deducted from the marker level. It is $10 \times \lg (1\,\text{Hz}/\text{BW}_{\text{Noise}})$, where BW_{Noise} is the noise or power bandwidth of the set resolution filter (RBW).

• **Sample detector**

  – As a result of video filter averaging and trace averaging, 1.05 dB is added to the marker level. This is the difference between the average value and the RMS value of white noise.

  – With a logarithmic level axis, 1.45 dB is added additionally. Logarithmic averaging is thus fully taken into account which yields a value that is 1.45 dB lower than that of linear averaging.

• **RMS detector**

  – With the exception of bandwidth correction, no further corrections are required for the RMS detector since it already indicates the power with every point of the trace.

To allow a more stable noise display the adjacent (symmetric to the measurement frequency) points of the trace are averaged.

In time domain mode, the measured values are averaged versus time (after a sweep).

IEC/IEEE bus command: `CALC:MARK:FUNC:NOIS ON;`
                                    `CALC:MARK:FUNC:NOIS:RES?`

Example: Measurement of inherent ESU noise

[**PRESET**]   The ESU is set to default setting.

[**MARKER**]   Marker 1 is switched on and set to the maximum value of the displayed spectrum. Set marker to desired frequency using the rotary knob.

[**NOISE**]   The ESU switches the sample detector on and sets the video bandwidth to 300 kHz (0.1 × RBW). The power density level of inherent noise is displayed in dBm/Hz in the marker info field.

Note

The ESU noise figure can be calculated from the measured power density level. It is calculated by deducting the set RF attenuation (RF Att) from the displayed noise level. 174 is to be added to the result to obtain the ESU noise figure.

Phase Noise Measurement

PHASE NOISE
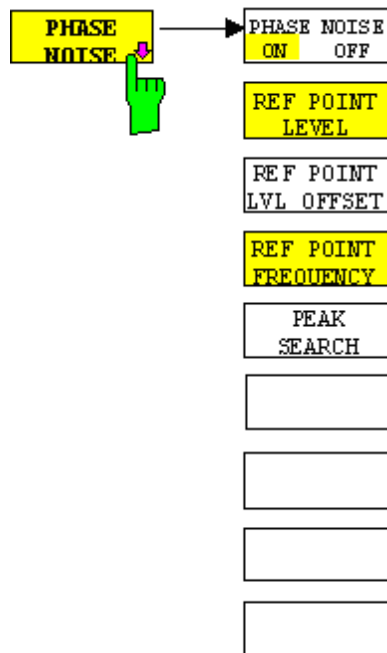
The *PHASE NOISE* softkey switches the *PHASE NOISE* function on/off. Additionally, the softkey opens the submenu for manually setting the reference point. The phase noise measurement can be switched off in the submenu.

MARKER 1 (= reference marker) is used as a reference for the phase noise measurement. The frequency and level of the reference marker are used as fixed reference values, i.e. the *REFERENCE FIXED* function is activated. After switching on the phase noise measurement the reference level or the center frequency can thus be set in a way that the carrier is outside the displayed frequency range, or, for example, a notch filter is switched on to suppress the carrier.

A noise power density measurement is carried out with the delta marker or delta markers. This measurement corresponds to the NOISE function in the *MARKER* menu (*MKR*). The result of the phase noise measurement is the difference in level between the reference point and the noise power density.

The following possibilities can be selected on switching on *PHASE NOISE*:

No marker enabled:

[**MKR FCTN**]   MARKER 1 is enabled and set to peak.

[*PHASE NOISE*]   MARKER 1 becomes the reference marker, MARKER 2 the delta marker; frequency = frequency of the reference marker. The delta marker is the active marker, i.e. it can be moved with the rotary knob or adjusted by entering numerals.

                        The PHASE NOISE function is switched on and the measured value is output.

Markers are enabled:

[**MKR FCTN**]   The previous marker configuration remains unchanged.

[*PHASE NOISE*]   MARKER 1 becomes the reference marker. If other markers are enabled, they become delta markers and measure the phase noise at their respective positions.

If further markers are enabled during the phase noise measurement, they automatically become delta markers and measure the phase noise at their respective positions.

When the phase noise measurement is switched off, the marker configuration remains unchanged and the delta markers measure the relative level to the reference marker (*MARKER 1*).

The *PHASE NOISE* function measures the noise power at the delta markers referred to 1 Hz bandwidth. The sample detector is automatically used and the video bandwidth set to 0.1 times the resolution bandwidth (RBW). The two settings are taken into account in the correction values used for the noise power measurement.

To obtain stable results, two pixels on the right and the left of the respective delta marker position are taken for the measurement. The procedure for determining the noise power is identical to the method used for the noise power measurement (see *NOISE* softkey). The measured noise level referred to 1 Hz bandwidth is subtracted from the carrier level at the reference marker (*MARKER 1*). The measured values are displayed in the delta marker field in dBc/Hz (= spacing in dB of the noise power from the carrier level in 1 Hz bandwidth).

If several delta markers are enabled, only the value read by the active marker is shown in the marker field. If several delta markers are active, their measurement results are shown in the marker info field.

The reference value for the phase noise measurement can be defined with *REF POINT LEVEL*, *REF POINT FREQUENCY* and *REF POINT LVL OFFSET* to differ from that of the reference marker.

IEC/IEEE bus command: --

PH NOISE ON/OFF

The *PH NOISE ON/OFF* softkey switches on/off the phase noise measurement. Switching on is performed by means of the *PHASE NOISE* softkey and is only necessary when the phase noise measurement has been switched off in the submenu.

IEC/IEEE bus command: `CALC:DELT1:FUNC:PNO ON`
                                        `CALC:DELT1:FUNC:PNO:RES?`

REF POINT LEVEL

The *REF POINT LEVEL* softkey activates an entry box for the input of a reference level other than the reference marker level. The function is identical to that of the softkey with the same name in the *MARKER* menu (*MKR*).

IEC/IEEE bus command: `CALC:DELT1:FUNC:FIX:RPO:Y -10dB`

REF POINT LVL OFFSET

The *REF POINT LVL OFFSET* softkey activates an entry box for the input of an additional level offset for the phase noise calculation.

This level offset is set to 0 dB on when the *REFERENCE FIXED* or *PHASE NOISE* function is enabled.

IEC/IEEE bus command: `CALC:DELT:FUNC:FIX:RPO:Y:OFFS 10dB`

REF POINT FREQUENCY

The *REF POINT FREQUENCY* softkey activates an entry box for the manual input of a reference frequency for the *REFERENCE FIXED* or *PHASE NOISE* function.

IEC/IEEE bus command: `CALC:DELT1:FUNC:FIX:RPO:X 10.7MHz`

PEAK SEARCH

The PEAK SEARCH sets the reference point level for delta marker 2 in the selected measurement window to the peak of the selected trace.

IEC/IEEE bus command: `CALC:DELT:FUNC:FIX:RPO:MAX`

Measurement example

The phase noise of a CW signal at 100 MHz with 0 dBm level is to be measured at 800 kHz from the carrier

[**PRESET**]	The ESU is set to the default setting.
[**CENTER**: 100 **MHz**]	The center frequency is set to 100 MHz.
[**SPAN**: 2 **MHz**]	The span is set to 2 MHz.
[**AMPT**: 0 **dBm**]	The reference level is set to 0 dBm.
[**MKR FCTN**]	MARKER 1 is switched on and positioned at the maximum of the displayed trace.
[*PHASE NOISE*: 800 **kHz**]	The phase noise measurement is switched on. The delta marker is positioned on the main marker and the measured phase noise value is displayed in the marker info field. The sample detector is used and the video bandwidth is set to 3 × RBW. When the phase noise measurement function is enabled, the entry of the delta marker frequency is activated. It can be entered directly.

Measurement of the Filter or Signal Bandwidth

N dB DOWN

The *N dB DOWN* softkey activates the temporary markers T1 and T2 which are n dB below the active reference marker. Marker T1 is placed to the left and marker T2 at the right of the reference marker. The value n can be input in a window.

The default setting is 3 dB.

Span > 0:   The frequency spacing of the two temporary markers is indicated in the marker info field.

Span = 0:   The pulse width between the two temporary markers is indicated in the marker info field.

If, for example, it is not possible to form the frequency spacing for the n dB value because of the noise display, dashes are indicated instead of a measured value.

If a negative value is entered than the markers are placed n dB above the active reference marker. This is then a n dB up function which can be used for notch filter measurements,

IEC/IEEE bus command: `CALC:MARK1:FUNC:NDBD:STAT ON`
                                       `CALC:MARK1:FUNC:NDBD 3dB`
                                       `CALC:MARK1:FUNC:NDBD:RES?`
                                       `CALC:MARK1:FUNC:NDBD:FREQ? 'Span > 0`
                                       `CALC:MARK1:FUNC:NDBD:TIME? 'Span = 0`

Measurement of a Peak List

PEAK LIST
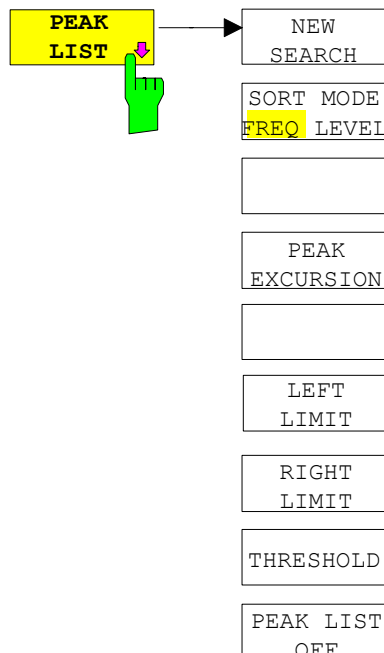
The *PEAK LIST* softkey allows the peak values of the trace to be determined and entered in a list with 50 entries max. The order of the entries is defined by the *SORT MODE*:

- FREQ: sorting in ascending order of frequency values (see screenshot); if span = 0, the entries are sorted in ascending order of time values

- LEVEL: sorting according to level

The search range can be restricted by means of the *LEFT LIMIT, RIGHT LIMIT* and *THRESHOLD* softkeys. The definition of the peak values can be modified using the *PEAK EXCURSION* softkey. The *MKR->TRACE* softkey in the main menu is used to select the trace for searching peak values.

Opening the list performs a single search at the end of the sweep. The *NEW SEARCH* softkey triggers a new sweep, determines the peak values of the trace at the end of the sweep and enters them in the list.

Use the *PEAK LIST OFF* key to delete the list from the screen.

IEC/IEEE bus command:
```
INIT:CONT OFF;
CALC:MARK:TRAC 1;
CALC:MARK:FUNC:FPE:SORT X;
INIT;*WAI;
CALC:MARK:FUNC:FPE 10;
CALC:MARK:FUNC:FPE:COUN?;
CALC:MARK:FUNC:FPE:Y?;
CALC:MARK:FUNC:FPE:X?
```

NEW SEARCH   The *NEW SEARCH* softkey starts a new peak search and enters the results in the peak list.

IEC/IEEE bus command:
```
INIT;*WAI;
CALC:MARK:FUNC:FPE 10;
CALC:MARK:FUNC:FPE:COUN?;
CALC:MARK:FUNC:FPE:Y?;
CALC:MARK:FUNC:FPE:X?
```

SORT MODE FREQ/ LEVEL	The *SORT MODE FREQ/LEVEL* softkey defines the position of the peak values in the list:

- FREQ: sorting in ascending order of frequency values (time values if span = 0)

- LEVEL: sorting according to level

IEC/IEEE bus command: `CALC:MARK:FUNC:FPE:SORT X;`

PEAK EXCURSION	With level measurements, the *PEAK EXCURSION* softkey allows the minimum amount to be entered by which a signal must decrease or increase in order to be recognized as a maximum by the peak search function.

Values between 0 dB and 80 dB may be entered, the resolution being 0.1 dB

IEC/IEEE bus command: `CALC:MARK:PEXC 6dB`

LEFT LIMIT / RIGHT LIMIT	The *LEFT LIMIT* and *RIGHT LIMIT* softkeys define the vertical lines F1/F2 in the frequency domain (span > 0) and T1/T2 in the time domain (span = 0) between which the search is carried out.

If only one line is active, the F1/T1 line is used as the lower limit; the upper limit is the stop frequency. If F2/T2 is also active, it defines the upper limit.

IEC/IEEE bus command: `CALC:MARK:X:SLIM:LEFT 1MHZ`
                          `CALC:MARK:X:SLIM:RIGH 10MHZ`
                          `CALC:MARK:X:SLIM ON`

THRESHOLD	The *THRESHOLD* softkey defines a horizontal threshold line which represents the lower limit of the peak search level range.

IEC/IEEE bus command: `CALC:THR -20dBm`
                          `CALC:THR ON`

PEAK LIST OFF	The *PEAK LIST OFF* softkey switches off the table with the search results.

IEC/IEEE bus command: `--`

AF Demodulation

The ESU provides demodulators for AM and FM signals. With these demodulators, a displayed signal can be identified acoustically through the use of the internal loudspeaker or with headphones. The frequency at which the demodulation is enabled is coupled to the markers. The sweep stops at the frequency determined by the active marker for the selected time and the RF signal is demodulated. During a measurement in the time domain (span = 0 Hz) the demodulation is continuously on.

The threshold line (*MKR->SEARCH LIMITS:THRESHOLD*) performs a squelch function in the demodulator. If the threshold is set, the ESU LF demodulation is switched on only when the signal to be demodulated exceeds the set threshold.

MARKER DEMOD
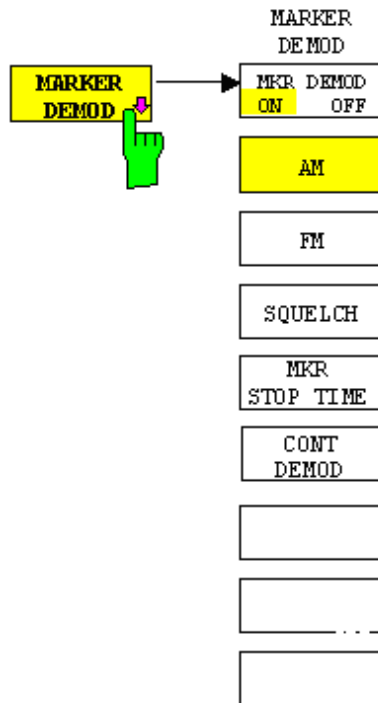
The *MARKER DEMOD* softkey switches on the audio demodulator and calls a submenu in which the demodulation mode and the duration of the demodulation can be selected.

IEC/IEEE bus command: `CALC:MARK1:FUNC:DEM ON`

MKR DEMOD ON/ OFF

The *MKR DEMOD ON/OFF* softkey switches the demodulation on/off.

In the frequency range (span >0), the frequency scan is stopped at the frequency of the active marker with demodulation switched on – provided that the level is above the threshold line - and the signal is demodulated during the given stop time.

In the time domain (span = 0) demodulation is continuous, i.e. not only active at the marker position.

IEC/IEEE bus command: `CALC:MARK1:FUNC:DEM ON`

AM
FM

The softkeys *AM* and *FM* are selector switches one of which only may be active at a time. They set the desired demodulation mode FM or AM. Default setting is AM.

IEC/IEEE bus command: `CALC:MARK1:FUNC:DEM:SEL AM`
                                         `CALC:MARK1:FUNC:DEM:SEL FM`

SQUELCH

The *SQUELCH* softkey enables the input of a level threshold below which the audible AF is cut off. The squelch function is associated with the internal trigger function (*TRIGGER* menu), which will be switched on automatically with the squelch. Squelch level and trigger level do have the same value.

The default setting for the squelch is off.

IEC/IEEE bus command: `:CALC:MARK1:FUNC:DEM:SQU ON | OFF`
                                         `:CALC:MARK1:FUNC:DEM:SQU:LEV 80 PCT`

MKR STOP TIME

The *MKR STOP TIME* softkey defines the stop time for demodulation at the marker(s).

The ESU interrupts the frequency sweep at the marker position and activates the demodulation for the duration of the stop time (see also *MKR DEMOD ON/ OFF*).

In the time domain (span = 0) the demodulation is continuously active irrespective of the stop time set.

IEC/IEEE bus command: `CALC:MARK1:FUNC:DEM:HOLD 3s`

CONT DEMOD

The *CONT DEMOD* softkey switches on the continuous demodulation in the frequency domain. If the sweep time is long enough, the set frequency range can be monitored acoustically.

IEC/IEEE bus command: `CALC:MARK1:FUNC:DEM:CONT ON`

Selecting the Trace

MKR→TRACE

The *MKR->TRACE* softkey sets the active marker to different traces. Only those traces can be selected which are visible on the screen in the same window.

The function of the softkey is identical to that of the softkey with the same name in the *MKR->* menu.

Example

Three traces are displayed on the screen. The marker is always on Trace 1 on switching on.

[*MKR ->TRACE*] "1"<ENTER>   The marker jumps to Trace 2, but remains at the previous frequency or time.

[*MKR ->TRACE*] "3"<ENTER>   The marker jumps to Trace 3.

IEC/IEEE bus command: `CALC:MARK:TRAC 2`

Change of Settings via Markers – MKR->

The *MKR->* menu offers functions through which instrument parameters can be changed with the aid of the currently active marker. The functions can be used on markers and delta markers.

On opening the menu, the entry for the last active marker is activated; if no marker was enabled, MARKER 1 is activated and a peak search is performed.

SELECT MARKER	
PEAK	
CENTER = MKR	
REF LEVEL = MKR LVL	
NEXT PEAK	
NEXT PEAK RIGHT	
NEXT PEAK LEFT	
SEARCH LIMITS ⇩	LEFT LIMIT / RIGHT LIMIT
	THRESHOLD
	SEARCH LIMIT OFF
MKR->TRACE	
Side menu	
MKR->CF STEPSIZE	
MIN	
NEXT MIN	
NEXT MIN RIGHT	
NEXT MIN LEFT	
EXCLUDE LO	
EXCLUDE LO	

SELECT MARKER   The *SELECT MARKER* softkey activates the numerical selection of the marker in the data entry field. Delta marker 1 is selected by input of ' 0 '.

IEC/IEEE bus command: `CALC:MARK1 ON;`
                        `CALC:MARK1:X <value>;`
                        `CALC:MARK1:Y?`

PEAK   The *PEAK* softkey sets the active marker/delta marker to the peak of the trace. If no marker is active when *MKR->* menu is called, MARKER 1 is automatically switched on and the peak search is performed.

IEC/IEEE bus command: `CALC:MARK:MAX`
                        `CALC:DELT:MAX`

CENTER = MKR   The *CENTER = MKR FREQ* softkey sets the center frequency to the current marker or delta marker frequency.

A signal can thus be set to the center of the frequency display range, for example, so that it can then be examined in detail with a smaller span.

The softkey is not available in the time domain (zero span).

IEC/IEEE bus command: `CALC:MARK:FUNC:CENT`

Example

A spectrum is displayed with a large span after PRESET. A signal off the center is to be examined in detail:

[**PRESET**]	ESU is set to the default setting.
[**MKR->**]	MARKER 1 is switched on and automatically jumps to the largest signal of the trace.
[*CENTER=MKR FREQ*]	The center frequency is set to the marker frequency. The span is adapted in such a way that the minimum frequency (= 0 Hz) or the maximum frequency is not exceeded.
[*SPAN*]	The span can, for example, be reduced using the rotary knob.

REF LEVEL = MKR LVL

The *REF LEVEL = MKR LVL* softkey sets the reference level to the current marker level.

IEC/IEEE bus command: `CALC:MARK:FUNC:REF`

Example

A spectrum is displayed with a large span after PRESET. A signal off the center is to be examined in detail:

[**PRESET**]	ESU is set to the default setting.
[**MKR->**]	MARKER 1 is switched on and automatically jumps to the largest signal of the trace.
[*CENTER=MKR FREQ*]	The center frequency is set to the marker frequency. The span is adapted in such a way that the minimum frequency (= 0 Hz) or the maximum frequency is not exceeded.
[*REF LEVEL = MKR LVL*]	The reference level is set to the measured marker level.
[**SPAN**]	The span can, for example, be reduced using the rotary knob.

NEXT PEAK

The *NEXT PEAK* softkey sets the active marker/delta marker to the next lower maximum of the selected trace.

IEC/IEEE bus command: `CALC:MARK:MAX:NEXT`
                                           `CALC:DELT:MAX:NEXT`

NEXT PEAK RIGHT

The *NEXT PEAK RIGHT* softkey sets the active marker/delta marker to the next lower maximum right of the current marker position on the selected trace.

IEC/IEEE bus command: `CALC:MARK:MAX:RIGH`
                                           `CALC:DELT:MAX:RIGH`

NEXT PEAK LEFT

The *NEXT PEAK LEFT* softkey sets the active marker/delta marker to the next lower maximum left of the current marker position the selected trace.

IEC/IEEE bus command: `CALC:MARK:MAX:LEFT`
                                           `CALC:DELT:MAX:LEFT`

SEARCH LIMITS

The *SEARCH LIMITS* softkey limits the search range for maximum or minimum search. The softkey switches to a submenu in which the search range limits can be set in the x and y direction.

LEFT LIMIT / RIGHT LIMIT
The *LEFT LIMIT* and *RIGHT LIMIT* softkeys define the two vertical lines F1 and F2 in the frequency domain (span > 0) and T1 / T2 in the time domain (span = 0). The search is performed between these lines in the frequency and time domain

If only *LEFT LIMIT* is enabled, line F1/T1 is the lower limit and the upper limit corresponds to the stop frequency. If *RIGHT LIMIT* is also enabled, it determines the upper limit.

IEC/IEEE bus command: CALC:MARK:X:SLIM:LEFT 1MHZ
                            CALC:MARK:X:SLIM:RIGH 10MHZ
                            CALC:MARK:X:SLIM ON

THRESHOLD
The *THRESHOLD* softkey defines the threshold line.

The threshold line represents a limit for the level range of the max. search at the lower end and that of the min. search at the upper end.

IEC/IEEE bus command: CALC:THR –20dBm
                            CALC:THR ON

SEARCH LIMIT OFF
The *SEARCH LIMIT OFF* softkey disables all limits of the search range.

IEC/IEEE bus command: CALC:MARK:X:SLIM OFF
                            CALC:THR OFF

MKR->TRACE   The *MKR->TRACE* softkey sets the active marker to a new trace. If only one trace is available on the screen, the softkey does not appear. If several traces are available on the screen, only these are offered.

IEC/IEEE bus command: `CALC:MARK:TRAC 2`

Example

Three traces are displayed on the screen. The marker is always on Trace 1 after switching on.

[*MKR ->TRACE*] "2" <ENTER>	The marker jumps to Trace 2 but remains at the previous frequency or time.
[*MKR ->TRACE*] "3" <ENTER>	The marker jumps to Trace 3.

MKR->CF STEPSIZE   The *MKR->CF STEPSIZE* softkey sets the step size for the center frequency variation to the current marker frequency, and also sets step size adaptation to *MANUAL*. *CF STEPSIZE* remains at this value until the center frequency entry mode in the *STEP* menu is switched from *MANUAL* to *AUTO* again.

The *MKR->CF STEPSIZE* function is, above all, useful in the measurement of harmonics with large dynamic range (narrow bandwidth and narrow span).

The softkey is not available in the time domain (span = 0 Hz).

IEC/IEEE bus command: `CALC:MARK:FUNC:CST`

Example

The harmonics levels of a CW carrier are to be measured at 100 MHz.

[**PRESET**]	ESU is set to the default setting.
[**CENTER**: 100 **MHz**]	ESU sets the center frequency to 100 MHz. The span is set to 200 MHz.
[**SPAN**: 1 **MHz**]	The span is set to 100 MHz.
[**MKR->**]	MARKER 1 is switched on and set to the maximum value of the signal.
[**NEXT**]	ESU switches to the submenu.
[*MKR->CF STEPSIZE*]	The step size of the center frequency setting equals the marker frequency (100 MHz).
[**CENTER**]	The center frequency entry mode is activated.
[**Right key**]	The center frequency is set to 200 MHz. The first harmonic of the test signal is displayed.
[**MKR->:** *PEAK*]	The marker is set to the harmonic and the level of the latter is output in the marker info field.

MIN   The *MIN* softkey sets the active marker/delta marker to the minimum of the selected trace.

IEC/IEEE bus command: `CALC:MARK:MIN`
                         `CALC:DELT:MIN`

NEXT MIN   The *NEXT MIN* softkey sets the active marker/delta marker to the next higher minimum of the selected trace. The search direction is defined in the *NEXT MODE* submenu (see above).

         IEC/IEEE bus command: `CALC:MARK:MIN:NEXT`
                                      `CALC:DELT:MIN:NEXT`

NEXT MIN RIGHT   The *NEXT MIN RIGHT* softkey sets the active marker/delta marker to the next higher minimum right of the current marker position on the selected trace.

         IEC/IEEE bus command: `CALC:MARK:MIN:RIGH`
                                      `CALC:DELT:MIN:RIGH`

NEXT MIN LEFT   The *NEXT MIN LEFT* softkey sets the active marker/delta marker to the next higher minimum left of the current marker position on the selected trace.

         IEC/IEEE bus command: `CALC:MARK:MIN:LEFT`
                                      `CALC:DELT:MIN:LEFT`

EXCLUDE LO   The *EXCLUDE LO* softkey limits the frequency range for the marker search functions or disables the limit.

         activated   Because of the feed through of the first local oscillator to the first intermediate frequency at the input mixer, the LO is represented as a signal at 0 Hz. To avoid the marker jumping to the LO at 0 Hz with the peak function when setting the display range, this frequency is excluded. The minimum frequency to which the marker jumps, is $\geq 6 \times$ resolution bandwidth (RBW).

         deactivated   No restriction to the search range. The frequency 0 Hz is included in the marker search functions.

         IEC/IEEE bus command: `CALC:MARK:LOEX ON`

PEAK EXCURSION   The *PEAK EXCURSION* softkey enables – for level measurements – the entry of a minimum level value by which a signal must rise or fall so that it will be identified as a maximum or a minimum by the *NEXT PEAK* and *NEXT MIN* search functions.

         Valid entries are from 0 dB to 80 dB; the resolution is 0.1 dB.

         IEC/IEEE bus command: `CALC:MARK:PEXC 10dB`

         The default setting for the peak excursion is 6 dB. This value is sufficient for the *NEXT PEAK* and *NEXT MIN* functions since, in this mode, the next lower maximum or next higher minimum will always be detected.

         If *NEXT PEAK LEFT* or *NEXT PEAK RIGHT* is selected, these functions search for the next relative maximum left or right of the current marker position irrespective of the current signal amplitude. *Relative maximum* is understood to mean a decrease of the signal amplitude by a defined value – i.e. the peak excursion – right and left of the amplitude peak.

         The 6 dB level change set as a default value may be attained already by the inherent noise of the instrument. In such a case, the R&S ESU would identify noise peaks as maxima or minima. The value entered for the *PEAK EXCURSION* should therefore be higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

The following example illustrates the effect of different settings of the *PEAK EXCURSION*.
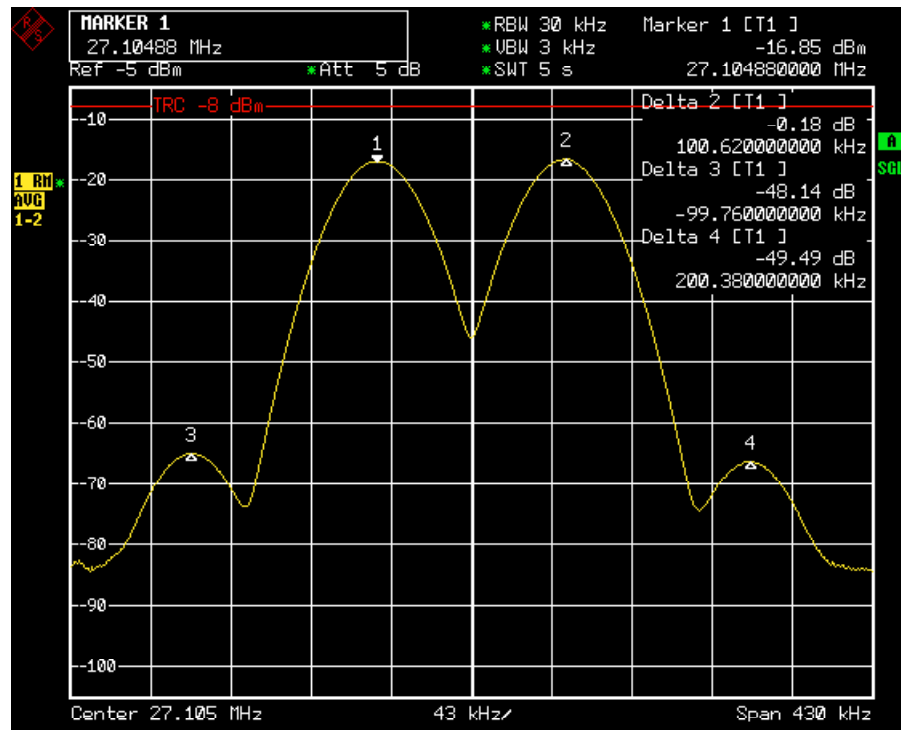
Fig. 4-16   Examples of level measurement with different settings of *PEAK EXCURSION*

The following table lists the signals as indicated by marker numbers in the diagram above, as well as the minimum of the amplitude decrease to both sides of the signal:

signal #	min. amplitude decrease to both sides of the signal
1	30 dB
2	29.85 dB
3	7 dB
4	7 dB

With **40 dB peak excursion**, NEXT PEAK, NEXT PEAK RIGHT and NEXT PEAK LEFT will not find any signal, as the signal level does not decrease by more than 30 dB to either side of any signal.

Order of signals detected:

PEAK: signal 1

NEXT PEAK: signal 1 (no further signal detected)

or

PEAK: signal 1

NEXT PEAK LEFT: signal 1 (no further signal detected)

NEXT PEAK RIGHT: signal 1 (no further signal detected)

With **20 dB peak excursion**, NEXT PEAK and NEXT PEAK RIGHT will also detect signal 2, as the signal level decreases at least by 29.85 dB to either side of this signal, which is now greater than the peak excursion.

Order of signals detected:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 2 (no further signal detected)

or

PEAK:	Signal 1
NEXT PEAK LEFT:	Signal 1 (no further signal detected)
NEXT PEAK RIGHT:	Signal 2
NEXT PEAK RIGHT:	Signal 2 (no further signal detected)

With **6 dB peak excursion**, all signals will be detected with NEXT PEAK and NEXT PEAK RIGHT / NEXT PEAK LEFT.

Order of signals detected:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 3
NEXT PEAK:	Signal 4

or

PEAK:	Signal 1
NEXT PEAK LEFT:	Signal 3
NEXT PEAK RIGHT:	Signal 1
NEXT PEAK RIGHT:	Signal 2
NEXT PEAK RIGHT.	Signal 4

Power Measurements – MEAS

With its power measurement functions the ESU is able to measure all the necessary parameters with high accuracy in a wide dynamic range.

A modulated carrier is almost always used (except e.g. SSB-AM) for high-frequency transmission of information. Due to the information modulated upon the carrier, the latter covers a spectrum which is defined by the modulation, the transmission data rate and the signal filtering. Within a transmission band each carrier is assigned a channel taking into account these parameters. In order to ensure error-free transmission, each transmitter must be conforming to the specified parameters. These include among others:

• the output power,

• the occupied bandwidth, i.e. the bandwidth which must contain a defined percentage of the power and

• the power dissipation allowed in the adjacent channels.

Additionally the menu contains functions to determine the modulation depth of AM modulated signals and to measure the 3rd order intercept point.

The measurements and the corresponding settings are selected in the *MEAS* menu.
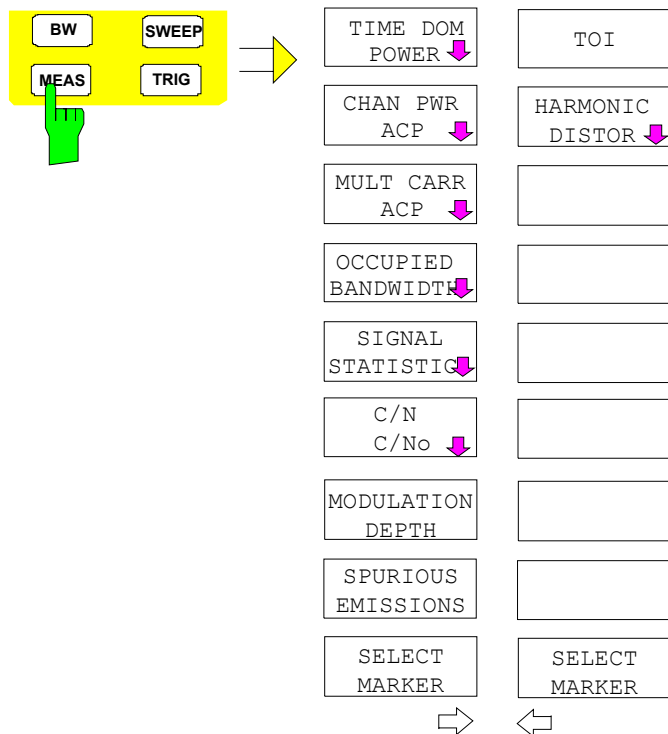
The *MEAS* key opens the menu to select and set the power measurement.

The following measurements can be selected:

• Power in the time domain (*TIME DOM POWER*)

• Channel power and adjacent-channel power in the frequency domain with a single carrier (*CHAN PWR ACP*)

• Channel power and adjacent-channel power in the frequency domain with several carriers (*MULT CARR ACP*)

• Occupied bandwidth (*OCCUPIED BANDWIDTH*)

• Carrier-to-noise ratio (*C/N, C/No*)

• Amplitude probability distribution (*SIGNAL STATISTICS*)

• Modulation depth (*MODULATION DEPTH*)

• SPURIOUS EMISSIONS

• 3rd order intercept (*TOI*)

• Harmonic distortion (*HARMONIC DISTOR)*

The above measurements are carried out alternatively.

Power Measurement in Time Domain

With the aid of the power measurement function, the ESU determines the power of the signal in the time domain (SPAN = 0 Hz) by summing up the power at the individual pixels and dividing the result by the number of pixels. In this way it is possible to measure for example the power of TDMA signals during transmission or during the muting phase. Both the mean power and the rms power can be measured by means of the individual power values.

The result is displayed in the marker info field.

The measured values are updated after each sweep or averaged over a user-defined number of sweeps (*AVERAGE ON/OFF* and *NUMBER OF SWEEPS*) in order to determine e.g. the mean power over several bursts. For determination of the peak value (*MAX HOLD ON*) the maximum value from several sweeps is displayed.

Example

Marker info field for: *MEAN* selected, *AVERAGE ON* and *MAX HOLD ON*:

```
MEAN HOLD      -2.33 dBm
MEAN AV        -2.39 dBm
```

If both the on and off phase of a burst signal are displayed, the measurement range can be limited to the transmission or to the muting phase with the aid of vertical lines. The ratio between signal and noise power of a TDMA signal for instance can be measured by using a measurement as a reference value and after that varying the measurement range.

Upon switching on power measurement the sample detector is activated (*TRACE-DETECTOR-SAMPLE)*.

TIME DOM POWER

TIME DOM POWER ⬇	POWER ON **OFF**	SET REFERENCE
	PEAK	POWER **ABS** REL
	RMS	
	MEAN	MAX HOLD ON **OFF**
	STANDARD DEVIATION	AVERAGE ON **OFF**
	LIMITS ON **OFF**	NUMBER OF SWEEPS
	START LIMIT	
	STOP LIMIT	
	⇨	⇦
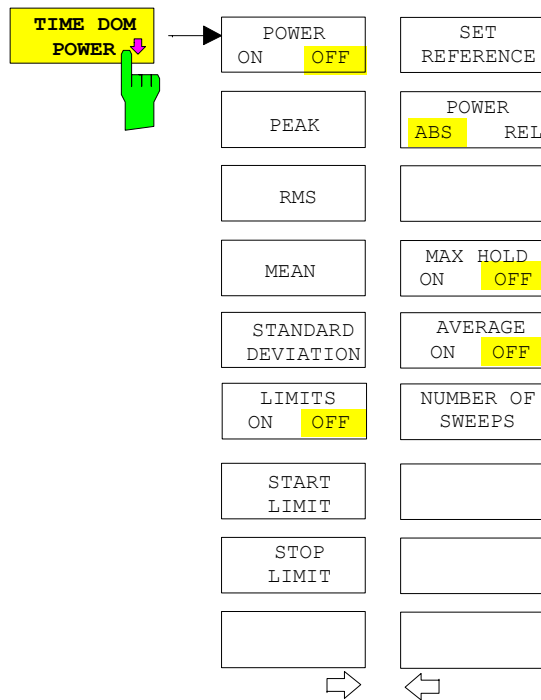
The *TIME DOM POWER* softkey activates the power measurement in the time domain and opens a submenu for configuration of the power measurement.

The submenu allows selection of the type of power measurement (rms or mean power), the settings for max hold and averaging as well as the definition of limits.

The power evaluation range can be limited by input of limit values.

Note

This softkey is only available in time domain (SPAN = 0).

POWER ON/OFF   The *POWER ON/OFF* softkey switches the power measurement on and off. When entering the submenu it is *ON* since the power measurement is already switched on with the *TIME DOM POWER* softkey in the main menu.

Note

The measurement is performed on the trace on which marker 1 is placed. To evaluate another trace, marker 1 should be set on another trace using the *SELECT TRACE* softkey in *MARKER* menu (*MKR*).

IEC/IEEE bus command: `CALC:MARK:FUNC:SUMM:PPE ON`
`CALC:MARK:FUNC:SUMM:PPE:RES?`
`CALC:MARK:FUNC:SUMM:RMS ON`
`CALC:MARK:FUNC:SUMM:RMS:RES?`
`CALC:MARK:FUNC:SUMM:MEAN ON`
`CALC:MARK:FUNC:SUMM:MEAN:RES?`
`CALC:MARK:FUNC:SUMM:SDEV ON`
`CALC:MARK:FUNC:SUMM:SDEV:RES?`

PEAK   The *PEAK* softkey switches on the calculation of the peak value from the points of the displayed trace or a segment thereof.

For the maximum peak, the largest peak value obtained since the activation of *MAX HOLD ON* is displayed.

With *AVERAGE ON*, the peak values of a trace are averaged over several sweeps and displayed.

The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

IEC/IEEE bus command: `CALC:MARK:FUNC:SUMM:PPE ONCALC:MARK:`
`FUNC:SUMM:PPE:RES?`

RMS   The *RMS* softkey switches on the calculation of the rms value from the points of the displayed trace or a segment of it.

For the maximum peak, the largest rms value obtained since the activation of *MAX HOLD ON* is displayed.

With *AVERAGE ON*, the rms values of a trace are averaged over several sweeps and displayed.

The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

IEC/IEEE bus command: `CALC:MARK:FUNC:SUMM:RMS ON`
`CALC:MARK:FUNC:SUMM:RMS:RES?`

MEAN
: The *MEAN* softkey switches on the calculation of the mean value from the points of the displayed trace or a segment of it. The linear mean value of the equivalent voltages is calculated.

    This can be used for instance to measure the mean power during a GSM burst.

    For the maximum peak, the largest mean value obtained since the activation of *MAX HOLD ON* is displayed.

    With *AVERAGE ON*, the mean values of a trace are averaged over several sweeps and displayed.

    The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

    IEC/IEEE bus command: `CALC:MARK:FUNC:SUMM:MEAN ON`
                                         `CALC:MARK:FUNC:SUMM:MEAN:RES?`

STANDARD DEVIATION
: The *STANDARD DEVIATION* softkey switches on the calculation of the standard deviation of trace points from the mean value and outputs them as measured value. The measurement of the mean power is automatically switched on at the same time.

    For the maximum peak, the largest standard deviation obtained since the activation of *MAX HOLD ON* is displayed.

    With *AVERAGE ON*, the standard deviations of a trace are averaged over several sweeps and displayed.

    The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

    IEC/IEEE bus command: `CALC:MARK:FUNC:SUMM:SDEV ON`
                                         `CALC:MARK:FUNC:SUMM:SDEV:RES?`

LIMIT ON/OFF
: The *LIMIT ON/OFF* softkey selects the limited (*ON*) or non-limited (*OFF*) evaluation range.

    The evaluation range is defined by the *START LIMIT* and *STOP LIMIT* softkeys. If *LIMIT = ON*, signals are only searched between the two lines.

    If only one limit line is switched on, time line 1 is the lower limit and the upper limit corresponds to the stop frequency. If time line 2 is also switched on, it defines the upper limit.

    If no limit line is switched on, the evaluation range is not limited.

    The default setting is *LIMIT = OFF*.

    IEC/IEEE bus command: `CALC:MARK:X:SLIM OFF`

START LIMIT
: The *START LIMIT* softkey activates the entry of the lower limit of the evaluation range.

    IEC/IEEE bus command: `CALC:MARK:X:SLIM:LEFT <value>`

STOP LIMIT
: The *STOP LIMIT* softkey activates the entry of the upper limit of the evaluation range.

    IEC/IEEE bus command: `CALC:MARK:X:SLIM:RIGH <value>`

SET REFERENCE   The *SET REFERENCE* softkey sets the power values currently measured as reference values for the calculation of the mean value (*MEAN)* and the rms value (*RMS)*. The reference values are used to perform relative measurements.

If the calculation of the mean value (*MEAN)* and rms value (*RMS)* is not switched on, 0 dBm is used as a reference value.

If the average value (*AVERAGE)* or maximum value (*MAX HOLD*) is calculated over several sweeps, the current value is the measured value summed up at the actual time.

IEC/IEEE bus command: `CALC:MARK:FUNC:SUMM:REF:AUTO ONCE`

POWER ABS/REL   The *POWER ABS/REL* softkey selects the absolute power measurement (default setting) or relative power measurement. The reference value for the relative power is defined by *SET REFERENCE*.

The value 0 dBm is used if the reference value is not defined.

IEC/IEEE bus command: `CALC:MARK:FUNC:SUMM:MODE ABS`

MAX HOLD ON/OFF   The *MAX HOLD ON/OFF* softkey switches the display of the maximum peak obtained from measurements at successive sweeps on and off.

The displayed maximum peak is only updated at the end of a sweep if a higher value has occurred.

The maximum value can be reset by switching the *MAX HOLD ON / OFF* softkey off and on again.

IEC/IEEE bus command:
```
CALC:MARK:FUNC:SUMM:PHOL ON
CALC:MARK:FUNC:SUMM:PPE:PHOL:RES?
CALC:MARK:FUNC:SUMM:RMS:PHOL:RES?
CALC:MARK:FUNC:SUMM:MEAN:PHOL:RES?
CALC:MARK:FUNC:SUMM:SDEV:PHOL:RES?
```

AVERAGE ON/OFF   The *AVERAGE ON/OFF* softkey switches averaging over successive sweep measurements on and off.

The measured values can be reset by switching the *AVERAGE ON / OFF* softkey off and on again.

IEC/IEEE bus command:
```
CALC:MARK:FUNC:SUMM:AVER ON
CALC:MARK:FUNC:SUMM:PPE:AVER:RES?
CALC:MARK:FUNC:SUMM:RMS:AVER:RES?
CALC:MARK:FUNC:SUMM:MEAN:AVER:RES?
CALC:MARK:FUNC:SUMM:SDEV:AVER:RES?
```

NUMBER OF SWEEPS | The *NUMBER OF SWEEPS* softkey activates the entry of the number of sweeps for maximum or average value calculation.

SINGLE SWEEP mode	The ESU performs sweeps until the selected number of sweeps is reached and stops then.
CONTINUOUS SWEEP mode	Averaging is carried out until the selected number of sweeps is reached. After that, averaging is performed in continuous mode and is then continued as running averaging. Calculation of the maximum peak (*MAX HOLD*) is performed continuously irrespective of the selected number of sweeps.

The valid range values is 0 to 32767.

Depending on the specified number of sweeps, averaging is carried out according to the following rules:

NUMBER OF SWEEPS = 0	Continuous averaging is carried out over 10 measured values.
NUMBER OF SWEEPS = 1	No averaging is carried out.
NUMBER OF SWEEPS > 1	Averaging is carried out over the set number of measured values.

Note

This setting is equivalent to the setting of the sweep count in the *TRACE* menu.

IEC/IEEE bus command: `SWE:COUN <value>`

Example

The mean power of a GSM burst with 0 dBm nominal power at 800 MHz is to be measured.

[**PRESET**]	Set the ESU to the default setting.
[**FREQ:** *CENTER*: 800 **MHz**]	Set the center frequency to 800 MHz.
[**SPAN**: *ZERO SPAN*]	Select time domain display (span = 0 Hz).
[**AMPT**: 0 **dBm**]	Set the reference level to 0 dBm.
[**BW**: *RES BW MANUAL*: 30 **kHz**]	Set the resolution bandwidth to 30 kHz in line with the requirements of the GSM standard.
[**SWEEP**: *SWEEPTIME MANUAL* 600 µs]	Set the sweep time to 600 µs.
[**TRIG**: *VIDEO*: 50**%**]	Use the video signal as trigger source.
[**MEAS**]	Call the menu for the measurement functions.

[*TIME DOM POWER*]	Select power measurement in the time domain. The ESU calculates the mean power from the points of the whole trace.
	The submenu for configuration of the power measurement is opened. *MEAN* is already switched on.
[*LIMITS ON*]	Activate the limitation of the time domain of the power measurement.
[*START LIMIT*: 250 **µs**]	Set the start of the power measurement at 250 µs.
[*STOP LIMIT*: 500 **µs**]	Set the end of the power measurement at 500 µs.

Note

The GSM specifications require the power to be measured between 50% and 90% of the TDMA burst. The time limits set above approximately correspond to the required time domain.

Channel and Adjacent-Channel Power Measurements

For all channel and adjacent-channel power measurements a specified channel configuration is assumed which is for instance based on a specific radio communication system.

This configuration is defined by the nominal channel frequency (= center frequency of the ESU if only one carrier is active), the channel bandwidth, the channel spacing, the adjacent-channel bandwidth and the adjacent-channel spacing. The ESU is able to simultaneously measure the power in up to four transmission channels and up to three adjacent channels (10 channels: 4 transmission channels, 3 lower and 3 upper adjacent channels).

It offers two methods for channel and adjacent-channel power measurement:

- The integrated bandwidth method (IBW method), i.e. the integration of trace pixels within the bandwidth of the channel to be measured to the total power of the channel,

- The measurement in time domain (Fast ACP) by means of steep resolution filters simulating the channel.

The two measurements yield the same results. The measurement in time domain can be performed much faster since the complete signal is measured within a channel at the same time. With the IBW method, the channel is divided into subspectra. This is done by means of a bandwidth which is small compared to the channel bandwidth. These subspectra are then combined by integration of the trace pixels.

With the IBW method, the transmission channels or adjacent channels are marked by vertical lines at a distance of half the channel bandwidth to the left and to the right of the corresponding channel center frequency (see Fig. 4-17 Screen display of adjacent-channel power measurement using the IBW method).

With the time-domain method, the power versus time is shown for each channel. The boundaries of the channels are marked by vertical lines (see Fig. 4-18 Screen display of adjacent-channel power measurement using the time-domain method).

For both methods, the results are listed in tables in the lower half of the screen.

The ESU offers predefined standard settings which can be selected from a table for the common mobile radio standards. Thus, channel configuration is performed automatically without the need to enter the corresponding parameters manually.

For some standards, the channel power and the adjacent-channel power are to be weighted by means of a root-raised cosine filter corresponding to a receive filter. This type of filtering is switched on automatically for both methods on selecting the standard (e.g. NADC, TETRA or 3GPP W-CDMA).
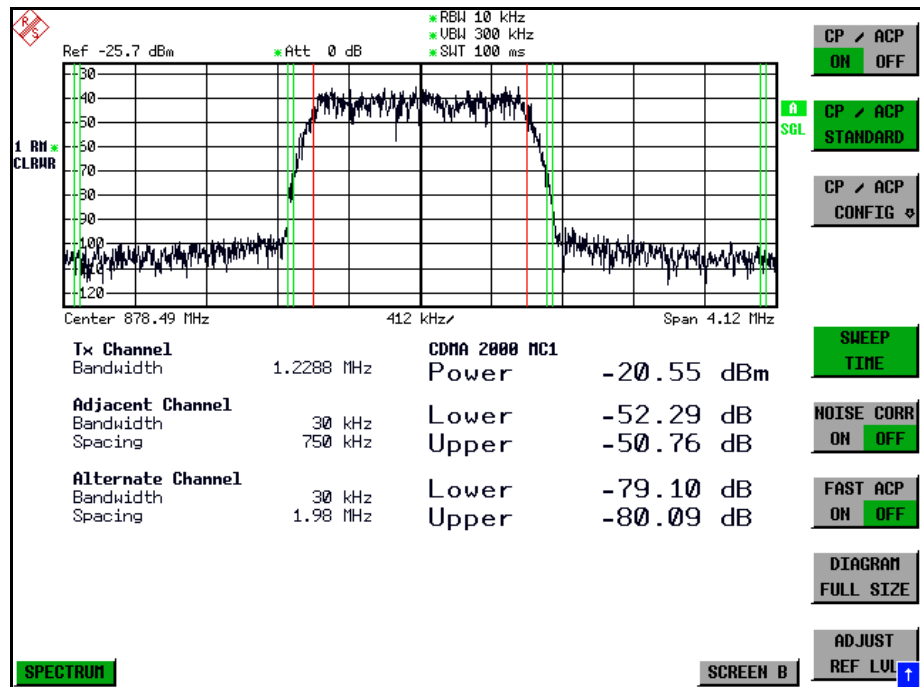
Fig. 4-17   Screen display of adjacent-channel power measurement using the IBW method
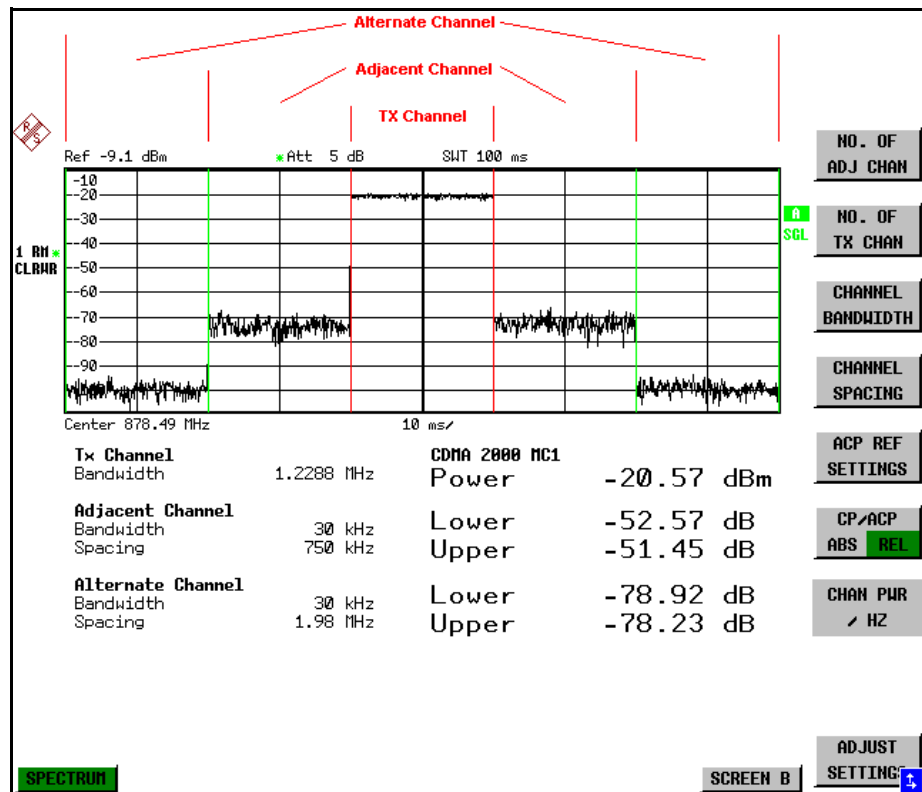
Fig. 4-18   Screen display of adjacent-channel power measurement using the time-domain method

Limit values for the adjacent-channel power can be defined for the measurement. If limit checking is switched on, a pass/fail information indicating that the power has been exceeded is displayed during the measurement in the table in the lower half of the screen.

> **Note**
>
> With the CP/ACP measurement switched on the functions SPLIT SCREEN and FULL SCREEN are inhibited.

The channel configuration is defined in the *MEAS - CHAN PWR ACP* or the *MEAS - MULT CARR ACP* menu.

**CHAN PWR ACP /
MULT CARR ACP**

CP/ACP ON/OFF		
CP/ACP STANDARD		
CP/ACP CONFIG ⇩	NO. OF ADJ CHAN	
	NO. OF TX CHAN	
	CHANNEL BANDWIDTH	
	CHANNEL SPACING	
	ACP REF SETTINGS	
	CP/ACP ABS/REL	
	CHAN PWR / HZ	
	POWER MODE ⇩	CLEAR/WRITE
		MAX HOLD
	ADJUST SETTINGS	
	Side menu	
	ACP LIMIT CHECK	
	EDIT ACP LIMITS	
	SELECT TRACE	
SET CP REFERENCE		
SWEEP TIME		
NOISE CORR ON/OFF		
FAST ACP ON/OFF		
DIAGRAM FULL SIZE		
ADJUST REF LVL		

The *CHAN PWR ACP* and *MULT CARR ACP* softkeys activate channel or adjacent-channel power measurement either for a single carrier signal (*CHAN PWR ACP*) or for several carrier signals (*MULT CARR ACP*), depending on the current measurement configuration. In addition, they open a submenu for defining the parameters for channel power measurement. The softkey selected is shown in color to indicate that a channel or adjacent-channel power measurement is active.

Note

The softkeys are available only for measurements in the frequency domain (span > 0).

CP/ACP ON/OFF   The *CP/ACP ON/OFF* softkey switches calculation of the channel power or adjacent-channel power on and off.

With default settings the measurement is performed by integrating the powers at the display points within the specified channels (IBW method).

The powers of the adjacent channels are measured either as absolute values or as relative values referenced to the power of a transmission channel. The default setting is relative-value measurement (see *CP/ACP ABS/REL* softkey).

When multi carrier ACP measurement is activated, the number of test points is increased to ensure that adjacent-channel powers are measured with adequate accuracy.

IEC/IEEE bus command: `CALC:MARK:FUNC:POW:SEL CPOW|ACP|MCAC`
`CALC:MARK:FUNC:POW:RES?`
`CPOW|ACP|MCAC`
`CALC:MARK:FUNC:POW OFF`

CP/ACP STANDARD   The *CP/ACP STANDARD* softkey opens a table for the selection of the settings according to predefined standards. The test parameters for the channel and adjacent-channel measurements are set according to the mobile radio standard.

ACP STANDARD
√NONE
NADC IS136
TETRA
PDC
PHS
CDPD
CDMA IS95A FWD
CDMA IS95A REV
CDMA IS95C Class 0 FWD
CDMA IS95C Class 0 REV
CDMA J-STD008 FWD
CDMA J-STD008 REV
CDMA IS95C Class 1 FWD
CDMA IS95C Class 1 REV
W-CDMA 4.096 FWD
W-CDMA 4.096 REV
W-CDMA 3GPP FWD
W-CDMA 3GPP REV
CDMA 2000 DS
CDMA 2000 MC1
CDMA 2000 MC3
TD-SCDMA
WLAN 802.11A
WLAN 802.11B

The standards available are listed in the table above.

Note

For the ESU, the channel spacing is defined as the distance between the center frequency of the adjacent channel and the center frequency of the transmission channel. The definition of the adjacent-channel spacing in standards IS95 B and C, IS97 B and C and IS98 B and C is different. These standards define the adjacent-channel spacing from the center of the transmission channel to the closest border of the adjacent channel. This definition is also used for the ESU when the following standard settings are selected:

CDMA IS95 Class 0 FWD

CDMA IS95 Class 0 REV

CDMA IS95 Class 1 FWD

CDMA IS95 Class 1 REV

FAST ACP is not available if a WLAN standard is selected.

The selection of the standard influences the following parameters:

- channel spacing and adjacent-channel spacing
- channel bandwidth, adjacent-channel bandwidth, and type of filtering
- resolution bandwidth
- video bandwidth
- detector
- # of adjacent channels

Trace mathematics and trace averaging are switched off.

The reference level is not influenced by the selection of a standard. To achieve an optimum dynamic range, the reference level has to be set in a way that places the signal maximum close to the reference level without forcing an overload message.

The default setting is CP/*ACP STANDARD NONE*.

IEC/IEEE bus command: `CALC:MARK:FUNC:POW:PRES <standard>`

CP/ACP CONFIG   See following section .

SET CP REFERENCE   With channel power measurement activated, the *SET CP REFERENCE* softkey defines the currently measured channel power as the reference value. The reference value is displayed in the *CH PWR REF* field; the default value is 0 dBm.

In adjacent-channel power measurement with one or several carrier signals, the power is always referenced to a transmission channel, i.e. no value is displayed for *CH PWR REF*.

IEC/IEEE bus command: `POW:ACH:REF:AUTO ONCE`

SWEEP TIME   The *SWEEP TIME* softkey activates the entry of the sweep time. With the RMS detector, a longer sweep time increases the stability of the measurement results.

The function of the softkey is identical to the softkey *SWEEP TIME MANUAL* in the *BW* menu.

IEC/IEEE bus command: `SWE:TIM <value>`

NOISE CORR ON/ OFF   If the *NOISE CORR ON/OFF* softkey is activated, the results will be corrected by the instrument's inherent noise, which increases the dynamic range.

When the function is switched on, a reference measurement of the instrument's inherent noise is carried out. The noise power measured is then subtracted from the power in the channel that is being examined.

The inherent noise of the instrument depends on the selected center frequency, resolution bandwidth and level setting. Therefore, the correction function is disabled whenever one of these parameters is changed. A disable message is displayed on the screen.

To enable the correction function in conjunction with the changed setting, press the softkey once more. A new reference measurement is carried out.

IEC/IEEE bus command: `SENS:POW:NCOR ON`

FAST ACP ON/OFF   The *FAST ACP ON/OFF softkey* switches between the IBW method (*FAST ACP OFF*) and the time domain method (*FAST ACP ON*).

With *FAST ACP ON* the power measurement is performed in the different channels in the time domain. The ESU sets the center frequency consecutively to the different channel center frequencies and measures the power with the selected measurement time (= sweep time/number of channels). The RBW filters suitable for the selected standard and frequency offset are automatically used (e.g. root raised cos with IS 136). The list of available channel filters is included in section "Setting the Bandwidths and Sweep Time – BW" on page 4.123.

The RMS detector is used for obtaining correct power measurement results. Therefore this requires no software correction factors.

Measured values are output as a list. The powers of the transmission channels are output in dBm, the powers of the adjacent channels in dBm *(CP/ACP ABS)* or dB *(CP/ACP REL)*.

The sweep time is selected depending on the desired reproducibility of results. Reproducibility increases with sweep time since power measurement is then performed over a longer time period.

As a general approach, it can be assumed that approx. 500 non-correlated measured values are required for a reproducibility of 0.5 dB (99% of the measurements are within 0.5 dB of the true measured value). This holds true for white noise. The measured values are considered as non-correlated when their time interval corresponds to the reciprocal of the measured bandwidth.

With IS 136 the measurement bandwidth is approx. 25 kHz, i.e. measured values at an interval of 40 µs are considered as non correlated. A measurement time of 20 ms is thus required per channel for 1000 measured values. This is the default sweep time which the ESU sets in coupled mode. Approx. 5000 measured values are required for a reproducibility of 0.1 dB (99%), i.e. the measurement time is to be increased to 200 ms.

IEC/IEEE bus command: `SENS:POW:HSP ON`

DIAGRAM FULL SIZE   The *DIAGRAM FULL SIZE* softkey switches the diagram to full screen size.

IEC/IEEE bus command: `DISP:WIND1:SIZE LARG|SMAL`

ADJUST REF LVL   The *ADJUST REF LVL* softkey adjusts the reference level of the ESU to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the ESU or limiting the dynamic range by a too small S/N ratio.

Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is still significantly below the reference level.

IEC/IEEE bus command: `SENS:POW:ACH:PRES:RLEV`

For manual setting of the test parameters different from the settings made with *ADJUST SETTINGS* the following should be observed:

Frequency span

The frequency span must at least cover the channels to be measured plus a measurement margin of 10%.

For channel power measurement, the span is 1.1 × channel bandwidth.

> **Note**
>
> If the frequency span is large in comparison with the channel bandwidth (or the adjacent-channel bandwidths) being examined, only a few points on the trace are available per channel. This reduces the accuracy of the waveform calculation for the channel filter used, which has a negative effect on the measurement accuracy.
>
> We therefore strongly recommend that the formulas mentioned be taken into consideration when selecting the frequency span.

Resolution bandwidth (RBW)

To ensure both an acceptable measurement speed and the required selection (to suppress spectral components outside the channel to be measured, especially of the adjacent channels), the resolution bandwidth must not be selected too small or too large. As a general approach, the resolution bandwidth is to be set to values between 1% and 4% of the channel bandwidth.

A larger resolution bandwidth can be selected if the spectrum within the channel to be measured and around it has a flat characteristic. In the standard setting, e.g. for standard IS95A REV at an adjacent channel bandwidth of 30 kHz, a resolution bandwidth of 30 kHz is used. This yields correct results since the spectrum in the neighborhood of the adjacent channels normally has a constant level. For standard NADC/IS136 this is not possible for example, since the spectrum of the transmit signal penetrates into the adjacent channels and a too large resolution bandwidth causes a too low selection of the channel filter. The adjacent-channel power would thus be measured too high.

With the exception of the IS95 CDMA standards, the *ADJUST SETTINGS* softkey sets the resolution bandwidth (RBW) as a function of the channel bandwidth:

RBW $\leq$ 1/40 of channel bandwidth.

The maximum possible resolution bandwidth (with respect to the requirement RBW $\leq$ 1/40) resulting from the available RBW steps (1, 3) is selected.

Video bandwidth (VBW)

For a correct power measurement, the video signal must not be limited in bandwidth. A restricted bandwidth of the logarithmic video signal would cause signal averaging and thus result in a too low indication of the power (-2.51 dB at very low video bandwidths). The video bandwidth should therefore be selected at least three times the resolution bandwidth.

The *ADJUST SETTINGS* softkey sets the video bandwidth (VBW) as a function of the channel bandwidth as follows:

VBW $\geq$ 3 × RBW.

The smallest possible VBW with regard to the available step size will be selected.

Detector

The *ADJUST SETTINGS* softkey selects the RMS detector.

The RMS detector is selected since it correctly indicates the power irrespective of the characteristics of the signal to be measured. In principle, the sample detector would be possible as well. Due to the limited number of trace pixels used to calculate the power in the channel, the sample detector would yield less stable results. Averaging, which is often performed to stabilize the measurement results, leads to a too low level indication and should therefore be avoided. The reduction in the displayed power depends on the number of averages and the signal characteristics in the channel to be measured.

Setting the Channel Configuration

CP/ACP CONFIG

```
CP/ACP          NO. OF        ACP LIMIT
CONFIG          ADJ CHAN       CHECK

                NO. OF          EDIT
                TX CHAN       ACP LIMIT

               CHANNEL
               BANDWIDTH

               CHANNEL
               SPACING

               ACP REF
               SETTINGS

               CP/ACP
               ABS   REL

               CHAN PWR
                / HZ

                POWER
                MODE  ⇩

                ADJUST
               SETTINGS
               ⇧ ⇨        ⇦ ⇧
```
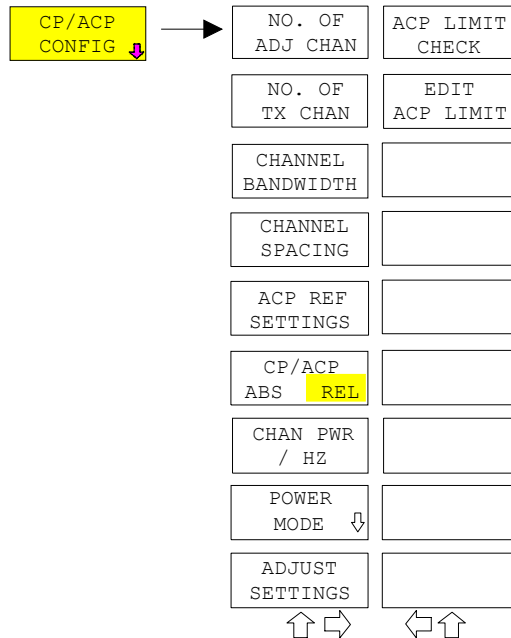
The *CP/ACP CONFIG* softkey opens a submenu for configuration of the channel power and adjacent channel power measurement independently of the offered standards.

The channel configuration includes the number of channels to be measured, the channel bandwidths (*CHANNEL BANDWIDTH*), and the channel spacings (*CHANNEL SPACING*).

Limit values can additionally be specified for the adjacent-channel power (*ACP LIMIT CHECK* and *EDIT ACP LIMITS*) which are checked for compliance during the measurement.

NO. OF ADJ CHAN
The *NO. OF ADJ CHAN* softkey activates the entry of the number ±n of adjacent channels to be considered in the adjacent-channel power measurement.

Numbers from 0 to 12 can be entered.

The following measurements are performed depending on the number of the channels.

0   Only the channel powers are measured.

1   The channel powers and the power of the upper and lower adjacent channel are measured.

2   The channel powers, the power of the upper and lower adjacent channel and of the next higher and lower channel (alternate channel 1) are measured.

3   The channel power, the power of the upper and lower adjacent channel, the power of the next higher and lower channel (alternate channel 1) and of the next but one higher and lower adjacent channel (alternate channel 2) are measured.

With higher numbers the procedure is expanded accordingly.

IEC/IEEE bus command:　　`POW:ACH:ACP 1`

This increased number of adjacent channels is realized all for the relevant settings like:

ACLR LIMIT CHECK	`:CALC:LIM:ACP:ACH:RES?`
	`:CALC:LIM:ACP:ALT1..11:RES?`
EDIT ACLR LIMITS	`:CALC:LIM:ACP:ACH:STAT ON`
	`:CALC:LIM:ACP:ACH:ABS –10dBm,–10dBm`
	`:CALC:LIM:ACP:ACH:ABS:STAT ON`
	`:CALC:LIM:ACP:ALT1..11 0dB,0dB`
	`:CALC:LIM:ACP:ALT1..11:STAT ON`
	`:CALC:LIM:ACP:ALT1..11:ABS –10dBm,–10dBm`
	`:CALC:LIM:ACP:ALT1..11:ABS:STAT ON`
ADJ CHAN BANDWIDTH	`:SENS:POW:ACH:BWID:ALT1..11 30kHz`
ADJ CHAN SPACING	`:SENS:POW:ACH:SPAC:ALT1..11 4MHz`

NO. OF TX CHAN　　The *NO. OF TX CHAN* softkey enables the entry of the number of carrier signals to be considered in channel and adjacent-channel power measurements.

Numbers from 1 to 12 can be entered.

The softkey is available only for multi carrier ACP measurements.

IEC/IEEE bus command:　　`SENS:POW:ACH:TXCH:COUN 12`

CHANNEL BANDWIDTH　　The *CHANNEL BANDWIDTH* softkey opens a table for defining the channel bandwidths for the transmission channels and the adjacent channels.

ACP CHANNEL BW	
CHAN	BANDWIDTH
ADJ	14 kHz
ALT1	14 kHz
ALT2	14 kHz

The transmission-channel bandwidth is normally defined by the transmission standard. The correct bandwidth is set automatically for the selected standard (see *CP/ACP STANDARD* softkey).

With the IBW method (*FAST ACP OFF),* the channel bandwidth limits are marked by two vertical lines right and left of the channel center frequency. It can in this way be visually checked whether the entire power of the signal under test is within the selected channel bandwidth.

Measurements in the time domain (*FAST ACP ON)* are performed in the zero span mode. The channel limits are indicated by vertical lines. For measurements requiring channel bandwidths deviating from those defined in the selected standard the IBW method is to be used.

Refer to section for a list of available channel filters.

When measuring according to the IBW method (FAST ACP OFF) the bandwidths of the different adjacent channels are to be entered numerically. Since all adjacent channels often have the same bandwidth, the other channels Alt1 and Alt2 are set to the bandwidth of the adjacent channel on entering the adjacent-channel bandwidth (ADJ). Thus only one value needs to be entered in case of equal adjacent channel bandwidths. The same holds true for the ALT2 channels (alternate channels 2) when the bandwidth of the ALT1 channel (alternate channel 1) is entered.

Note

The channel spacings can be set separately by overwriting the table from top to bottom.

IEC/IEEE bus command:
```
SENS:POW:ACH:BWID:CHAN 14kHz
SENS:POW:ACH:BWID:ACH 1kHz
SENS:POW:ACH:BWID:ALT1 14kHz
SENS:POW:ACH:BWID:ALT2 14kHz
```

CHANNEL SPACING   The *CHANNEL SPACING* softkey opens a table for defining the channel spacings for the TX channels as well as for the adjacent channels.

Note

The entry "TX" is only available for the multi carrier ACP measurement.

TX channels

The spacing between every TX channels can be defined separately. Therefore a TX spacing 1-2 for the spacing between the first and the second carrier, a TX spacing 2-3 for the spacing between the second and the third carrier and so on can be defined. In order to allow a convenient setup for the system with equal TX channel spacing, the value of TX spacing 1-2 will be copied in all the spacing below after entry, the TX spacing 2-3 will be copied in all the spacing below after entry and so forth.

Note

For different spacings a setup from top to bottom is necessary

If the spacings are not equal the channel distribution according to the center frequency is as follows:

• Odd number of TX channels:

The middle TX channel is centered to center frequency.

• Even number of TX channels:

The two TX channels in the middle are used to calculate the frequency between those two channels. This frequency is aligned to the center frequency.

TX/ACP CHANNEL SPACING	
CHAN	SPACING
TX1–2	20 kHz
TX2–3	20 kHz
TX3–4	20 kHz
TX4–5	20 kHz
TX5–6	20 kHz
TX6–7	20 kHz
TX7–8	20 kHz
TX8–9	20 kHz
TX9–10	20 kHz
TX10–11	20 kHz
TX11–12	20 kHz
ADJ	20 kHz
ALT1	40 kHz
ALT2	60 kHz
ALT3	80 kHz
ALT4	100 kHz
ALT5	120 kHz
ALT6	140 kHz
ALT7	160 kHz
ALT8	180 kHz
ALT9	200 kHz
ALT10	220 kHz
ALT11	240 kHz

Adjacent channels

Since all the adjacent channels often have the same distance to each other, the entry of the adjacent-channel spacing (ADJ) causes channel spacing ALT1 to be set to twice and channel spacing ALT2 to three times the adjacent-channel spacing (and so on). Thus only one value needs to be entered in case of equal channel spacing. The same holds true for the ALT2 channels when the bandwidth of the ALT1 channel is entered.

Note

The channel spacings can be set separately by overwriting the table from top to bottom

IEC/IEEE bus command: `:SENS:POW:ACH:SPAC:CHAN 20kHz`
                             `:SENS:POW:ACH:SPAC:ACH 20kHz`
                             `:SENS:POW:ACH:SPAC:ALT1 40kHz`
                             `:SENS:POW:ACH:SPAC:ALT2 60kHz`

> **Note**
>
> If the ACP or MCACP measurement is started all settings according to the standard including the channel bandwidths and channel spacings are set and can be adjusted afterwards.

ACP REF SETTINGS   The *ACP REF SETTINGS* softkey opens a table for selecting the transmission channel to which the adjacent-channel relative power values should be referenced.

```
ACP REFERENCE CHANNEL
√ TX CHANNEL 1
  TX CHANNEL 2
  TX CHANNEL 3
  TX CHANNEL 4
  MIN POWER TX CHANNEL
  MAX POWER TX CHANNEL
  LOWEST & HIGHEST CHANNEL
```

TX CHANNEL 1 - 4	Selection of one of channels 1 to 4.
MIN POWER TX CHANNEL	The transmission channel with the lowest power is used as a reference channel.
MAX POWER TX CHANNEL	The transmission channel with the highest power is used as a reference channel.
LOWEST & HIGHEST CHANNEL	The outer left hand transmission channel is the reference channel for the lower adjacent channels, the outer right hand transmission channel that for the upper adjacent channels.

> **Note**
>
> The softkey is only available for the multi carrier ACP measurement.

IEC/IEEE bus command: SENS:POW:ACH:REF:TXCH:MAN 1
                         SENS:POW:ACH:REF:TXCH:AUTO MIN

CP/ACP ABS/REL   The *CP/ACP ABS/REL* softkey (channel power absolute/relative) switches between absolute and relative power measurement in the channel.

CP/ACP ABS   The absolute power in the transmission channel and in the adjacent channels is displayed in the unit of the Y axis, e.g. in dBm, dBmV.

CP/ACP REL   For adjacent-channel power measurements (*NO. OF ADJ CHAN* > 0), the level of the adjacent channels is displayed relative to the level of the transmission channel in dBc.

For channel power measurements (*NO. OF ADJ CHAN* = 0) with a single carrier, the power of the transmission channel is displayed relative to the power of a reference channel defined by *SET CP REFERENCE*. This means:

1. Declare the power of the currently measured channel as the reference value, using the *SET CP REFERENCE* softkey.

2. Select the channel of interest by varying the channel frequency (ESU center frequency).

With linear scaling of the Y axis, the power of the new channel relative to the reference channel (CP/CP$_{ref}$) is displayed. With dB scaling, the logarithmic ratio 10lg (CP/CP$_{ref}$) is displayed.

The relative channel power measurement can thus also be used for universal adjacent-channel power measurements. Each channel can be measured individually.

IEC/IEEE bus command: `SENS:POW:ACH:MODE ABS`

CHAN PWR / HZ   The *CHAN PWR / HZ* softkey toggles between the measurement of the total channel power and the measurement of the channel power referenced to a 1-Hz bandwidth.

The conversion factor is $10 \cdot \lg \dfrac{1}{\text{Channel} \cdot \text{Bandwidth}}$

By means of this function it is possible e.g. to measure the signal/noise power density or use the additional functions *CP/ACP REL* and *SET CP REFERENCE* to obtain the signal to noise ratio.

IEC/IEEE bus command: `CALC:MARK:FUNC:POW:RES:PHZ ON|OFF`

POWER MODE
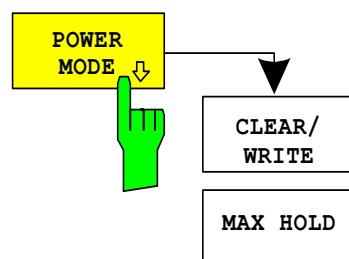
The *POWER MODE* softkey opens the submenu for selecting the power mode.

CLEAR/WRITE   In the *CLEAR/WRITE* mode the channel power and the adjacent channel powers are calculated directly from the current trace (default mode).

MAX HOLD   In *MAX HOLD* mode the power values are still derived from the current trace, but they are compared with the previous power value using a maximum algorithm. The higher value is remained.

IEC/IEEE bus command: `:CALC:MARK:FUNC:POW:MODE WRIT|MAXH`

ADJUST SETTINGS   The *ADJUST SETTINGS* softkey automatically optimizes the instrument settings for the selected power measurement (see below).

All instrument settings relevant for a power measurement within a specific frequency range (channel bandwidth) are optimized for the selected channel configuration (channel bandwidth, channel spacing):

- Frequency span:

  The frequency span should cover at least all channels to be considered in a measurement.

  For channel power measurements, the frequency span is set as follows:

  (No. of transmission channels - 1) × transmission channel spacing + 2 × transmission channel bandwidth + measurement margin

  For adjacent-channel power measurements, the frequency span is set as a function of the number of transmission channels, the transmission channel spacing, the adjacent-channel spacing, and the bandwidth of one of adjacent-channels ADJ, ALT1 or ALT2, whichever is furthest away from the transmission channels:

  (No. of transmission channels - 1) × transmission channel spacing + 2 × (adjacent-channel spacing + adjacent-channel bandwidth) + measurement margin

  The measurement margin is approx. 10% of the value obtained by adding the channel spacing and the channel bandwidth.

- Resolution bandwidth: RBW $\leq$ 1/40 of channel bandwidth

- Video bandwidth: VBW $\geq$ 3 × RBW

- Detector: RMS detector

Trace math and trace averaging functions are switched off.

The reference level is not influenced by *ADJUST SETTINGS*. It can be separately adjusted with *ADJUST REF LVL.*

The adjustment is carried out only once; if necessary, the instrument settings can be changed later.

IEC/IEEE bus command: `SENS:POW:ACH:PRES ACP|CPOW|MCAC|OBW`

ACP LIMIT CHECK   The *ACP LIMIT CHECK* softkey switches the limit check for the ACP measurement on and off.

IEC/IEEE bus command: `CALC:LIM:ACP ON`
`CALC:LIM:ACP:ACH:RES?`
`CALC:LIM:ACP:ALT:RES?`

EDIT ACP LIMITS   The *EDIT ACP LIMITS* softkey opens a table for defining the limits for the ACP measurement.

ACP LIMITS				
CHAN	RELATIVE LIMIT CHECK		ABSOLUTE LIMIT CHECK	
	VALUE	ON	VALUE	ON
ADJ	-45 dB	√		
ALT1	-60 dB	√		
ALT2				

The following rules apply for the limits:

• A separate limit can be defined for each adjacent channel. The limit applies to both the upper and the lower adjacent channel.

• A relative and/or absolute limit can be defined. The check of both limit values can be activated independently.

• The ESU checks adherence to the limits irrespective of whether the limits are absolute or relative or whether the measurement is carried out with absolute or relative levels. If both limits are active and if the higher of both limit values is exceeded, the measured value is marked accordingly.

Note

Measured values exceeding the limit are marked by a preceding asterisk.

IEC/IEEE bus command: CALC:LIM:ACP ON
                          CALC:LIM:ACP:ACH 0dB,0dB
                          CALC:LIM:ACP:ACH:STAT ON
                          CALC:LIM:ACP:ACH:ABS −10dBm,−10dBm
                          CALC:LIM:ACP:ACH:ABS:STAT ON
                          CALC:LIM:ACP:ALT1 0dB,0dB
                          CALC:LIM:ACP:ALT1:STAT ON
                          CALC:LIM:ACP:ALT1:ABS −10dBm,−10dBm
                          CALC:LIM:ACP:ALT1:ABS:STAT ON
                          CALC:LIM:ACP:ALT2 0dB,0dB
                          CALC:LIM:ACP:ALT2:STAT ON
                          CALC:LIM:ACP:ALT2:ABS −10dBm,−10dBm
                          CALC:LIM:ACP:ALT2:ABS:STAT ON

SELECT TRACE   The *SELECT TRACE* softkey selects the trace on which the CP/ACP measurement is to be performed. Only activated traces can be selected, i.e. traces not set to BLANK.

IEC/IEEE bus command: SENS:POW:TRAC 1

Examples

1. Measurement of adjacent-channel power for a specific standard:

The adjacent-channel power is to be measured for a signal at 800 MHz with 0 dBm level in line with IS136.

[**PRESET**]	Set the ESU to the default setting.
[**FREQ**: *CENTER*: 800 **MHz**]	Set the center frequency to 800 MHz.
[**AMPT**: 0 **dBm**]	Set the reference level to 0 dBm.
[**MEAS**]	Call the menu for the measurement functions.
[*CHAN PWR / ACP*]	Select the channel and adjacent-channel power measurement function. The measurement is performed with the default settings or a previously defined setting. The submenu for setting the desired new configuration is opened.
[*CP/ACP STANDARD*: select IS136: **ENTER**]	Select the NADC (IS136) standard.
[*CP/ACP CONFIG*]	Call the submenu for configuration of the adjacent-channel power measurement.
[*NO. OF ADJ CHAN*: 2 **ENTER**]	Select two adjacent channels for the measurement, i.e. the adjacent channel and the alternate channel are measured.
[*ADJUST SETTINGS*]	Set the optimum span, resolution bandwidth (RBW), video bandwidth (VBW) and detector automatically for the measurement. The absolute channel power and the relative power of the adjacent channels are displayed on the screen.
PREV	Change to the main menu for channel power measurement.
[*ADJUST REF LVL*]	Set the reference level equal to the channel power measured.

2. Measurement with user-specific channel configuration:

Measurement of the adjacent-channel power ratio (ACPR) of an IS95 CDMA signal at 800 MHz, level 0 dBm. Similar to example 1, the setting can be simplified by using *CP/ACP STANDARD*.

[**PRESET**]	Set the ESU to the default setting.
[**FREQ:** *CENTER*: 800 **MHz**]	Set the center frequency to 800 MHz.
[**AMPT**: 0 **dBm**]	Set the reference level to 0 dBm.
[**MEAS**]	Call the menu for the measurement functions.
[*CHAN PWR / ACP*]	Select the channel and adjacent-channel power measurement function. The measurement is carried out with the default settings or a previously defined setting. The submenu for setting the desired new configuration is opened.
[*CP/ACP CONFIG*]	Call the submenu for defining the channel configuration.

| [*NO. OF ADJ CHAN*: 2 **ENTER**] | Select two adjacent channels for the measurement, i.e. the adjacent channel and the alternate channel are measured. |

| [*CHANNEL BANDWIDTH*: 1.23 **MHz**: ⊙: 30 **kHz**] | Set the channel bandwidth to 1.23 MHz in accordance with IS 95. Set the adjacent-channel bandwidth to 30 kHz. |

```
TX/ACP CHANNEL BW
CHAN    BANDWIDTH
TX      1.23 MHz
ADJ       30 kHz
ALT1      30 kHz
ALT2      30 kHz
```

Upon entry of 30 kHz for the adjacent channel the alternate channels are also set to 30 kHz.

| [*CHAN SPACING*: 1.25 **MHz**:⊙ 885 **kHz:** ⊙: -1.98 **MHz**] ⊙: 2.97 **MHz**] | Open the list for entering the channel spacings. |

```
TX/ACP CHAN SPACING
CHAN     SPACING
TX       1.25 MHz
ADJ       885 kHz
ALT1     1.98 MHz
ALT2     2.97 MHz
```

Upon entry of 885 kHz for the adjacent channel the channels ALT1 and ALT2 are set to 1770 kHz and 2655 kHz. Upon entry of 1.98 MHz for the alternate channel 1 the alternate channel 2 is set to 2.97 MHz.

| [*ADJUST SETTINGS*] | Automatically set the optimum span (= 5 MHz), resolution bandwidth (RBW = 30 kHz), video bandwidth (VBW = 300 kHz) and detector (RMS) for the measurement. The absolute channel power and the relative power of the adjacent channels and alternate channels are displayed on the screen. |

| PREV | Go to the main menu for channel power measurement. |

| [*ADJUST REF LVL*] | Set the reference level equal to the channel power measured. |

3. Measurement of signal/noise power density (C/No) of an IS95 CDMA signal (frequency 800 MHz, level 0 dBm)

[**PRESET**]	Set the ESU to the default setting.
[**FREQ:** *CENTER*: 800 **MHz**]	Set the center frequency to 800 MHz.
[**AMPT**: 0 **dBm**]	Set the reference level to 0 dBm.
MEAS]	Call the menu for the measurement functions.
[*CHAN PWR / ACP*]	Select the channel and adjacent-channel power measurement. The measurement is performed with the default setting or a previously defined setting. The submenu for setting the desired new configuration is opened.
[*CP/ACP CONFIG*]	Call the submenu for defining the channel configuration.
[*NO. OF ADJ CHAN*: 0 **ENTER**]	Do not select an adjacent channel for the measurement, i.e. the measurement is carried out in one channel only.
[*CHANNEL BANDWIDTH*: 1.23 **MHz**]	Set the channel bandwidth to 1.23 MHz in line with IS95.
[*ADJUST SETTINGS*]	Set the optimum span (= 5 MHz), resolution bandwidth (RBW = 30 kHz), video bandwidth (VBW = 300 kHz) and detector (RMS) for the measurement automatically. The absolute channel power and the relative power of the adjacent channels and alternate channels are displayed on the screen.
[PREV]	Go to the main menu for channel power measurement
[*ADJUST REF LVL*]	Set the reference level equal to the channel power measured.
[*SET CP REFERENCE*]	Set the measured channel power as a reference for the subsequent measurements.
[*CP/ACP ABS / REL*]	Select relative measurement related to the reference power set with *SET REFERENCE* (result 0 dB).
[*CHAN PWR / HZ*]	Select power measurement related to 1 Hz bandwidth (result -60.9 dB).
[**FREQ:** *CENTER*: 805 **MHz**]	Set the center frequency to 805 MHz. The ESU measures the channel power at 1.23 MHz bandwidth and outputs the result in dB relative to the reference power and 1 Hz bandwidth.

Measurement of Occupied Bandwidth

An important characteristics of a modulated signal is its occupied bandwidth. In a radio communications system for instance the occupied bandwidth must be limited to enable distortion-free transmission in adjacent channels. The occupied bandwidth is defined as the bandwidth containing a defined percentage of the total transmitted power. A percentage between 10% and 99.9% can be set on the ESU.

OCCUPIED BANDWIDTH

OCCUPIED BANDWIDTH →

OCCUP BW ON **OFF**
% POWER BANDWIDTH
CHANNEL BANDWIDTH
ADJUST SETTINGS
ADJUST REF LVL
⇧
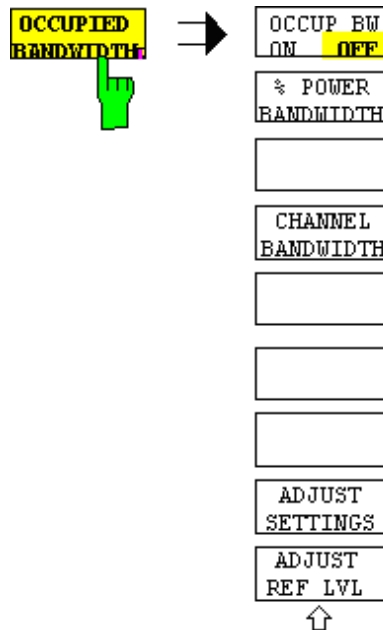
The *OCCUPIED BANDWIDTH* softkey activates measurement of the occupied bandwidth according to the current configuration and opens the submenu for configuring the measurement. The softkey is available only in frequency domain (span > 0) and is highlighted when the measurement is switched on.

In the spectrum display mode, this measurement determines the bandwidth that contains a predefined percentage of the power of the displayed frequency range (*% POWER BANDWIDTH* softkey). The occupied bandwidth is output in the marker display field and marked on the trace by temporary markers.

Note

- The softkey is only available in the frequency domain (span > 0).

- The measurement is performed on the trace with marker 1. In order to evaluate another trace, marker 1 must be placed on another trace by means of *SELECT TRACE* in the *MARKER* menu

OCCUP BW ON/OFF

The *OCCUP BW ON/OFF* softkey switches measurement of the occupied bandwidth on or off.

IEC/IEEE bus command:
```
CALC:MARK:FUNC:POW:SEL OBW
CALC:MARK:FUNC:POW:RES? OBW
CALC:MARK:FUNC:POW OFF
```

% POWER BANDWIDTH

The *% POWER BANDWIDTH* softkey opens the entry of the percentage of power related to the total power in the displayed frequency range which defines the occupied bandwidth (percentage of total power).

The valid range of values is 10% to 99.9%.

IEC/IEEE bus command: `SENS:POW:BWID 99PCT`

CHANNEL BANDWIDTH

The *CHANNEL BANDWIDTH* softkey opens an input window for defining the channel bandwidth for the transmission channel. For measurements in line with a specific transmission standard, the bandwidth specified by the standard for the transmission channel must be entered.

The default setting is 14 kHz.

The specified channel bandwidth is used for optimization of the test parameters of the ESU with *ADJUST SETTINGS*.

IEC/IEEE bus command: `SENS:POW:ACH:BWID 14kHz`

ADJUST REF LVL

The *ADJUST REF LVL* softkey adjusts the reference level of the ESU to the measured total power of the signal. The softkey is activated after the first sweep with the measurement of the occupied bandwidth has been completed and the total power of the signal is thus known.

Adjusting the reference level ensures that the signal path of the ESU will not be overloaded and the dynamic range not limited by too low a reference level.

Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is distinctly below the reference level. If the measured channel power is equal to the reference level, the signal path cannot be overloaded.

IEC/IEEE bus command: `SENS:POW:ACH:PRES:RLEV`

ADJUST SETTINGS

The *ADJUST SETTINGS* softkey optimizes the instrument settings for the measurement of the occupied bandwidth according to the specified channel bandwidth.

All instrument settings relevant for power measurement within a specific frequency range are optimized:

- frequency span: 3 × channel bandwidth
- resolution bandwidth: RBW $\leq$ 1/40 of channel bandwidth
- video bandwidth: VBW $\geq$ 3 × RBW
- detector: RMS

The reference level is not influenced by *ADJUST SETTINGS*. For an optimum dynamic range it should be selected in a way that the signal maximum is close to the reference level.

The adjustment is carried out only once; if necessary, the instrument settings may be changed later.

IEC/IEEE bus command: `SENS:POW:PRES OBW`

Measurement principle

For example, the bandwidth containing 99% of the signal power is to be determined. The routine first calculates the total power of all displayed points of the trace. In the next step, the points from the right edge of the trace are summed up until 0.5% of the total power is reached. Auxiliary marker 1 is positioned at the corresponding frequency. Then the ESU sums up the points from the left edge of the trace until 0.5% of the power is reached. Auxiliary marker 2 is positioned at this point. 99% of the power is now between the two markers. The distance between the two frequency markers is the occupied bandwidth which is displayed in the marker info field.

A prerequisite for correct measurement is that only the signal to be measured is visible on the screen of the ESU. An additional signal would invalidate the measurement.

To ensure correct power measurement especially for noise signals and to obtain the correct occupied bandwidth, the following settings should be selected:

RBW   << occupied bandwidth (approx. 1/20 of occupied bandwidth, for voice communication type. 300 Hz or 1 kHz)

VBW $\geq 3 \times$ RBW

Detector   RMS or sample

Span ≥ 2 to $3 \times$ occupied bandwidth

Some of the measurement specifications (e.g. PDC, RCR STD-27B) require measurement of the occupied bandwidth using a peak detector. The detector setting of the ESU has to be changed accordingly then.

Example

Measurement of occupied bandwidth of a PDC signal at 800 MHz, level 0 dBm

[**PRESET**]	Set the ESU to the default setting.
[**FREQ**: *CENTER*: 800 MHz]	Set the center frequency to 800 MHz.
[**AMPT**: 0 dBm]	Set the reference level to 0 dBm.
[**MEAS**]	Call the menu for the measurement functions.
[*OCCUPIED BANDWIDTH*]	Select measurement of the occupied bandwidth and open the submenu for configuring the measurement.
[% POWER BANDWIDTH: 99**%**]	Select 99% for the bandwidth to be measured.
[*CHANNEL BANDWIDTH*: 21 **kHz**]	Enter the channel bandwidth of 21 kHz specified by PDC.

[*ADJUST SETTINGS*]   Optimize the measurement parameters for the specified channel bandwidth.

Allow for a complete frequency sweep so that the ESU can determine the total signal power.

[*ADJUST REF LVL*]   Adjust the reference level to the measured signal power.

[**TRACE**: *DETECTOR*:   PDC requires measurement of the occupied bandwidth using a

DETECTOR MAX PEAK] peak detector. Therefore, switch on the peak detector instead of the RMS detector selected by *ADJUST SETTINGS*.

Measurement of Signal Amplitude Statistics

Digital modulated signals are similar to white noise within the transmit channel, but are different in their amplitude distribution. In order to transmit the modulated signal without distortion all amplitudes of the signal have to be transmitted linearly, e.g. from the output power amplifier. Most critical are the peak amplitude values, of course.

Degradation in transmit quality caused by a transmitter two port network is dependent on the amplitude of the peak values as well as on their probability.

The probability of amplitude values can be measured with the APD function (Amplitude Probability Distribution). During a selectable measurement time all occurring amplitude values are assigned to an amplitude range. The number of amplitude values in the specific ranges is counted and the result is displayed as a histogram. Each bar of the histogram represents the percentage of measured amplitudes within the specific amplitude range.
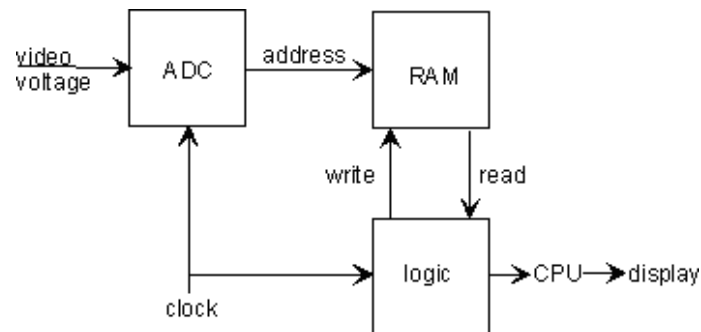
Fig. 4-19   Simplified block diagram for APD measurement
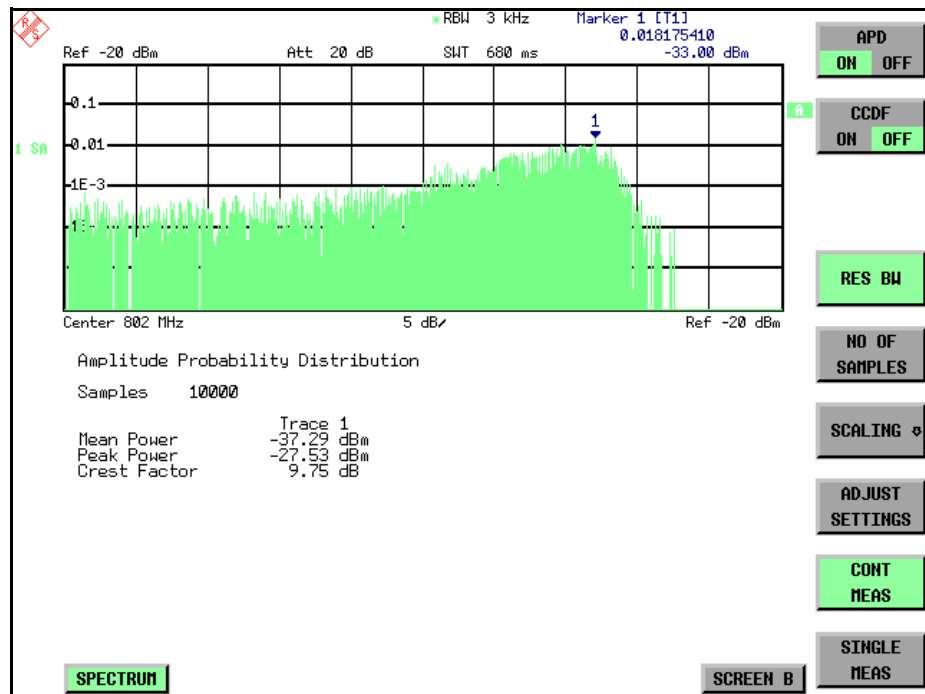
Fig. 4-20   Display of the amplitude probability distribution
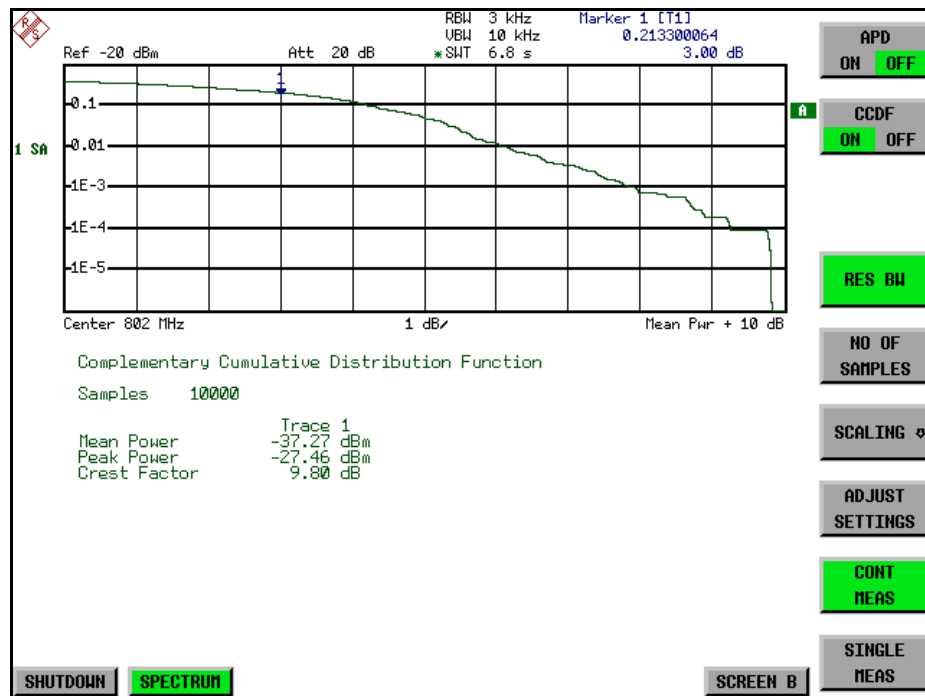
Fig. 4-21   Display of the complementary cumulative distribution function (CCDF)

Alternate to the histogram display of the APD the Complementary Cumulative Distribution Function (CCDF) can be displayed. It shows the probability of an amplitude exceeding a specific value.

For the APD function the x-axis is scaled in absolute values in dBm, whereas for the CCDF function the x-axis is scaled relative to the MEAN POWER measured.

Definitions:

Crest factor = peak voltage to rms

CCDF = complementary cumulative distribution function

Note

During an active statistic measurement the functions FULL SCREEN, SPLIT SCREEN and selection of the active diagram via SCREEN A / SCREEN B are disabled.

SIGNAL STATISTIC

APD ON/OFF	
CCDF ON/OFF	
PERCENT MARKER	
RES BW	
NO OF SAMPLES	
SCALING	X-AXIS REF LEVEL
	X-AXIS RANGE
	Y-UNIT %/ABS
	Y-AXIS MAX VALUE
	Y-AXIS MIN VALUE
	ADJUST SETTINGS
	DEFAULT SETTINGS
ADJUST SETTINGS	
CONT MEAS	
SINGLE MEAS	

The *SIGNAL STATISTIC* softkey opens a submenu for measurement of signal statistics.

In the submenu measurement of amplitude probability density (*APD*) and complementary cumulative distribution (*CCDF*) can be selected alternately. Only one of the signal statistic functions can be switched on at a time.

In default mode all statistic functions are switched off.

With a statistic function switched on the ESU is set into zero span mode automatically.

The ESU measures the statistics of the signal applied to the RF input with the resolution bandwidth set. In order not to influence the peak amplitudes the video bandwidth is automatically set to 10 times the resolution bandwidth. The sample detector is used for detecting the video voltage.

APD ON/OFF   The *APD ON/OFF* softkey switches on or off the amplitude probability distribution function. When the APD function is switched on, the CCDF function is switched off automatically.

IEC/IEEE bus command: `CALC:STAT:APD ON`

CCDF ON/OFF   The *CCDF ON/OFF* softkey switches on or off the complementary cumulative distribution function. When the CCDF function is switched on, the APD function is switched off automatically.

IEC/IEEE bus command: `CALC:STAT:CCDF ON`

PERCENT MARKER   If the CCDF function is active, the *PERCENT MARKER* softkey allows to position marker 1 by entering a probability value. Thus, the power which is exceeded with a given probability can be determined very easily.

If marker 1 is in the switched-off state, it will be switched on automatically.

IEC/IEEE bus command: `CALC:MARK:Y:PERC 0...100%`

RES BW   The *RES BW* softkey sets the resolution bandwidth in the menu *STATISTIC FUNCTION* directly without switching to the corresponding menu (*BW*). The function of the softkey is identical to the softkey *RES BW MANUAL* in the *BW* menu.

For correct measurement of the signal statistics the resolution bandwidth has to be wider than the signal bandwidth in order to transmit the actual peaks of the signal amplitude correctly. Video bandwidth is set to 10 MHz automatically with a statistic function switched on.

IEC/IEEE bus command: `BAND 3 MHz`

NO OF SAMPLES   The *NO OF SAMPLES* softkey sets the number of power measurements taken into account for the statistics.

Please note that the overall measurement time is influenced by the number of samples selected as well as by the resolution bandwidth set up for the measurement as the resolution bandwidth directly influences the sampling rate.

IEC/IEEE bus command: `CALC:STAT:NSAM <value>`

SCALING

SCALING	→	X-AXIS REF LEVEL
		X-AXIS RANGE
		Y-UNIT % ABS
		Y-AXIS MAX VALUE
		Y-AXIS MIN VALUE
		ADJUST SETTINGS
		DEFAULT SETTINGS
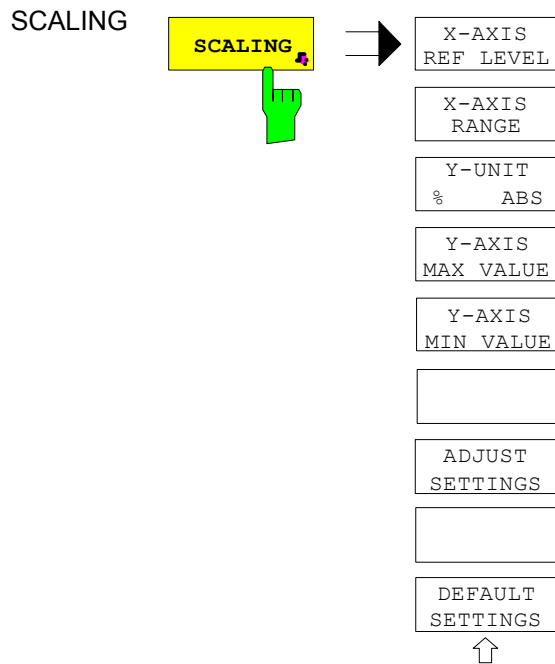
The *SCALING* softkey opens a submenu that allows changing the scaling parameters for both the x- and the y-axis.

X-AXIS REF LEVEL

The *X-AXIS REF LEVEL* softkey changes the level settings of the instrument and sets the maximum power to be measured.

The function is identical to softkey *REF LEVEL* in *AMPT* menu.

For the *APD* function this value is mapped to the right diagram border. For the *CCDF* function there is no direct representation of this value on the diagram as the x-axis is scaled relatively to the *MEAN POWER* measured.

IEC/IEEE bus command: `CALC:STAT:SCAL:X:RLEV <value>`

X-AXIS RANGE

The *X-AXIS RANGE* softkey changes the level range to be covered by the statistics measurement selected.

The function is identical to softkey *RANGE LOG MANUAL* in *AMPT* menu.

IEC/IEEE bus command: `CALC:STAT:SCAL:X:RANG <value>`

Y-UNIT %/ABS

The softkey *Y-UNIT %/ABS* defines the scaling type on the y-axis. The default case are the absolute probability. This can be changed to percent values. The softkeys *Y-AXIS MIN* and *Y-AXIS MAX* are using values based on the *Y-UNIT* setting.

IEC/IEEE bus command: `:CALC:STAT:SCAL:Y:UNIT PCT | ABS`

The 0.1%, 1% and 10% value from the CCDF measurement are shown in the bottom screen half. Those values can also queried via remote:

IEC/IEEE bus command:

Y-AXIS MAX VALUE The *Y-AXIS MAX VALUE* softkey defines the upper limit of the displayed probability range.

Values on the y-axis are normalized which means that the maximum value is 1.0. As the y-axis scaling has a logarithmic axis the distance between max and min value must be at least one decade.

IEC/IEEE bus command: `CALC:STAT:SCAL:Y:UPP <value>`

Y-AXIS MIN VALUE The *Y-AXIS MIN VALUE* softkey defines the lower limit of the displayed probability range.

As the y-axis scaling has a logarithmic axis the distance between max and min value must be at least one decade. Valid values are in the range 0 < value < 1.

IEC/IEEE bus command: `CALC:STAT:SCAL:Y:LOW <value>`

ADJUST SETTINGS The *ADJUST SETTINGS* softkey optimizes the level settings of the ESU according to the measured peak power in order to gain maximum sensitivity of the instrument.

The level range is adjusted according to the measured difference between peak and minimum power for APD measurement and peak and mean power for CCDF measurement in order to obtain maximum power resolution.

Additionally the probability scale is adapted to the selected number of samples.

IEC/IEEE bus command: `CALC:STAT:SCAL:AUTO ONCE`

DEFAULT SETTINGS The *DEFAULT SETTINGS* softkey resets the x- and y-axis scalings to their PRESET values.

- x-axis ref level: -20 dBm

- x-axis range APD: 100 dB

- x-axis range CCDF: 20 dB

- y-axis upper limit: 1.0

- y-axis lower limit: 1E-6

IEC/IEEE bus command: `CALC:STAT:PRES`

ADJUST SETTINGS see

CONT MEAS The *CONT MEAS* softkey starts collecting a new sequence of sample data and calculating the APD or CCDF curve depending on the selected measurement. The next measurement is started automatically as soon as the indicated number of samples has been reached ("CONTinuous MEASurement").

IEC/IEEE bus command: `INIT:CONT ON;`
`INIT:IMM`

SINGLE MEAS   The *SINGLE MEAS* softkey starts collecting a new sequence of sample data and calculating the APD or CCDF curve depending on the selected measurement. At the beginning of the measurement previously obtained measurement results are discarded.

IEC/IEEE bus command: `INIT:CONT OFF;`
                          `INIT:IMM`

Hint for usage of the marker functions with measurement of signal statistics

With the signal statistic measurement level always is displayed on x-axis. Y-axis always is a normalized value between 0 and 1. In contrary to use of marker in frequency or time domain marker is input in level values and the output is in percentage values.

Example

Measurement of CCDF of a IS95 BTS signal, level 0 dBm, frequency 800 MHz

[**PRESET**]	Switch on preset settings.
[**FREQ**: *CENTER*: 800 MHz]	Set center frequency to 800 MHz.
[**AMPT**: 10 dBm]	Set reference level to 10 dBm.
[**BW**: 3 MHz]	Set resolution bandwidth to 3 MHz (resolution bandwidth shall be wider then signal bandwidth (1.25 MHz) in order to have the complete signal within the resolution bandwidth).
[**MEAS**]	Call the menu for measurement functions.
[*SIGNAL STATISTIC*]	Call the menu for signal statistics measurement.
[*CCDF ON /OFF*]	Switch on measurement of the complementary cumulative distribution function. The ESU switches to zero span mode. The power of the signal and the CCDF is calculated for the number of samples selected. With the CCDF function sample detector and video bandwidth are set automatically.
[NO OF SAMPLES: 10000]	Set the number of measurement samples to 10000.
[SINGLE MEAS]	Start the measurement sequence. At the end the resulting trace will display the CCDF for the measured 10000 samples.

Measurement of Carrier/Noise Ratio C/N and C/N$_\text{o}$

Using the carrier/noise measurement function, the ESU determines the C/N ratio which can also be shown normalized to a 1 Hz bandwidth (function C/N$_\text{o}$).

To determine the noise power, a channel at the set center frequency is examined. The bandwidth of the channel is fixed by means of the *CHANNEL BANDWIDTH* function.

The largest signal in the frequency span is the carrier. It is searched when the function is activated and is marked by means of the *REFERENCE FIXED* marker. The noise power of the channel is subtracted from the signal level obtained (C/N), and in the case of a C/N$_\text{o}$ measurement it is referred to a 1 Hz bandwidth.

There are two methods for measuring the carrier/noise ratio:

1. The carrier is outside the channel examined:

    In this case, it is sufficient to switch on the desired measurement function and to set the channel bandwidth. The carrier/noise ratio is displayed on the screen.

2. The carrier is inside the channel examined:

    In this case, the measurement must be performed in two steps. First, the reference measurement is performed with the carrier being active. This is done by switching on either the C/N or the C/N$_\text{o}$ measurement and waiting for the end of the next measurement run. Then, the carrier is switched off so that only the noise of the test setup is active in the channel. The carrier/noise ratio is displayed after the subsequent measurement has been completed.

The *ADJUST SETTINGS* function facilitates the selection of the frequency span appropriate for the channel bandwidth: it automatically sets the *SPAN* to approx. 4 × channel bandwidth.

The RMS detector is enabled when the power measurement is switched on (*TRACE-DETECTOR-RMS)*.

C/N C/No
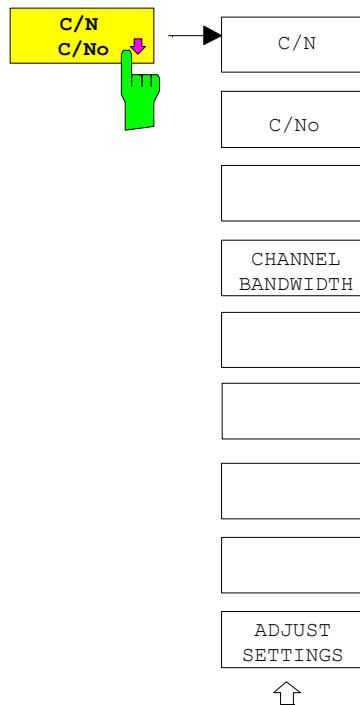
The *C/N, C/No* softkeys open the submenu for configuring the carrier/noise ratio measurement.

The user can choose between measurement without (C/N) and measurement with reference to the bandwidth (C/No). In addition, it is possible to select the bandwidth of the channel and to adapt the span.

Note

The measurements are only available in the frequency domain (span >0).

The *C/N* and *C/No* softkeys enable and disable the measurement of the carrier/ noise ratio, the C/N_o measurement also being referred to a 1 Hz bandwidth.

The maximum value of the current trace is determined when the function is activated and is marked by means of the *REFERENCE FIXED* marker.

> **Note**
>
> The measurement is performed on the trace where MARKER 1 is located. To measure another trace, MARKER 1 has to be shifted to the trace in question using the *SELECT TRACE* softkey in the *MARKER* menu.
>
> If no marker is active, MARKER 1 is activated when the function is switched on.

IEC/IEEE bus command: `CALC:MARK:FUNC:POW:SEL CN`
`CALC:MARK:FUNC:POW:RES? CN`
`CALC:MARK:FUNC:POW:SEL CN0`
`CALC:MARK:FUNC:POW:RES? CN0`
`CALC:MARK:FUNC:POW OFF`

CHANNEL BANDWIDTH   The *CHANNEL BANDWIDTH* softkey opens a window for selecting the measurement channel bandwidth.

The default setting is 14 kHz.

The specified channel bandwidth allows the optimal setting of the measurement parameters of the ESU using *ADJUST SETTINGS*.

IEC/IEEE bus command: `SENS:POW:ACH:BWID 14kHz`

ADJUST SETTINGS   The *ADJUST SETTINGS* softkey adapts the span to the channel bandwidth selected.

For the carrier/noise ratio measurement, the span is set to:

   4 × channel bandwidth + measurement margin

The adjustment is performed once; if necessary, the setting can be changed later on.

IEC/IEEE bus command: `SENS:POW:ACH:PRES CN | CN0`

Measurement of the AM Modulation Depth

MODULATION DEPTH

The *MODULATION DEPTH* softkey switches on the measurement of the AM modulation depth. An AM-modulated carrier is required on the screen for ensuring correct operation.

The level value of *MARKER 1* is taken as the carrier level. When this function is activated, *MARKER 2* and *MARKER 3* are automatically set symmetrically to the carrier on the adjacent peak values of the trace as delta markers and *MARKER 2* is activated for the entry.

When the position of MARKER 2 (delta) is changed, MARKER 3 (delta) is moved symmetrically with respect to the reference marker (MARKER 1).

If the data entry is activated for MARKER 3 (*MARKER 1 2 3 4* softkey), the latter can be moved for fine adjustment irrespective of MARKER 2.

The ESU calculates the power at the marker positions from the measured levels. The AM modulation depth is calculated from the ratio between the power values at the reference marker and at the delta markers. When the powers of the two AM side bands are unequal, the mean value of the two power values is used for AM modulation depth calculation.

Measurement example

The AM modulation depth of a carrier modulated with 1 kHz is to be measured at 100 MHz.

[**PRESET**]	The ESU is set to the default setting.
[**CENTER**: 100 **MHz**]	The center frequency is set to 100 MHz.
[**SPAN**: 5 **kHz**]	The span is set to 5 kHz.
[**AMPT**: 0 **dBm**]	The reference level is set to 0 dBm.
[**MKR FCTN**]	MARKER 1 is switched on and positioned at the maximum of the displayed trace.
[*MODULATION DEPTH*: 1 **kHz**]	The measurement of the AM modulation depth is switched on. MARKERS 2 and 3 (delta markers) are set to the adjacent peak values of the trace and are activated for the frequency entry.
	The AM modulation depth is output in % in the marker info field.
	When 1 kHz is entered, MARKER 2 can be exactly positioned on 1 kHz and MARKER 3 at -1 kHz from the reference marker.

IEC/IEEE bus command: `CALC:MARK:FUNC:MDEP ON;`
                                          `CALC:MARK:FUNC:MDEP:RES?`

Measurement of the Third Order Intercept (TOI)

If several signals are applied to a transmission two port device with nonlinear characteristic, intermodulation products appear at its output by the sums and differences of the signals. The nonlinear characteristic produces harmonics of the useful signals which intermodulate at the characteristic. The intermodulation products of lower order have a special effect since their level is largest and they are near the useful signals. The intermodulation product of third order causes the highest interference. It is the intermodulation product generated from one of the useful signals and the 2nd harmonic of the second useful signal in case of two-tone modulation.

The frequencies of the intermodulation products are above and below the useful signals. Fig. 4-22 Intermodulation products PU1 and PU2 shows intermodulation products P_{I1} and P_{I2} generated by the two useful signals P_{U1} and P_{U2}.
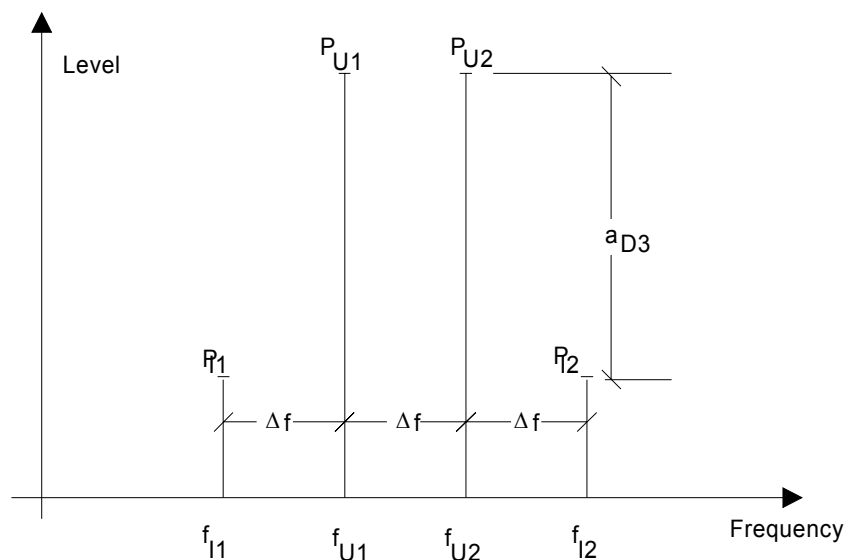
Fig. 4-22   Intermodulation products P_{U1} and P_{U2}

The intermodulation product at f_{I2} is generated by mixing the 2nd harmonic of useful signal P_{U2} and signal P_{U1}, the intermodulation product at f_{I1} by mixing the 2nd harmonic of useful signal P_{U1} and signal P_{U2}.

$$f_{I1} = 2 \times f_{U1} - f_{U2} \tag{1}$$

$$f_{I2} = 2 \times f_{U2} - f_{U1} \tag{2}$$

The level of the intermodulation products depends on the level of the useful signals. If the two useful signals are increased by 1 dB, the level of the intermodulation products increases by 3 dB, which means that spacing a_{D3} between intermodulation signals and useful signals is reduced by 2 dB. This is illustrated in Fig. 4-23 Dependence of intermodulation level on useful signal level.
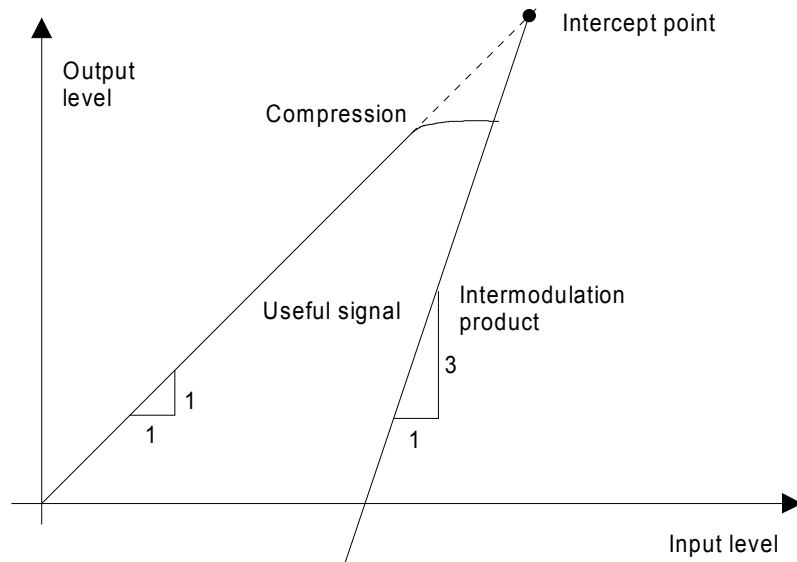
Fig. 4-23   Dependence of intermodulation level on useful signal level

The useful signals at the two port output increase proportionally with the input level as long as the two port is in the linear range. A level change of 1 dB at the input causes a level change of 1 dB at the output. Beyond a certain input level, the two port goes into compression and the output level stops increasing. The intermodulation products of the third order increase three times as much as the useful signals. The intercept point is the fictitious level where the two lines intersect. It cannot be measured directly since the useful level is previously limited by the maximum two port output power.

It can be calculated from the known line slopes and the measured spacing a_{D3} at a given level according to the following formula.

$$IP3 = \frac{a_{D3}}{2} + P_N$$

(3)

The 3rd order intercept point (TOI), for example, is calculated for an intermodulation of 60 dB and an input level PU of -20 dBm according to the following formula:

$$IP3 = \frac{60}{2} + (-20dBm) = 10dBm$$

(4)

TOI   The *TOI* softkey enables the measurement of the 3rd order intercept point.

A two-tone signal with equal carrier levels is expected at the ESU input. MARKER 1 and MARKER 2 (both normal markers) are set to the maximum of the two signals. MARKER 3 and MARKER 4 (both delta markers) are placed on the intermodulation products. When the function is enabled, the frequency entry is activated for the delta markers. They can be set manually.

The ESU calculates the third order intercept from the level spacing between normal markers and delta markers and outputs it in the marker info field.

IEC/IEEE bus command: `CALC:MARK:FUNC:TOI ON;`
                           `CALC:MARK:FUNC:TOI:RES?`

Example

A two-tone signal with frequencies of 100 MHz and 101 MHz is applied to the RF input of the ESU. The level of the two signals is -10 dBm.

[**PRESET**]	The ESU is set to the default setting.
[**CENTER**: 100.5 **MHz**]	The center frequency is set to 100.5 MHz.
[**SPAN**: 3 **MHz**]	The span is set to 3 MHz.
[**AMPT**: -10 **dBm**]	The reference level is set to -10 dBm.
[*MKR FCTN*]	MARKER 1 is switched on and set to the signal peak.
[*TOI*]	The ESU sets the 4 markers to the useful signals and the intermodulation products and calculates the third order intercept. The result is output in the marker info field.

SELECT MARKER   The *SELECT MARKER* softkey activates the selection of a marker for functions *MODULATION DEPTH* and *TOI*. Thus, the markers can be fine-adjusted for these functions.

The markers are numerically selected in a data entry field. Delta marker 1 is selected by entering '0'.

If the marker is in the switch-off state, it will be switched on and can thus be shifted.

IEC/IEEE bus command: CALC:MARK1 ON;
                         CALC:MARK1:X <value>;
                         CALC:MARK1:Y?

Harmonic Measurement

HARMONIC DISTORTION

```
┌──────────────┐        ┌──────────────┐
│  HARMONIC    │   ───► │  HARMONIC    │
│  DISTOR   ▼  │        │  ON   OFF    │
└──────────────┘        └──────────────┘
                        ┌──────────────┐
                        │   NO. OF     │
                        │  HARMONICS   │
                        └──────────────┘
                        ┌──────────────┐
                        │   HARMONIC   │
                        │  SWEEPTIME   │
                        └──────────────┘
                        ┌──────────────┐
                        │              │
                        └──────────────┘
                        ┌──────────────┐
                        │   HARMONIC   │
                        │  RBW AUTO    │
                        └──────────────┘
                        ┌──────────────┐
                        │              │
                        └──────────────┘
                        ┌──────────────┐
                        │              │
                        └──────────────┘
                        ┌──────────────┐
                        │              │
                        └──────────────┘
                        ┌──────────────┐
                        │   ADJUST     │
                        │  SETTINGS    │
                        └──────────────┘
```
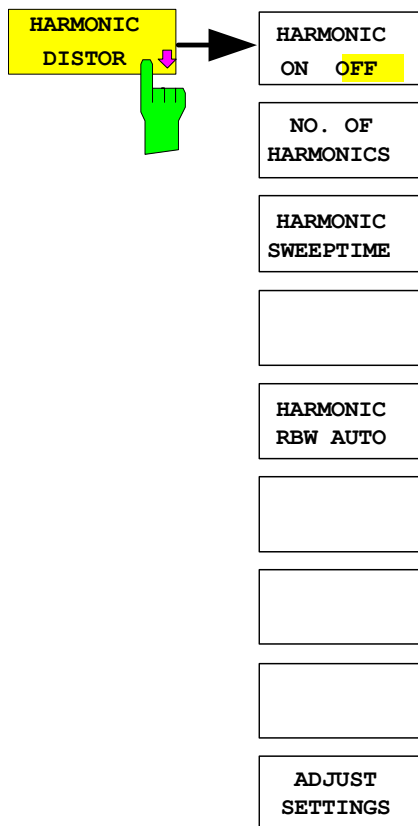
The *HARMONIC DISTORTION* softkey opens this submenu.

In the upper screen the zero span sweeps on all harmonics are shown, separated by a grid line. This allows a very good overview about the measurement. In the lower screen the mean RMS results are displayed in numerical values and the THD values can be seen in the marker info field.

The resolution bandwidth will be automatically adjusted: $RBW_n = RBW_1 * n$, if that RBW is not available the next higher value is used.

HARMONIC ON OFF

The *HARMONIC ON OFF* Softkey activates the harmonic distortion measurement. With this measurement it is possible to measure easily the harmonics e.g. from a VCO. In addition the THD (total harmonic distortion) is calculated in % and dB.

There are 2 possible modes within the harmonic measurement. When entering the harmonic measurement from a frequency sweep (span > 0 Hz) an automatic search for the first harmonic is carried out within that given frequency range. Also a level adjust will be carried out. Is the zero span mode active before entering the harmonic measurement, the center frequency is unchanged.

IEC/IEEE bus command: `:CALC:MARKer:FUNC:HARM:STAT ON | OFF`

NO. OF HARMONICS

With the softkey *NO. OF HARMONICS* the number of harmonics which shall be measured can be adjusted. The range is from 1 to 26.

IEC/IEEE bus command: `:CALC:MARK:FUNC:HARM:NHAR <numerical value>`

HARMONIC SWEEPTIME	The *HARMONIC SWEEPTIME* softkey allows to set the value how long the zero span measurement on each harmonic frequency shall take place. This is an alias softkey to the normal sweep time of the zero span, therefore the same parser command is to be used.

HARMONIC RBW AUTO

The softkey *HARMONIC RBW AUTO* disabled the resolution bandwidth.

IEC/IEEE bus command: `:CALC:MARK:FUNC:HARM:BAND:AUTO ON | OFF`

ADJUST SETTINGS

The *ADJUST SETTINGS* softkey activated he frequency search in the frequency range from before starting the harmonic measurement (if harmonic measurement was started from frequency sweep) and the level adjust.

IEC/IEEE bus command: `:CALC:MARK:FUNC:HARM:PRES`

The results can be obtained via IEC/IEEE-bus via the following commands:

Trace read out via the normal trace subsystem. The first harmonic frequency can be read out via the center frequency command.

THD value comma separated in % and dB:

  `:CALC:MARK:FUNC:HARM:DIST? TOT`

Comma separated list of harmonic levels, for each harmonic one value:

  `:CALC:MARK:FUNC:HARM:LIST?`

Measuring Spurious Emissions

All real amplifiers also generate unwanted RF products outside the assigned frequency band. These spurious emissions are usually measured across a wide frequency range, for example from 9 kHz to 12.75 GHz (ETSI). The analyzer settings are specified for each frequency range.

SPURIOUS EMISSIONS

SPURIOUS ON OFF	
SWEEP LIST ⇩	EDIT SWEEP LIST
	INS BEFORE RANGE
	INS AFTER RANGE
	DELETE RANGE
	NEXT RANGES
	PREVIOUS RANGES
	ADJUST AXIS
	START MEAS
	STOP MEAS
PEAK SEARCH	
PEAKS PER RANGE	
MARGIN	
VIEW PEAK LIST ⇩	SORT BY FREQUENCY
	SORT BY DELTA LIM
	ASCII FILE EXPORT
	DECIM SEP
	PAGE UP / PAGE DOWN
START MEAS	
STOP MEAS	

In the Spurious Emissions mode, the ESU performs measurements in predefined frequency ranges with settings that can be specified individually for each of these ranges.

For this purpose, the SWEEP TABLE settings or the current device settings are used. Up to 20 subranges can be defined (they need not directly follow one another) across which the ESU sweeps in subsequent order. However, the measurement ranges must not overlap. The measurement parameters can be selected independently from each other in every subrange (*SWEEP LIST* menu, EDIT SWEEP LIST).

Limit lines are defined and displayed irrespective of the sweep ranges, i.e. they are not part of the sweep ranges. The unit of the limit lines is restricted to dB or dBm.

The frequency range where measurements are actually performed is set by the start and stop frequency parameters of the ESU; these parameters are independent of the sweep ranges. It is thus possible to define sweep ranges for a measurement task that can be stored and reloaded and to quickly and easily set the frequency range to be actually measured by means of two parameters; complex editing in the sweep table is not necessary.

> **Note**
>
> When a limit line is defined in steps, the weaker limit is used at the frequency point with the straight vertical section.

SPURIOUS ON OFF   The *SPURIOUS ON OFF* softkey switches the spurious emissions measurement on or off according to the current configuration.

IEC/IEEE bus command: `SWEEP:MODE LIST` switches the spurious list on
                                  `SWEEP:MODE AUTO` switches the spurious list off

SWEEP LIST   The *SWEEP LIST* softkey opens a submenu where predefined sweep ranges can be edited, or new ranges generated or deleted. A table listing the current sweep ranges is displayed.

IEC/IEEE bus command: `--`

EDIT SWEEP LIST   The *EDIT SWEEP LIST* softkey opens the table for editing the sweep ranges.

SWEEP LIST					
	RANGE 1	RANGE 2	RANGE 3	RANGE 4	RANGE 5
Range Start	9 kHz	50 MHz	500 MHz		
Range Stop	50 MHz	500 MHz	1 GHz		
Filter Type	NORMAL	CHANNEL	RRC		
RBW	10 kHz	100 kHz	3 MHz		
VBW	30 kHz	300 kHz	10 MHz		
Sweep time mode	AUTO	MANUAL	AUTO		
Sweep time	10 ms	10 ms	100 ms		
Detector	Peak	RMS	Peak		
REF-Level	-20 dBm	-20 dBm	-20 dBm		
RF-Att. mode	AUTO	MANUAL	AUTO		
RF-Attenuator	10 dB	10 dB	5 dB		
PRE-AMP	OFF	OFF	OFF		
Sweep Points	625	625	625		
Stop after sweep	ON	OFF	OFF		
Transd. factor	LOWFREQ	MIDFREQ	MIDFREQ		

In the *SWEEP LIST* table, the individual sweep ranges are set.

Range Start:	Start frequency of the range
Range Stop:	Stop frequency of the range
Filter Type:	Filter type: NORMAL, CHANNEL, RRC
RBW:	Resolution filter bandwidth
VBW:	Video filter bandwidth; not applicable for CHANNEL and RRC filters
Sweep Time Mode:	AUTO / MANUAL
Sweep Time:	Sweep time; if *AUTO* is indicated for the sweep time mode, the automatically calculated sweep time is displayed. If the cell is edited, the associated sweep time mode is automatically set to MANUAL.
Detector:	Specifies the range detector: Sample, Average, Max Peak, RMS, Min Peak and Auto Peak
REF-Level	Reference level in dBm
	The upper edge of the displayed screen area is the value of the maximum reference level, corrected by the associated transducer factor.
RF-Attenuator-Mode	AUTO / MANUAL
RF-Attenuator	Number; as with Sweep Time
PRE-AMP	ON / OFF; preamplifier selection
Sweep Points	Number of sweep points per range (sweep segment). The number of sweep points must not exceed **100001**.
Stop after Sweep	ON / OFF; if *ON*, the sweep is stopped after the range and continued only if confirmed by you via a message box.
Transd. factor	NONE or factor (enter via selection list)

IEC/IEEE bus command:

```
SENS:LIST:RANGE<1…20>:…
LIST:RANG1:STAR
LIST:RANG1:STOP
LIST:RANG1:FILTER:TYP
LIST:RANG1:BANDwidth
LIST:RANG1:BANDwidth:VID
LIST:RANG1:SWEEP:TIME:AUTO
LIST:RANG1:SWEEP:TIME
LIST:RANG1:DET
LIST:RANG1:RLEV
LIST:RANG1:INPUT:ATT:AUTO
LIST:RANG1:INPUT:ATT
LIST:RANG1:INPUT:GAIN:STAT
LIST:RANG1:POINt
LIST:RANG1:BREA
LIST:RANG1:TRAN
```

INS BEFORE RANGE   The *INS BEFORE RANGE* softkey inserts a range in front of the marked line.

IEC/IEEE bus command: --

INS AFTER RANGE   The *INS AFTER RANGE* softkey inserts a range following the marked line.

IEC/IEEE bus command: `--`

DELETE RANGE   The *DELETE RANGE* softkey deletes the current range. All higher ranges are set back by one.

IEC/IEEE bus command: `LIST:RANGe<1…20>:DELete`

NEXT RANGES   The *NEXT RANGES* softkey activates the displays of the next higher subranges, i.e. 6 to 10, 11 to 15 or 16 to 20.

IEC/IEEE bus command: `--`

PREVIOUS RANGES   The *PREVIOUS RANGES* softkey activates the displays of the next lower subranges, i.e. 1 to 5, 6 to 10 or 11 to 15.

IEC/IEEE bus command: `--`

ADJUST AXIS   The *ADJUST AXIS* softkey automatically adjusts the frequency axis of measurement diagram so that the start frequency matches the start frequency of the first sweep range, and the stop frequency of the last sweep range.

IEC/IEEE bus command: `--`
(via `FREQuency:STARt <num_value>` / `FREQuency:STOP <num_value>`)

START MEAS   Using the *START MEAS* softkey, you can start the measurement while the submenu is simultaneously exited.

When the measurement is started, the ESU sets up the measurement diagram in the selected measurement window and starts the measurement in the selected mode.

With *SINGLE*, a single frequency sweep occurs; afterwards the ESU remains on the stop frequency.

With *CONTINUOUS*, the measurement continues until it is stopped.

You can stop the measurement with *STOP SWEEP*.

If a *STOP AFTER SWEEP* point has been defined in the range, the sweep stops automatically at the end of the respective range to allow you to change the external circuitry, for example. This is indicated in a message box:

SWEEP Range# reached CONTINUE/BREAK

If *CONTINUE* is selected, the sweep is continued in the next range. If *BREAK* is selected, the sweep is stopped.

IEC/IEEE bus command: `INIT:SPUR` starts the measurement
`INIT:CONM` starts the measurement after a BREAK has been reached
`ABORt` stops the measurement after a range has been reached

STOP MEAS   The *STOP MEAS* softkey stops the measurement. The measurement data can be analyzed.

IEC/IEEE bus command: `ABORt`

ASCII FILE EXPORT   The *ASCII FILE EXPORT* softkey stores the peak list in ASCII format to a file on a memory stick.

IEC/IEEE bus command: `MMEM:STOR:SPUR,'F:\TEST.ASC'`

The file has a header containing important parameters for scaling, several data sections containing the sweep settings per range and a data section containing the peak list.

The header data is made up of three columns, separated by ';':

   parameter name; numeric value; basic unit

The data section for the measurement values starts with the key word "TRACE <n>:", where <n> includes the number of the used trace. Next comes the peak list with several columns also separated by ';'.

Spreadsheet programs such as MS Excel can read this format. Use ';' as the delimiter for the table cells.

> **Note**
>
> Different language versions of evaluation programs may require different handling of the decimal point. Using the *DECIM SEP* softkey, you can thus choose between the delimiters '.' (decimal point) and ',' (comma).

DECIM SEP   In the case of floating-point numbers, use the *DECIM SEP* softkey to select between '.' (decimal point) and ',' (comma) as the decimal delimiter for the ASCII FILE EXPORT function.

By selecting the decimal delimiter, various language versions of evaluation programs (e.g. MS Excel) are supported.

IEC/IEEE bus command: `FORM:DEXP:DSEP POIN`

Example: ASCII export table - file header

File contents	Explanation
Type;ESU;	Model
Version;3.55;	Firmware version
Date;02.Aug 2004;	Storage date of data set
Mode;ANALYZER; SPURIOUS;	Operating mode of the device
Start;9000.000000;Hz Stop;8000000000.000000;Hz	Start/stop of the span Unit: Hz
x-Axis;LIN;	Linear (LIN) or logarithmic (LOG) (future feature) scaling of the x-axis
Sweep Count;1;	Selected number of sweeps

Example: ASCII export table - file data section

File contents	Explanation
TRACE 1:	Selected trace
Trace Mode;CLR/WRITE;	Display mode of trace: CLR/WRITE,AVERAGE,MAX HOLD,MIN HOLD, VIEW, BLANK
x-Unit;Hz;	Unit of x values:
y-Unit;dBm;	Unit of y values:
Margin;6.000000:s	Peak List margin
Values;8;	Number of measurement points
1;1548807257.5999999000;-65.602280;-5.602280 1;1587207214.4000001000;-65.327530;-5.327530 1;2112006624.0000000000;-4.388008;55.611992	Measurement values: <Trace>;<x value>; <y value>;<delta limit>

PAGE UP / PAGE DOWN   Using *PAGE UP* and *PAGE DOWN*, you can scroll forward and backward through the peak list pages.

They are active only as long as a peak list is displayed.

START MEAS   See .

STOP MEAS   See .

Basic Settings

In this section, all mode-independent functions are described. If a softkey is only available in a special mode, the corresponding mode is indicated in the softkey description.

Setup of Limit Lines and Display Lines – LINES Key

Limit lines are used to define amplitude curves or spectral distribution boundaries on the display screen which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a unit under test (UUT). For transmission of information in TDMA (e.g. GSM), the amplitude of the bursts in a timeslot must adhere to a curve which must fall within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).

The instrument supports limit lines with a maximum of 50 data points. 8 of the limit lines stored in the instrument can be used simultaneously and activated in the split-screen mode either in Screen A, Screen B or in the two windows. The number of limit lines stored in the instrument is only limited by the capacity of the flash disk used.

For each limit line, the following characteristics must be defined:

• The name of the limit line. The limit line data are stored under this name and can be examined in the table *LIMIT LINES.*

• The domain in which the limit line is to be used. Here, a distinction is made between the time domain (span = 0 Hz, analyzer mode only) and the frequency domain (span > 0 Hz).

• The reference of the interpolation points to the X axis. The limit line may be specified either for absolute frequencies or times or for frequencies which are related to the set center frequency and times related to the time on the left edge of the diagram. In receiver mode, only absolute scaling is used.

• The reference of the interpolation points to the Y axis. The limit line can be selected either for absolute levels or voltages or referred to the set maximum level (Ref Lvl). The position on the display depends on the *REF LEVEL POSITION*. In receiver mode, only absolute scaling is used.

• With relative reference values for the Y axis, it is possible to enter an absolute threshold (THRESHOLD) which lowers the relative limit values (see below, analyzer mode only).

• The type of limit line (upper or lower limit, lower limit for analyzer mode only). With this information and the active limit checking function (Table *LIMIT LINES*, *LIMIT CHECK ON*, analyzer mode only), the ESU checks for compliance with each limit.

• The limit line units to be used. The units of the limit line must be compatible with the level axis in the active measurement window.

- The measurement curve (trace) to which the limit line is assigned. For the ESU, this defines the curve to which the limit is to be applied when several traces are simultaneously displayed.

- For each limit line, a margin can be defined which serves as a threshold for automatic evaluation.

- In addition, commentary can be written for each limit line, e.g. a description of the application.

Display lines are exclusively used to optically mark relevant frequencies or points in time (span = 0) as well as constant level values. It is not possible to check automatically whether the marked level values have been underranged or exceeded.

Selection of Limit Lines

The *LINES* key opens the menu for fixing the limit lines and the display lines.
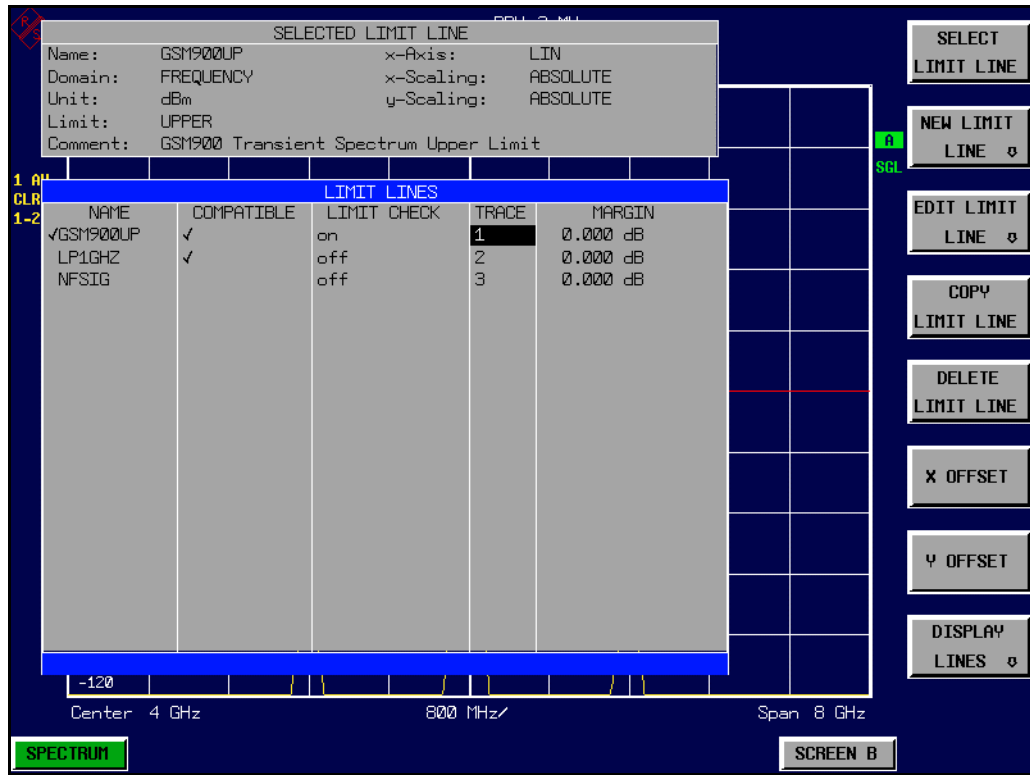
The *SELECTED LIMIT LINE* display field provides information concerning the characteristics of the marked limit lines.

In the *LIMIT LINES* table, the limit lines compatible to the settings of the active screen can be enabled.

New limit lines can be specified and edited in the *NEW LIMIT LINE and EDIT LIMIT LINE* submenus, respectively.

The horizontal and vertical lines of the *DISPLAY LINES* submenu mark individual levels or frequencies (span > 0) or times (span = 0) in the diagram.

The *SELECTED LIMIT LINE* table provides information about the characteristics of the marked limit line:

Name	name
Domain	frequency or time
Unit	vertical scale
X-Axis	interpolation
Limit	upper/lower limit
X-Scaling	absolute or relative frequencies/times
Y-Scaling	absolute or relative Y units
Threshold	absolute limit with relative Y units
Comment	commentary

The characteristics of the limit line are set in the *EDIT LIMIT LINE (=NEW LIMIT LINE)* submenu.

SELECT LIMIT LINE   The *SELECT LIMIT LINE* softkey activates the *LIMIT LINES* table and the selection bar jumps to the uppermost name in the table.

The following information is offered in the columns of the table:

Name   Enable the limit line.

Compatible   Indicates if the limit line is compatible with the measurement window of the given trace.

Limit Check   Activate automatic violation check for upper/lower limits.

Trace   Select the measurement curve to which the limit is assigned.

Margin   Define margin.

Name and Compatible - Enabling limit lines

A maximum of 8 limit lines can be enabled at any one time. In split screen mode, they may be assigned to screen A, screen B or to both screens. A check mark at the left edge of a cell indicates that this limit line is enabled.

A limit line can only be enabled when it has a check mark in the *Compatible* column, i.e. only when the horizontal display (time or frequency) and vertical scales are *identical* to those of the display in the measurement window.

Lines with the unit dB are compatible to all dB(..) settings of the Y axis.

If the scale of the y axis or the domain (frequency or time axis) are changed, all non-compatible limit lines are automatically switched off in order to avoid misinterpretation. The limit lines must be enabled anew when the original display is re-displayed.

IEC/IEEE bus command: `CALC:LIM3:NAME "GSM1"`
                            `CALC:LIM3:UPP:STAT ON`
                            `CALC:LIM4:LOW:STAT ON`

Limit Check - Activate automatic limit violation check (analyzer mode only)

When *LIMIT CHECK ON* is activated, a GO/NOGO test is performed in the active screen. In the center of the diagram, a display window appears which indicates the results of the limit check test:

LIMIT CHECK: PASSED   No violations of active limits.

LIMIT CHECK: FAILED   One or more active limit lines were violated. The message contains the names of the limit lines which were violated or whose margins were not complied with.

LIMIT CHECK: MARGIN   The margin of at least one active limit lines was not complied with, however, no limit line was violated. The message contains the names of the limit lines whose margins were not complied with.

The following example shows two active limit lines:

```
 LIMIT CHECK: FAILED

 LINE VHF_MASK: Failed
 LINE UHF2MASK: Margin
```

A check for violations of limit lines takes place only if the limit line of the assigned measurement curve (trace) is enabled.

If *LIM CHECK* is set to *OFF* for all active limit lines, then the limit line check is not executed and the display window is activated.

IEC/IEEE bus command: `CALC:LIM:STAT ON`
                          `INIT;*WAI`
                          `CALC:LIM:FAIL?`

***Trace* - Select the measurement curve to which the limit line is assigned.**

The selection of the measurement curve (trace) takes place in an entry window. Allowed are the integer entries 1, 2 or 3. The default setting is trace 1. If the selected limit line is not compatible with the assigned measurement curve, then the limit line is disabled (display and limit check).

IEC/IEEE bus command: `CALC:LIM:TRAC 1`

NEW LIMIT LINE   See following section "Entry and Editing of Limit Lines" on page 4.247.

EDIT LIMIT LINE   See following section "Entry and Editing of Limit Lines" on page 4.247.

COPY LIMIT LINE   The *COPY LIMIT LINE* softkey copies the data file describing the marked limit line and saves it under a new name. In this way, a new limit line can be easily generated by parallel translation or editing of an existing limit line. The name can be arbitrarily chosen and input via an entry window (max. of 8 characters).

IEC/IEEE bus command: `CALC:LIM3:COPY 2`
                          or
                          `CALC:LIM3:COPY "GSM2"`

DELETE LIMIT LINE   The *DELETE LIMIT LINE* softkey erases the selected limit line. Before deletion, a message appears requesting confirmation.

IEC/IEEE bus command: `CALC:LIM3:DEL`

X OFFSET   The *X OFFSET* softkey horizontally shifts a limit line, which has been specified for relative frequencies or times (X axis). The softkey opens an entry window, where the value for shifting may be entered numerically or via the rotary knob.

> **Note**
>
> This softkey does not have any effect on limit lines that represent absolute values for the X axis.

IEC/IEEE bus command: `CALC:LIM3:CONT:OFFS 10kHz`

Y OFFSET

The *Y OFFSET* softkey vertically shifts a limit line, which has relative values for the Y axis (levels or linear units such as volt). The softkey opens an entry window where the value for shifting may be entered numerically or via the rotary knob.
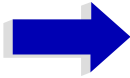
> **Note**
>
> This softkey does not have any effect on limit lines that represent absolute values for the Y axis.

IEC/IEEE bus command: `CALC:LIM3:LOW:OFFS 3dB`
                                               `CALC:LIM3:UPP:OFFS 3dB`

Entry and Editing of Limit Lines

A limit line is characterized by

- its name
- the assignment of domain (frequency or time)
- the scaling in absolute or relative times or frequencies
- the vertical unit
- the interpolation
- the vertical scaling
- the vertical threshold (only with relative vertical scaling)

- the margin

- the definition of the limit line as either upper or lower limit.

- the data points for frequency/time and level.

At the time of entry, the ESU immediately checks that all limit lines are in accordance with certain guidelines. These guidelines must be observed if specified operation is to be guaranteed.

- The frequencies/times for each data point must be entered in ascending order, however, for any single frequency/time, two data points may be input (vertical segment of a limit line).

  The data points are allocated in order of ascending frequency/time. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.

- The entered frequencies/times need not necessarily be selectable in ESU. A limit line may also exceed the specified frequency or time domains. The minimum frequency for a data point is -200 GHz, the maximum frequency is 200 GHz. For the time domain representation, negative times may also be entered. The valid range is -1000 s to +1000 s.

- The minimum/maximum value for a limit line is -200 dB to +200 dB for the logarithmic or 10^{-20} to 10^{+20} or -99.9% to + 999.9% for the linear amplitude scales.

EDIT LIMIT LINE / NEW LIMIT LINE

The *EDIT LIMIT LINE* and *NEW LIMIT LINE* softkeys both call the *EDIT LIMIT LINE* submenu used for editing limit lines. In the table heading, the characteristics of the limit line can be entered. The data points for frequency/ time and level values are entered in the columns.

Name	Enter name.
Domain	Select domain.
Unit	Select units.
X-Axis	Select interpolation
Limit	Select upper and lower limit value.
X-Scaling	Entry of absolute or relative values for the X axis
Y-Scaling	Entry of absolute or relative values for the Y axis
Margin	Entry of margin.
Threshold	Entry of vertical threshold (only with relative vertical scaling)
Comment	Enter comments.
Time/Frequency	Enter time/frequency for the data points.
Limit/dBm	Enter magnitudes for the data points.

Note

Domain, unit, X scaling and Y scaling cannot be modified as soon as reference values have been entered in the data section of the table.

NAME   The *NAME* softkey enables the entry of characteristics in the table heading.

Name - **Enter name**

A maximum of 8 characters is permitted for each name. All names must be compatible with the MS DOS conventions for file names. The instrument stores all limit lines with the .LIM extension.

IEC/IEEE bus command: `CALC:LIM3:NAME "GSM1"`

Domain - **Select time or frequency domain**

The default setting is frequency. In receiver mode, only the frequency domain can be selected.
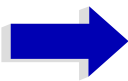
> **Note**
>
> A change in domain (frequency/time) is only permitted when the data point table is empty.

IEC/IEEE bus command: `CALC:LIM3:CONT:DOM FREQ`

X Axis - **Select interpolation**

Linear or logarithmic interpolation can be carried out between the frequency reference points of the table. The ENTER key toggles between LIN and LOG selection.

IEC/IEEE bus command: `CALC:LIM3:CONT:SPAC LIN`
`CALC:LIM3:UPP:SPAC LIN`
`CALC:LIM3:LOW:SPAC LIN`

Scaling - **selection of absolute or relative scaling**

The limit line can either be scaled in absolute (frequency or time) or relative units. In receiver mode, only absolute scaling is used. Any of the unit keys may be used to toggle between *ABSOLUTE* and *RELATIVE*, the cursor must be positioned in the X-*Scaling* or the *Y-Scaling* line.

The *RELATIVE* scaling is always suitable, if masks for bursts are to be defined in the time domain, or if masks for modulated signals are required in the frequency domain.

An X offset with half the sweep time may be entered in order to shift the mask in the time domain into the center of screen.

IEC/IEEE bus command: `CALC:LIM3:CONT:MODE ABS`
`CALC:LIM3:UPP:MODE ABS`
`CALC:LIM3:LOW:MODE ABS`

Unit - **Select the vertical scale units for the limit line**

The selection of units takes place in a selection box. The default setting is dBm**.**

```
      U N I T S
  V E R T I C A L   S C A L E

          d B

    √     d B m

          %
          d B u V
          d B m V
          d B u A
          d B p W
          V
          A
          W
```
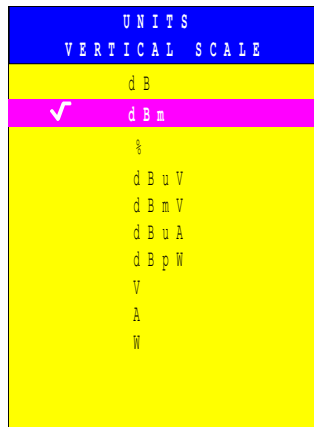
IEC/IEEE bus command: `CALC:LIM3:UNIT DBM`

Limit - **Select upper/lower limit**

A limit line can be defined as either an upper or lower limit. In receiver mode, only the upper limit line is used.

IEC/IEEE bus command: `--` (defined by key words :UPPer or :LOWer)

Margin - **Setting a margin.**

The margin is defined as the signal-level distance to the limit line. When the limit line is defined as an upper limit, the margin means that the level is below the limit line. When the limit line is defined as a lower limit, the margin means that the level is above the limit line. The default setting is 0 dB (i.e. no margin).

IEC/IEEE bus command: `CALC:LIM3:UPP:MARG 10dB`
`CALC:LIM3:LOW:MARG 10dB`

Threshold – **Selection of the threshold value with relative Y scaling**

With relative Y scaling, an absolute threshold value can be defined which lowers the relative limit values. The function is useful especially for mobile radio applications provided the limit values are defined in relation to the carrier power as long as they are above an absolute limit value.

Example:
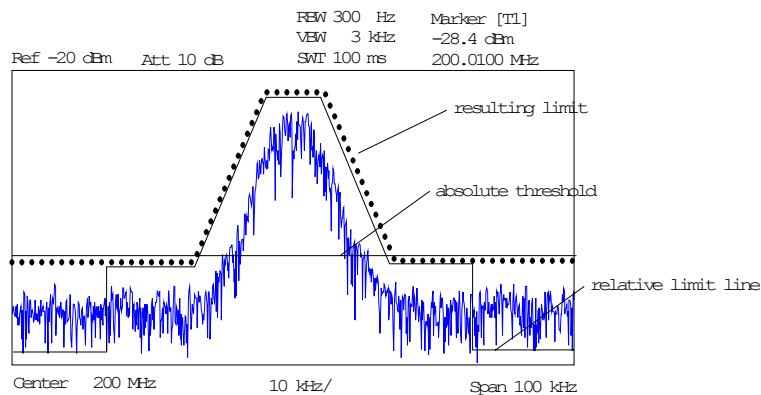
The preset value is at -200 dBm. The field is displayed if the value RELATIVE is entered in the field Y-SCALING.

IEC/IEEE bus command: `CALC:LIM3:UPP:THR –30 dBm`
                                          `or`
                                          `CALC:LIM3:LOW:THR –30 dBm`

Comment - Enter comments

Comments are arbitrary, however, they must be less than 41 characters long.

IEC/IEEE bus command: `CALC:LIM3:COMM "Upper limit"`

VALUES	The *VALUES* softkey activates the entry of the data points in the table columns *Time*/*Frequency* and *Limit/dB*. Which table columns appear depends upon the *Domain* selection in the table heading.

The desired frequency/time data points are entered in ascending order (two repeated frequencies/time values are permitted).

IEC/IEEE bus command: `CALC:LIM3:CONT:DATA 1MHz,3MHz,30MHz`
                                          `CALC:LIM3:UPP:DATA –10,0,0`
                                          `CALC:LIM3:LOW:DATA –30,–40,–40`

INSERT VALUE   The *INSERT VALUE* softkey creates an empty line above the current cursor position where a new data point may be entered. However, during the entry of new values, it is necessary to observe an ascending order for frequency/time.

IEC/IEEE bus command: `--`

DELETE VALUE   The *DELETE VALUE* softkey erases the data point (complete line) at the cursor position. All succeeding data points are shifted down accordingly.

IEC/IEEE bus command: `--`

SHIFT X LIMIT LINE   The *SHIFT X LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted parallel in the horizontal direction.

The shift takes place according to the horizontal scale:

– in the frequency domain in Hz, kHz, MHz or GHz

– in the time domain in ns, µs, ms or s

In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally and stored (*SAVE LIMIT LINE* softkey) under a new name (*NAME* softkey).

IEC/IEEE bus command: `CALC:LIM3:CONT:SHIF 50KHz`

SHIFT Y LIMIT LINE   The *SHIFT Y LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted parallel in the vertical direction.

The shift takes place according to the vertical scale:

– for logarithmic units, relative, in dB

– for linear units, as a factor

In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted vertically and stored (*SAVE LIMIT LINE* softkey) under a new name (*NAME* softkey).

IEC/IEEE bus command: `CALC:LIM3:CONT:UPP:SHIF 20dB`
                           `CALC:LIM3:CONT:LOW:SHIF 20dB`

SAVE LIMIT LINE   The *SAVE LIMIT LINE* softkey stores the currently edited limit line. The name can be entered in an input window (max. 8 characters)

IEC/IEEE bus command: `--`

Display Lines

Display lines help to evaluate a trace – as do markers. The function of a display line is comparable to that of a ruler that can be shifted on the trace in order to mark absolute values.

The ESU provides two different types of display lines:

• two horizontal level lines for marking levels – Display Line 1/2,

• two vertical frequency or time lines for marking frequencies or points in time – Frequency/Time Line 1/2.

Each line is identified by one of the following abbreviations:

D1   Display Line 1
D2   Display Line 2
F1   Frequency Line 1
F2   Frequency Line 2
T1   Time Line 1
T2   Time Line 2

The level lines are continuous horizontal lines across the entire width of a diagram and can be shifted in y direction.

The frequency or time lines are continuous vertical lines across the entire height of the diagram and can be shifted in x direction.

The *DISPLAY LINES* submenu for activating and setting the display lines appears different depending on the display mode set in the active measurement window (frequency or time domain).

If the spectrum is shown (span ≠ 0) the *TIME LINE 1* and *TIME LINE 2* softkeys are disabled, whereas in the time domain (span = 0) the *FREQUENCY LINE 1* and *FREQUENCY LINE 2* softkeys are not available.

Working with display lines

The softkeys for setting and switching the display lines on/off work like triple switches:

Initial situation: The line is off (softkey with gray background)

1st press: The line is switched on (softkey with red background) and the data input function is activated. The position of the display line can be selected by means of the rotary knob, the step keys or a numerical entry in the appropriate field. The data input function is disabled if another function is activated. The line, however, remains switched on (softkey with green background).

2nd press: The line is switched off (softkey with gray background).

Initial situation: The line is on (softkey with green background)

1st press: The data input function is activated (softkey with red background). The position of the display line can be selected by means of the rotary knob, the step keys or a numerical entry in the appropriate field. The data input function is disabled if another function is activated. The line, however, remains switched on (softkey with green background).

2nd press: The line is switched off (softkey with gray background).

DISPLAY LINES
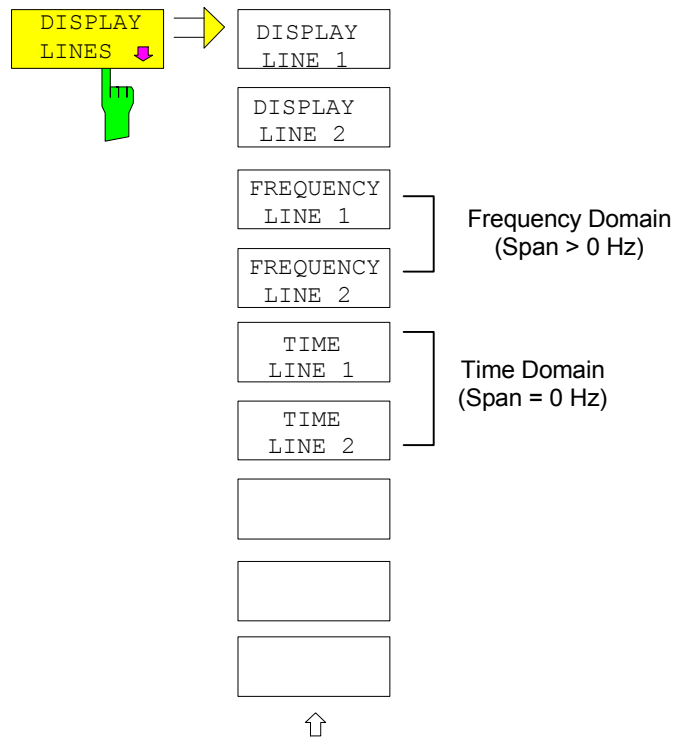
DISPLAY LINE 1
DISPLAY LINE 2

The *DISPLAY LINE 1/2* softkeys enable or disable the level lines and allow the user to enter the position of the lines.

The level lines mark the selected level in the measurement window.

IEC/IEEE bus command: CALC:DLIN:STAT ON
                          CALC:DLIN -20dBm

FREQUENCY LINE 1
FREQUENCY LINE 2
The *FREQUENCY LINE 1/2* softkeys enable or disable the frequency lines 1/2 and allow the user to enter the position of the lines.

The frequency lines mark the selected frequencies in the measurement window.

> **Note**
>
> The two softkeys cannot be used in the time domain (span = 0).

IEC/IEEE bus command: `CALC:FLIN:STAT ON`
                          `CALC:FLIN 120MHz`

TIME LINE 1
TIME LINE 2
The *TIME LINE 1/2* softkeys enable or disable the time lines 1/2 and allow the user to enter the position of the lines.

The time lines mark the selected times or define search ranges (see section "Marker Functions – MKR FCTN" on page 4.170).

> **Note**
>
> The two softkeys cannot be used in the frequency domain (span > 0).

IEC/IEEE bus command: `CALC:TLIN:STAT ON`
                          `CALC:TLIN 10ms`

Configuration of Screen Display – DISP Key

The *DISPLAY* menu allows the configuration of the diagram display on the screen and also the selection of the display elements and colors. The POWER SAVE mode is also configured in this menu for the display.

The test results are displayed on the screen of the ESU either in a full-screen window or in two overlapping windows. The two windows are called diagram A and diagram B.

In the default setting, the two windows are completely decoupled from each other, i.e. they behave like two separate instruments. This is very useful, for example with harmonics measurements or measurements on frequency-converting DUTs, since the input signal and the output signal lie in different frequency ranges.

However, specific settings of the two windows (reference level, center frequency) can be coupled, if required, so that with *CENTER B = MARKER A* for example, the shift of the marker in diagram A causes the frequency range (zoomed in some cases) to be shifted along diagram B.

In the default setting, the upper half of the screen shows the bar graph measurement of the receiver (screen A) and the lower half shows the sweep of the IF analysis (screen B). Various instrument settings such as RF attenuation are coupled together for the two measurement screens, i.e. changing a setting in one of the measurement screens automatically changes it in the other screen. You can define which instrument settings are to be coupled from the *PARAM COUPLING* menu.

New settings are performed in the diagram selected via *SCREEN A* or *SCREEN B* hotkey. If only one window is displayed, it is the diagram in which the measurements are performed; the diagram not displayed is not active for measurements.

Fig. 4-24   Typical split-screen display

The *DISP* key opens the menu for configuring the screen display and selecting the active diagram in SPLIT SCREEN mode.

	LINES
	DISP
	F...

Receiver

| FULL SCREEN |
| SPLIT SCREEN |
| PARAM COUPLING |
| |
| BARGRAPH MAXHOLD |
| BARGRAPH RESET |
| |
| |
| CONFIG DISPLAY |

Analyzer

| FULL SCREEN |
| SPLIT SCREEN |
| PARAM COUPLING |
| REF LEVEL COUPLED |
| |
| CENTER B = MARKER A |
| CENTER A = MARKER B |
| |
| CONFIG DISPLAY |

| SCREEN TITLE |
| TIME+DATE ON OFF |
| LOGO ON OFF |
| ANNOTATION ON OFF |
| DATA ENTRY OPAQUE |
| DEFAULT COLORS 1 |
| DEFAULT COLORS 2 |
| |
| DISPLAY PWR SAVE |

| SELECT OBJECT |
| BRIGHTNESS |
| TINT |
| SATURATION |
| |
| PREDEFINED COLORS |
| |
| |
| |

FULL SCREEN

The *FULL SCREEN* softkey selects the display of one diagram. This corresponds to the default setting of ESU.

In Analyzer mode, it is possible to switch between two different device settings by selecting the active window (screen A or screen B).

Switching between *SCREEN A* and *SCREEN B* is performed by means of the corresponding key in the hotkey bar (for details refer to "Mode Selection – Hotkey Bar" on page 4.10).

It should be noted that the measurements in the FULL SCREEN mode are performed only in the visible (active) window.

The active window is marked by **A** or **B** on the right of the diagram.

IEC/IEEE bus command: DISP:FORM SING
                          DISP:WIND<1|2>:SEL

SPLIT SCREEN

The *SPLIT SCREEN* softkey selects the display of two diagrams. The upper diagram is designated *SCREEN A*, the lower diagram *SCREEN B*.

Switching between *SCREEN A* and *SCREEN B* is performed via the corresponding key in the hotkey bar. The active window is marked by highlighting fields **A** and **B** on the right of the diagram.

In receiver mode, screen A displays the receiver bar graph and screen B the scan diagram or the IF analysis diagram.

IEC/IEEE bus command: DISP:FORM SPL

PARAM COUPLING   The *PARAM COUPLING* softkey opens the submenu for selecting the coupled
                       parameters of receiver and analyzer mode.

```
                  PARAMETER COUPLING
                        Frequency
  √  Analyzer Center <-> Receiver Frequency
     Start - Stop (Sweep <-> Scan)

                        Amplitude
  √  Attenuation + Unit
  √  Minimum Attenuation
  √  Preamp

                          Other
  √  Preselector
     Demodulator
     Bandwidth

            Press ENTER to select/deselect field
```
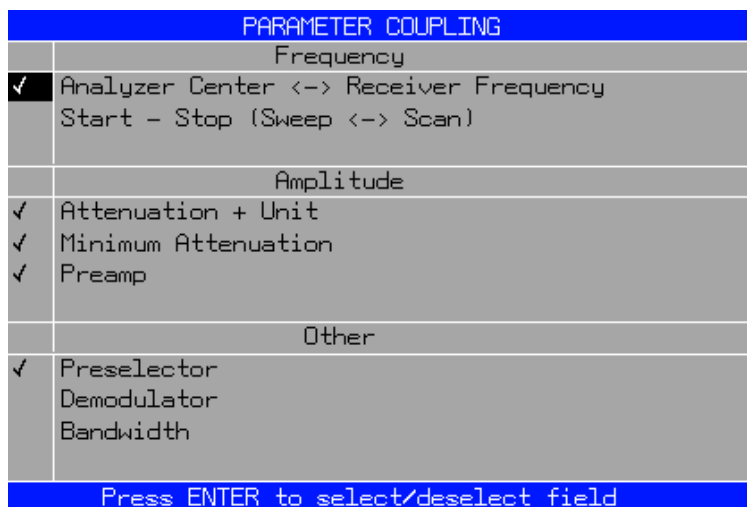
COUPLING TABLE   The *COUPLING TABLE* softkey opens the PARAMETER COUPLING table.

                       IEC/IEEE bus command:

Analyzer Center	`INST:COUP:CENT ALL`
Start-Stop	`INST:COUP:SPAN ALL`
Attenuation, Unit	`INST:COUP:ATT ALL`
Minimum Attenuation	`INST:COUP:PROT ALL`
Preamp	`INST:COUP:GAIN ALL`
Preselector	`INST:COUP:PRES ALL`
Demodulator	`INST:COUP:DEM ALL`
Bandwidth	`INST:COUP:BWID ALL`

DEFAULT CONFIG   The *DEFAULT CONFIG* softkey activates the preset settings of the
                       PARAMETER COUPLING table.

                       IEC/IEEE bus command: --

ENABLE ALL ITEMS   The *ENABLE ALL ITEMS* softkey switches all of the possible couplings to on.
                       The coupling of center frequency is switched on, therefore coupling of start /
                       stop frequency is switched off.

                       IEC/IEEE bus command: --

DISABLE ALL ITEMS   The *DISABLE ALL ITEMS* softkey switches all of the possible couplings to off.

                       IEC/IEEE bus command: --

BARGRAPH   The *BARGRAPH MAXHOLD* switches on the maxhold display of a single
MAXHOLD   measurement.

The *BARGRAPH MAXHOLD* softkey changes the display of the results of the bar graph measurement such that both the highest level for each detector and the frequency at which it is measured are displayed. The MAX Hold value will not be automatically reset by the instrument until BARGRAPH MAXHOLD is switched off or until, for example, the test receiver mode is deactivated as a result of switching to the spectrum analyzer.

Thus, you can also trace fluctuating interference signals in the frequency, and the highest measured value will remain on screen together with the associated frequency.

IEC/IEEE bus command: `DISP:BARG:PHOL ON`

BARGRAPH RESET   The *BARGRAPH RESET* softkey resets the stored maximum values of the bar graph measurement.

IEC/IEEE bus command: `DISP:BARG:PHOL:RES`

REF LEVEL COUPLED

The *REF LEVEL COUPLED* softkey switches the coupling of the reference level on and off. In addition to the reference level, the mixer level and input attenuation are coupled with one another.

For the level measurement, the same reference level and input attenuation must be set for the two diagrams.

IEC/IEEE bus command: `INST:COUP RLEV`

CENTER B = MARKER A / CENTER A = MARKER B

The *CENTER B = MARKER A* and *CENTER A = MARKER B* softkeys couple the center frequency in diagram B with the frequency of marker 1 in diagram A and the center frequency in diagram B with the frequency of marker 1 in diagram B. The two softkeys are mutually exclusive.

This coupling is useful, e.g. for viewing the signal at the marker position in diagram A with higher frequency resolution or in the time domain in diagram B.

If marker 1 is off, it is switched on and set to the maximum of the trace in the active diagram.

The softkeys are only available in receiver mode.

IEC/IEEE bus command: `INST:COUP CF_B`
                         `INST:COUP CF_A`

CONFIG DISPLAY
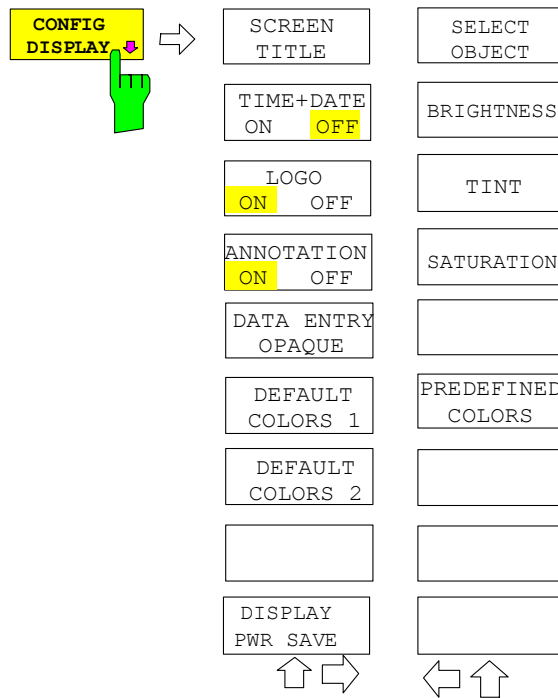
The *CONFIG DISPLAY* softkey opens a submenu allowing additional display items to be added to the screen. In addition, the display power-save mode (*DISPLAY PWR SAVE* softkey) and the colors of the display elements can be set here.

SCREEN TITLE The *SCREEN TITLE* softkey activates the entry of a title for the active diagram A or B. It switches on or off a title that is already input. The length of the title is limited to max. 20 characters.

IEC/IEEE bus command: `DISP:WIND1:TEXT 'Noise Meas'`
`DISP:WIND1:TEXT:STATe ON`

TIME+DATE ON/OFF The *TIME+DATE ON/OFF* softkey switches on or off the display of date and time above the diagram.

IEC/IEEE bus command: `DISP:TIME OFF`

LOGO ON/OFF The *LOGO ON/OFF* softkey switches the Rohde & Schwarz company logo displayed in the upper left corner of the display screen on or off.

IEC/IEEE bus command: `DISP:LOGO ON`

ANNOTATION ON/ OFF The *ANNOTATION ON/OFF* softkey switches the displaying of frequency information on the screen on and off.

- ON: Frequency information is displayed.

- OFF: Frequency information is not outputted to the display. This can be used for example to protect confidential data.

IEC/IEEE bus command: `DISP:ANN:FREQ ON`

DATAENTRY OPAQUE The *DATAENTRY OPAQUE* softkey sets the data entry windows to opaque. This means that entry windows are underlaid with the background color for tables.

IEC/IEEE bus command: `--`

DEFAULT COLORS 1
DEFAULT COLORS 2 The *DEFAULT COLORS 1/2* softkeys restores the default settings for brightness, color tint and color saturation for all display screen elements.

The color schemes have been selected to give optimum visibility of all picture elements at an angle of vision from above or below. *DEFAULT COLORS 1* is active in the default setting of the instrument.

IEC/IEEE bus command: `DISP:CMAP:DEF1`
`DISP:CMAP:DEF2`

DISPLAY PWR SAVE The *DISPLAY PWR SAVE* softkey is used to switch on/off the power-save mode for the display and to enter the time for the power-save function to respond. After the elapse of this time the display is completely switched off, i.e. including backlighting.

Note

This mode is recommended for saving the TFT display especially when the instrument is exclusively operated in remote control.

The power-save mode is configured as follows:

• The first keystroke activates the power-save mode and opens the editor for the response time. The response time is entered in minutes between 1 and 6 minutes and is confirmed by *ENTER*.

• The power-save mode is deactivated by pressing the key again.

On leaving the menu with the power-save mode in the activated state, the softkey is highlighted in color on returning to the menu and opens again the editor for the response time. Pressing again the key switches off the power-save mode.

IEC/IEEE bus command: `DISP:PSAV ON`
                          `DISP:PSAV:HOLD 15`

SELECT OBJECT   The *SELECT OBJECT* softkey activates the *SELECT DISPLAY OBJECT* table, with which a graphics element can be selected. After selection, the brightness, tint and saturation of the selected element can be changed using the softkeys of the same name. The color changes by means of the *PREDEFINED COLORS* softkey can be seen immediately on the display screen.

```
              SELECT DISPLAY OBJECT
√ Background
  Grid
  Function field + status field + data entry text
  Function field LED on
  Function field LED warn
  Enhancement label text
  Status field background
  Trace 1
  Trace 2
  Trace 3
  Marker
  Lines
  Measurement status + limit check pass
  Limit check fail
  Table + softkey text
  Table + softkey background
  Table selected field text
  Table selected field background
  Table + data entry field opaq titlebar
  Data entry field opaq text
  Data entry field opaq background
  3D shade bright part
  3D shade dark part
  Softkey state on
  Softkey state data entry
  Logo
```

BRIGHTNESS   The *BRIGHTNESS* softkey activates entry of the brightness of the selected graphics element.

Values between 0 and 100% can be entered.

IEC/IEEE bus command: `DISP:CMAP3:HSL< hue>,<sat>,<lum>`

TINT   The *TINT* softkey activates the entry of the color tint of the selected element. The entered value is related to a continuous color spectrum ranging from red (0%) to blue (100%).

IEC/IEEE bus command: `DISP:CMAP3:HSL <hue>,<sat>,<lum>`

SATURATION   The *SATURATION* softkey activates the entry of the color saturation for the selected element.

The range of inputs is from 0 to 100%.

IEC/IEEE bus command: `DISP:CMAP3:HSL <hue>,<sat>,<lum>`

PREDEFINED COLORS   The *PREDEFINED COLORS* softkey activates a table, with which the predefined colors for the display screen elements can be selected.

```
            COLOR

  √ BLACK
    BLUE
    BROWN
    GREEN
    CYAN
    RED
    MAGENTA

    YELLOW
    WHITE
    GRAY
    LIGHT GRAY
    LIGHT BLUE
    LIGHT GREEN
    LIGHT CYAN
    LIGHT RED
    LIGHT MAGENTA
```

IEC/IEEE bus command: `DISP:CMAP1 to 26:PDEF <color>`

Instrument Setup and Interface Configuration – SETUP Key

The *SETUP* key opens the menu for configuration of the ESU:

```
                                    TRANSDUCER   TRANSDUCER                            USER PORT
                                      FACTOR        SET                                 IN   OUT

        TRANSDUCER        INSERT     INS BEFORE        GPIB            SOFT             PORT 0
          FACTOR           LINE        RANGE                        FRONTPANEL          0    1

        TRANSDUCER        DELETE     INS AFTER      USER PORT                           PORT 1
           SET             LINE        RANGE                                            0    1

          NEW                         DELETE          COM                               PORT 2
                                      RANGE        INTERFACE                            0    1

          EDIT                        RANGES         TIME +                             PORT 3
                                     1-5   6-10       DATE                              0    1

         DELETE                                     CONFIGURE                           PORT 4
                                                     NETWORK                            0    1

          VIEW                                       NETWORK                            PORT 5
        TRANSDUCER                                    LOGIN                             0    1

       REFLVL ADJ                                                                       PORT 6
       AUTO   MAN                                                                       0    1

         PAGE UP         SAVE TRD    SAVE TRD                                           PORT 7
                          FACTOR       SET                                             0    1

        PAGE DOWN                                    OPTIONS



                                     INPUT          HARDWARE        INSTALL            GPIB
        REFERENCE       FIRMWARE       RF             INFO           OPTION           ADDRESS
        INT   EXT        UPDATE
                                     INPUT          STATISTICS      REMOVE           ID STRING
          LISN                        CAL                            OPTION           FACTORY

                                    SELFTEST         SYSTEM                          ID STRING
         PREAMP        NOISE SRC                    MESSAGES                            USER
        ON    OFF      ON    OFF     SELFTEST                                           GPIB
       PRESELECT                     RESULTS                                         LANGUAGE
        ON    OFF                                   CLEAR ALL
                                                    MESSAGES
        TRANSDUCER                 CAL GEN
                                   128 MHZ
         GENERAL        PRESET
         SETUP         RECEIVER    CAL GEN
                                  COMB PULSE
         SYSTEM         PRESET
          INFO         ANALYZER    CAL GEN
                                  COMB RECT
         SERVICE


                                   ENTER
                                  PASSWORD



        ESH2-Z5      PHASE N      PHASE N      PHASE N      PHASE N            FIRMWARE
                                                                               UPDATE
        ESH3-Z5      PHASE L1     PHASE L1     PHASE L1     PHASE L1           RESTORE
                                                                              FIRMWARE
        ENV 4200     PHASE L2                  PHASE L2                        UPDATE
                                                                               PATH
        ENV 216      PHASE L3      PE          PHASE L3     150 KHZ
                                 GROUNDED                  HIGHPASS
          OFF                      PE
                                 FLOATING
                        PE
                     GROUNDED
                        PE
                     FLOATING
```

The following settings can be modified here:

- The *REFERENCE INT/EXT* softkey determines the source of the reference. For details refer to section "External Reference" on page 4.264.

- The *LISN* softkey opens a submenu for the V-networks (LISNs) control. For details refer to section "Control of V-Networks (LISNs)" on page 4.265.

- The *PREAMP* softkey switches on the RF preamplifier gain. For details refer to section "Preamplification and Preselection" on page 4.266.

- The *PRESELECT ON/OFF* softkey is used to switch the preselection. For details refer to section "Preamplification and Preselection" on page 4.266.

- The *TRANSDUCER* softkey opens a submenu for entering the correction characteristics for transducers.

- The *GENERAL SETUP* softkey opens a submenu for all the general settings such as IEC/IEEE-bus address, date and time as well as the configuration of the device interfaces. *FIRMWARE OPTIONS* can be installed under this menu item.

- The *SYSTEM INFO* softkey opens a submenu for displaying the hardware configuration of the instrument, the switching cycle statistics and system messages.

- The *SERVICE* softkey opens a submenu in which special device functions and system information can be selected for servicing. The password required for service functions can be entered in this submenu.

- The *SERVICE FUNCTIONS* softkey enables additional special settings for servicing and troubleshooting. It is available after entering the corresponding password under the *SERVICE* softkey.

External Reference

The ESU can use the internal reference source or an external reference source as frequency standard from which all internal oscillators are derived. A 10 MHz crystal oscillator is used as internal reference source. In the default setting (internal reference), this frequency is available as output signal at rear-panel connector REF OUT, e.g. to synchronize other instruments to the reference of the ESU.

In the setting *REFERENCE EXT*, the connector REF IN is used as input connector for an external frequency standard. In this case all internal oscillators of the ESU are synchronized to the external reference frequency (also 10 MHz).

REFERENCE INT / EXT
The *REFERENCE INT / EXT* softkey switches between the internal and external reference.

If the external reference is selected, also the frequency of the external reference is adjustable between 1 MHz and 20 MHz.

The default value is 10 MHz.

These reference settings are not changed if a preset occurs to maintain the specific setup of a test system.

> **Note**
>
> If the reference signal is missing when switching to external reference, the message "EXREF" appears after a while to indicate that there is no synchronization.
>
> On switching to internal reference please ensure that the external reference signal is de-activated to avoid interactions with the internal reference signal.

IEC/IEEE bus command: `ROSC:SOUR INT`
                          `ROSC:EXT:FREQ <numeric value>`

Control of V-Networks (LISNs)

LISN   The *LISN* softkey opens the submenu including the settings required to control V-networks (LISNs).

ESH2-Z5 ENV 4200 / ESH3-Z5 / OFF
PHASE N / PHASE L1 / PHASE L2 / PHASE L3
PE GROUNDED / PE FLOATING

ESH2-Z5 ENV 4200 / ESH3-Z5 / OFF   The *ESH2-Z5 ENV 4200*, *ESH3-Z5*, and *OFF* softkeys select the V-network to be controlled via the user port. They are toggle softkeys, and only one of them can be activated at a time.

ESH2-Z5 ENV 4200   Four-line V-network is controlled.

ESH3-Z5   Two-line V-network is controlled.

OFF   Remote control is deactivated.

IEC/IEEE bus command: `INP:LISN TWOP|FOUR|OFF`

PHASE N / PHASE L1 / PHASE L2 / PHASE L3   The *PHASE N*, *PHASE L1*, *PHASE L2*, and *PHASE L3* softkeys select the phase of the V-network on which the RFI voltage is to be measured.

PHASE N   RFI on phase N is measured.

PHASE L1   RFI on phase L1 is measured.

PHASE L2   RFI on phase L2 is measured
                      (only for ESH2-Z5/ENV 4200).

PHASE L3   RFI on phase L3 is measured
                      (only for ESH2-Z5/ENV 4200).

IEC/IEEE bus command: `INP:LISN:PHAS L1|L2|L3|N`

PE GROUNDED / PE FLOATING

The *PE GROUNDED* and *PE FLOATING* softkeys switch the protective earth conductor chokes on or off.

> *PE GROUNDED*   Protective earth conductor choke is switched off.
>
> *PE FLOATING*   Protective earth conductor choke is switched on.

IEC/IEEE bus command: `INP:LISN:PEAR GRO|FLO`

Preamplification and Preselection

In the frequency range up to 3.6 GHz, R&S ESU offers a preselection with switchable preamplifier which can be selected by the user in the analyzer mode. The preselection is always active in the receiver mode.

The 20 dB preamplifier is available only if the preselection is switched on.

Preselection

The frequency range 20 Hz to 3.6 GHz is distributed over 12 filter bands.

Two fixed-tuned filters are used up to 2 MHz, eight tracking passband and high-pass filters from 2 MHz to 2000 MHz and two fixed-tuned high-pass filter above 2 GHz.

The filters are switched by a relay at 150 kHz and by PIN-diode switches above 150 kHz.
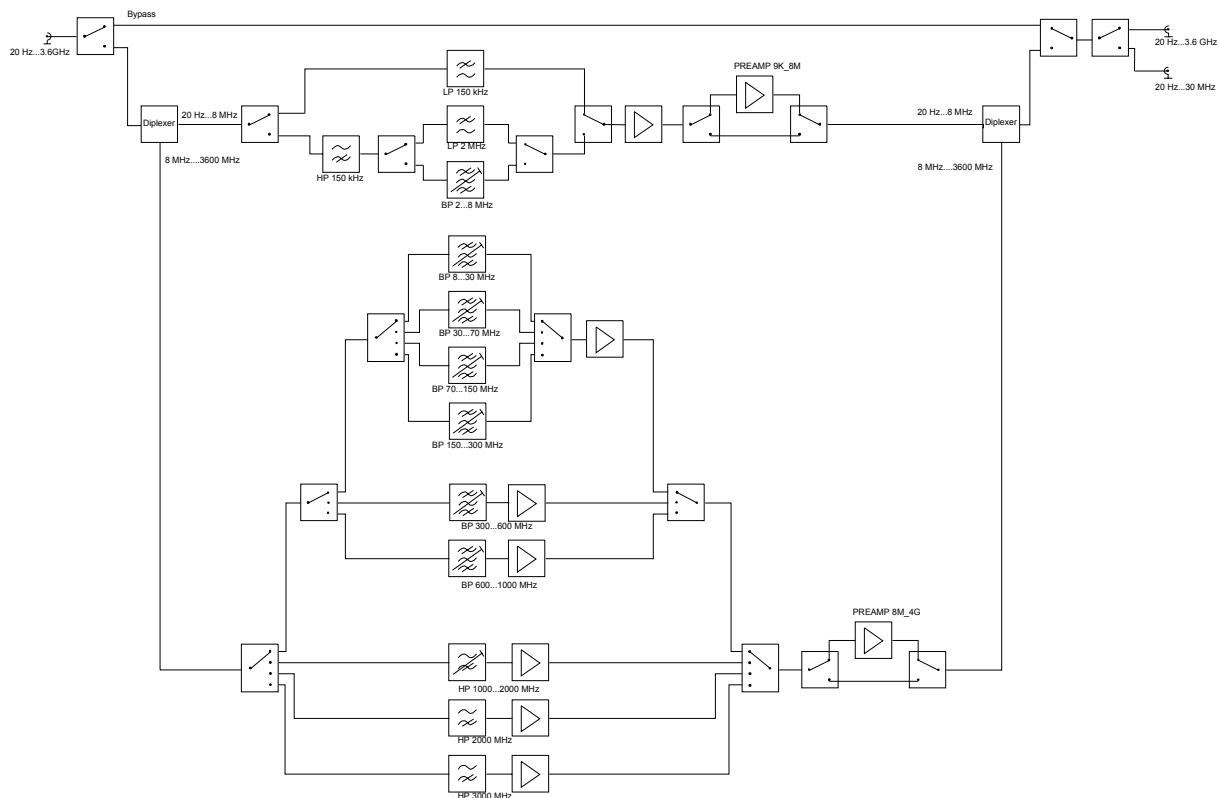
Fig. 4-1   Preselection and preamplifier

PRESELECT ON/ OFF

The *PRESELECT ON/OFF* softkey switches the preselection on or off.

The softkey is available only in the analyzer mode.

IEC/IEEE bus command: `INP:PRES ON`

Preselection causes additional dependencies which are automatically taken into account in the coupled setting.

• With the preselection active, the FFT bandwidths are not available.

• With the preselection active, the start frequency is set to 150 kHz in the FULL SPAN setting to avoid permanent switching of the relay at the band limit of 150 kHz.

• Due to the limited tuning speed of the tracking passband filters, the maximum sweep rate (3.6 GHz / 5 ms) can no longer be attained with the preselection switched on. The minimum settable sweep time is obtained from the sum of the minimum possible sweep times in the associated filter bands.

Filter band	Min. sweep time for filter band
9 kHz to 150 kHz	-
150 kHz to 2 MHz	-
2 to 8 MHz	500 ms
8 to 30 MHz	50 ms
30 to 70 MHz	50 ms
70 to 150 MHz	50 ms
150 to 300 MHz	50 ms
300 to 600 MHz	50 ms
600 to 1000 MHz	50 ms
1000 to 2000 MHz	50 ms
2000 to 3000 MHz	-
3000 to 3600 MHz	-

Preamplification

Switching on the preamplifier diminishes the total noise figure of the R&S ESU, thus increasing the sensitivity. The preamplifier follows the preselection filters so that the risk of overdriving by strong out-of-band signals is reduced to a minimum. The signal level of the subsequent mixer is 20 dB higher so that the maximum input level is reduced by the gain of the preamplifier. The total noise figure of R&S ESU is reduced from approx. 18 dB to approx. 11 dB with the preamplifier switched on. The use of the preamplifier is recommended when measurements with a maximum sensitivity are to be performed. If the measurement should be performed at maximum dynamic range, the preamplifier should be switched off.

The gain of the preamplifier is automatically considered in the level display. In Analyzer mode, on switching on the preamplifier the RF attenuation or the reference level is adapted depending on the settings of the R&S ESU.

PREAMP ON/OFF   The *PREAMP ON/OFF* softkey switches the preamplifier on or off.

The softkey is available only in the analyzer mode when the measurement with preselection is activated.

IEC/IEEE bus command: `:INP>:GAIN:STAT OFF`

Transducer

A transducer is often connected ahead of R&S ESU both during the measurement of useful signals and EMI and converts the useful or interference variable such as field strength, current or RFI voltage into a voltage across 50 Ohm.

Transducers such as antennas, probes or current probes mostly have a frequency-dependent transducer factor which can be stored in R&S ESU and automatically has the correct unit during level measurement.

If a transducer is switched on it is considered as part of the unit during the measurement, i.e. the measured values are displayed in the correct unit and magnitude. When working with two measurement windows, the transducer is always assigned to two windows.

R&S ESU distinguishes between **transducer factor** and **transducer set**. A transducer factor takes the frequency response of *a single* transfer element, e.g. an antenna into consideration. A transducer set can summarize different transducer factors in several subranges (several transducer factors at the same time), e.g. an antenna, a cable and a diplexer.

A transducer factor consists of max. 50 reference values defined with frequency, transducer factor and the unit. For the measurement between frequency values linear or logarithmic interpolation of the transducer factor can be chosen.

Several factors can be compiled in a transducer set provided that all factors have the same unit or unit "dB". The frequency range covered by a set can be subdivided into max. 10 subranges (each with up to 4 transducer factors) which follow each other without a gap, i.e. the stop frequency of a subrange is the start frequency of the next subrange.

The transducer factors used in a subrange have to fully cover the subrange.

The definition of a transducer set is recommended if different transducers are used in the frequency range to be measured or if a cable attenuation or an amplifier has to be taken into consideration.

If a transducer set is defined during a frequency sweep, the latter can be stopped at the interface between two transducer ranges and the user is asked to exchange the transducer.

The following message informs that the limit has been reached:

   TDS Range # reached, CONTINUE / BREAK

it is possible either to continue the sweep by confirming the message (*CONTINUE*) or to switch off the transducer (*BREAK*).

With the automatic switchover of the transducer used, the frequency sweep is not interrupted.

Activating Transducer Factors

The *TRANSDUCER* softkey opens a submenu enabling the user to activate or deactivate defined transducer factors, to generate new transducer factors or to edit existing ones. A table with the transducer factors defined is displayed.

As soon as a transducer is activated, the unit of the transducer is automatically used for all the level settings and outputs. The unit cannot be changed in the *AMPT* menu since the ESU and the transducer used are regarded as one measuring instrument. Only if the transducer has the unit dB, will the unit originally set on the ESU be maintained and can be changed.

If a transducer factor is active, the remark TDF appears in the enhancement labels column.

After all transducers have been switched off, the ESU returns to the unit that was used before a transducer was activated.

In the analyzer mode, an active transducer for a sweep is calculated once in advance for every point displayed and is added to the result of the level measurement during the sweep. If the sweep range changes, the correction values are calculated again. If several measured values are combined, only one value is taken into consideration.

In the receiver mode, the transducer is also calculated for a set scan. The transducer is uniquely calculated for each frequency point and added to the result of the level measurement as the measurement results are stored internally and can be zoomed subsequently.

If the active transducer factor is not defined for the entire sweep range, the values missing are replaced by zeroes.

TRANSDUCER

TRANSDUCER FACTOR
TRANSDUCER SET
EDIT
NEW
DELETE
VIEW TRANSDUCER
REFLVL ADJ AUTO MAN
PAGE UP
PAGE DOWN

The *TRANSDUCER* softkey opens a submenu for editing existing transducer factor and sets or creating new transducer factor and sets.

Tables show the settings of already existing factors and sets as well as the settings of the active factor and set.

TRANSDUCER FACTOR	
Name	**Unit**
√ Cable_1	dB
HK116	dBuV/m
HL223	dBuV/m

The *TRANSDUCER FACTOR* table contains all the defined factors with name and unit. If the number of transducer factors defined exceeds the number of lines available in the table, the user has to scroll through the table.

ACTIVE TRANSDUCER FACTOR			
Name:	Cable_1	Freq range:	10 MHz
Unit:	dB	to:	1 GHz
Comment:			

The *ACTIVE TRANSDUCER FACTOR / SET* table indicates the active transducer factor or the set with the associated name, frequency range and unit. If no factor or set is active, *NONE* is displayed in the table. Additional information can be entered in a comment line. If a transducer factor is active, the selected interpolation is displayed in addition, if a set is active, the break setting is displayed.

TRANSDUCER SET	
Name	**Unit**
30M-1G	dBuV/m

The *TRANSDUCER SET* table comprises all the defined transducer sets with the corresponding information.

Only one set or transducer can be activated. An already active transducer factor or set is switched off automatically if another one is switched on. An activated transducer factor or set is marked with a check sign.

TRANSDUCER FACTOR
The *TRANSDUCER FACTOR* softkey places the scrollbar on the position of the active transducer factor.

If a transducer factor is not active, the scrollbar is placed on the first line of the table.

IEC/IEEE bus command: `CORR:TRAN:SEL <name>`
                          `CORR:TRAN ON | OFF`

TRANSDUCER SET
The *TRANSDUCER SET* softkey sets the selection bar to the position of the active transducer set.

If no transducer set is switched on, the bar is set to the first line of the table.

IEC/IEEE bus command: `CORR:TSET:SEL <name>`
                          `CORR:TSET ON |OFF`

NEW
The *NEW* softkey gives access to the submenu for editing and generating transducer factors. For details refer to section "Entry and Editing of Transducer Factors" on page 4.271.

EDIT
The *EDIT* softkey gives access to the submenu for editing and generating transducer factors. For details refer to section "Entry and Editing of Transducer Factors" on page 4.271.

DELETE   The *DELETE* softkey deletes the marked factor or set.

To prevent deletion by mistake, deletion has to be confirmed.

```
                    MESSAGE
 Do you really want to delete this
 factor?

        YES                    NO
```
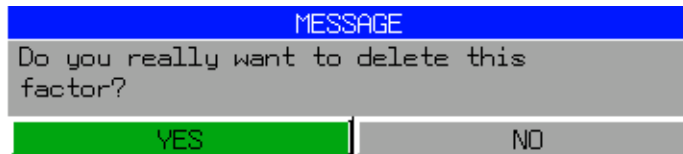
IEC/IEEE bus command: `CORR:TRAN DEL`

VIEW TRANSDUCER   The *VIEW TRANSDUCER* softkey activates the display of the active transducer factor or set.

IEC/IEEE bus command: `--`

REFLVL ADJ
AUTO MAN   When a transducer factor is used, the trace is moved by a calculated shift. However, an upward shift reduces the dynamic range for the displayed values. With the softkey *REFLVL ADJ* an automatic reference level offset adaptation allows to restore the original dynamic range by also shifting the reference level by the maximum value of the transducer factor.

IEC/IEEE bus command: `[:SENSe<1|2>:]CORRection:TRANsducer:`
                                      `ADJust:`
                                      `RLEVel[:STATe] ON | OFF`

Note

Command `CORR:TRAN:SEL` has to be sent prior to this command

PAGE UP   The *PAGE UP* softkey is used to scroll through large tables that cannot completely be displayed on the screen.

PAGE DOWN   The *PAGE DOWN* softkey is used to scroll through large tables that cannot completely be displayed on the screen.

Entry and Editing of Transducer Factors

A transducer factor is characterized by the following:

• Reference values with frequency and factor (*Values*)

• Unit of the factor (*Unit*) and

• Name (*Name*) to distinguish the various factors.

During entry the ESU checks the transducer factor for compliance with specific rules that must be met to ensure correct operation.

- The frequencies for the reference values must always be entered in ascending order. Otherwise the entry will not be accepted and the following message is displayed.

  Frequency Sequence!

- The frequencies entered may exceed the frequency range of the ESU since only the set frequency range is taken into account for measurements. The minimum frequency of a reference value is 0 Hz, the maximum frequency 200 GHz.

- The value range for the transducer factor is ±200 dB. If the minimum or maximum value is exceeded, the ESU outputs the following message:

  Min Level -200 dB or
  Max Level 200 dB.

- Gain has to be entered as a negative value, and attenuation as a positive value.

Note

The softkeys in the *UNIT* submenu of the *AMPT* key cannot be operated if the transducer is on.

NEW
EDIT
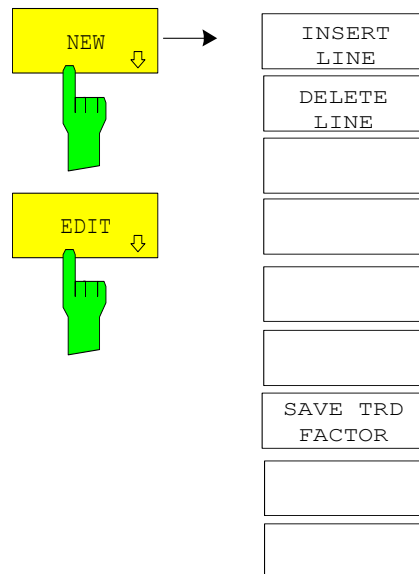
The *NEW* and *EDIT* softkeys give access to the submenu for editing and generating transducer factors.

EDIT TRANSDUCER FACTOR			
Name/Unit/Interpolation:	Cable	dB	LIN
Comment:			
FREQUENCY	TDF/dB..	FREQUENCY	TDF/dB..
1.0000000 MHz	1.000		
1.0000000 GHz	5.500		

Depending on the softkey selected, either the table with the data of the factor marked (*EDIT* softkey) or an empty table (*NEW* softkey) is displayed. This table is empty except for the following entries:

Unit: dB

Interpolation: LIN for linear frequency scaling
                              LOG for logarithmic frequency scaling

The features of the factor are entered in the header of the table, and the frequency and the transducer factor are entered in the columns.

Name	Entry of name
Unit	Selection of unit
Interpolation	Selection of interpolation
Comment	Entry of comment
FREQUENCY	Entry of frequency of reference values
TDF/dB	Entry of transducer factor.

During editing, a transducer factor remains stored in the background until the factor edited is saved with the *SAVE TRD FACTOR* softkey or until the table is closed. A factor that was edited by mistake can be restored by leaving the entry function.

Name – Entry of name

The name may consist of a maximum of 8 characters that have to comply with the conventions for DOS file names. The instrument automatically adds the extension.TDF to all transducer factors that are saved.

If an existing name is changed, the factor stored under the previous name is maintained and is not automatically overwritten by the new version. The old factor can be deleted later on using the *DELETE* function. This makes it possible to copy factors.

IEC/IEEE bus command: `CORR:TRAN:SEL <name>`

Unit - **Selection of unit**

The unit of the transducer factor is selected from a box that is activated by pressing ENTER.

```
┌─────────────────────┐
│   FACTOR UNIT       │
│      dB             │
│      dBm            │
│      dBµV           │
│      dBµV/m         │
│      dBµA           │
│      dBµA/m         │
│  ✓   dBpW           │
│      dBpT           │
└─────────────────────┘
```

The default setting is dB.

IEC/IEEE bus command: `CORR:TRAN:UNIT <string>`

Interpolation - **Selection of interpolation**

Linear or logarithmic interpolation can be performed between the frequency reference values of the table. The *ENTER* key allows the user to select LIN or LOG (toggle function).

IEC/IEEE bus command: `CORR:TRAN:SCAL LIN|LOG`

The following diagrams show the effect that interpolation has on the calculated trace:
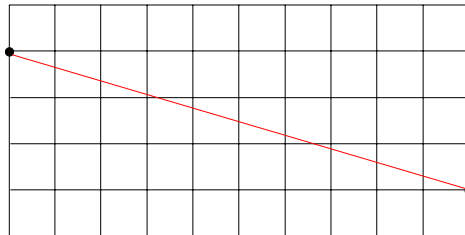
Fig. 4-25   Linear frequency axis and linear interpolation
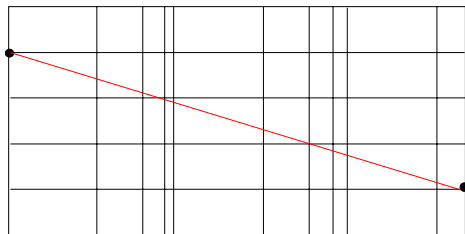
Fig. 4-26   Logarithmic frequency axis and interpolation

Comment - **Entry of comment**

Any comment with a maximum length of 50 characters can be entered.

IEC/IEEE bus command: `CORR:TRAN:COMM <string>`

FREQUENCY, TDF/dB **– Entry of values**

The scrollbar marks the first reference value. The desired reference values must be entered in ascending order of frequencies. After the frequency has been entered, the scrollbar automatically goes to the associated level value.

The table can be edited after entry of the first value using the *INSERT LINE* and *DELETE LINE* softkeys. To change individual values later on, the value has to be selected and a new one entered.

IEC/IEEE bus command: `CORR:TRAN:DATA <freq>,<level>.`

INSERT LINE
The *INSERT LINE* softkey inserts an empty line above the marked reference value. When entering a new reference value in the line, the ascending order of frequencies must be taken into consideration, however.

DELETE LINE
The *DELETE LINE* softkey deletes the marked reference value (complete line). The reference values that follow move one line up.

IEC/IEEE bus command: `--`

SAVE TRD FACTOR
The *SAVE TRD FACTOR* softkey saves the changed table in a file on the internal hard disk.

If there is already a transducer factor that has the same name, a confirmation query is output.

If the new factor is active, the new values become immediately valid.

If a transducer set is switched on comprising the factor, the values will only be used when the set is switched on next time.

IEC/IEEE bus command: `--`
(executed automatically after the definition of the reference values)

Entry and Editing of Transducer Sets

A transducer set is characterized by:

– maximum 10 ranges (*Ranges*) in which different transducer factors can be active

– the combination of several transducer factors per range (*Factor*)

– a transducer-set name *(Name)*

NEW
EDIT

```
┌─────────────┐        ┌─────────────┐
│  NEW     ⇩  │───────▶│ INS BEFORE  │
└─────────────┘        │    RANGE    │
      🖑               ├─────────────┤
                       │ INS AFTER   │
                       │    RANGE    │
                       ├─────────────┤
                       │  DELETE     │
┌─────────────┐        │    RANGE    │
│  EDIT    ⇩  │        ├─────────────┤
└─────────────┘        │    RANGE    │
      🖑               │ 1-5    6-10 │
                       ├─────────────┤
                       │             │
                       ├─────────────┤
                       │             │
                       ├─────────────┤
                       │  SAVE TRD   │
                       │    SET      │
                       ├─────────────┤
                       │             │
                       ├─────────────┤
                       │             │
                       └─────────────┘
```
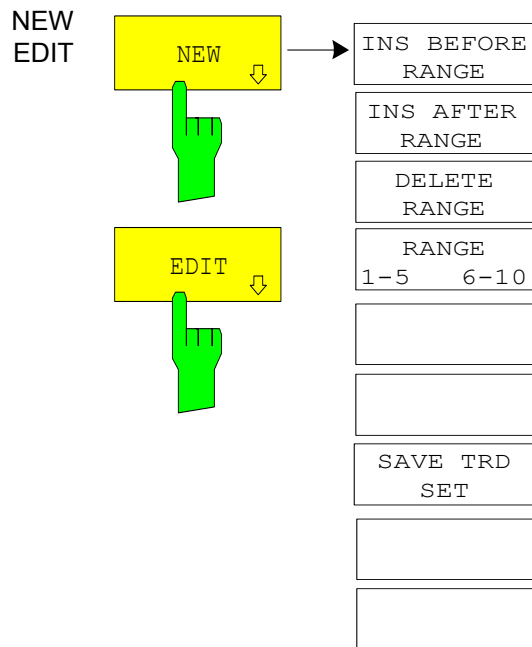
The *NEW* and *EDIT* softkeys both open the submenu for editing and entering new transducer factors if softkey *TRANSDUCER SET*.

EDIT TRANSDUCER SET					
Name/Unit/Break				**dBuV**	**OFF**
Comment:					
	RANGE1	**RANGE2**	**RANGE3**	**RANGE4**	**RANGE5**
Start **Stop** **Factors**	30 MHz 300 MHz Cable Antenna1	300 MHz 1 GHz Cable Preamp Antenna2			

The table with the data of the marked set (the *EDIT* softkey) or an empty table in which the following entries are preset (the *NEW* softkey) is displayed:

Unit: dB

Break: OFF

The characteristics of the set can be entered in the header field of the table, the subranges in the columns of the set.

Name	Entry of the name
Unit	Selection of unit
Break	Activating the query when changing the subrange
Comment	Entry of a comment
Start	Entry of the start frequency of the subrange
Stop	Entry of the stop frequency of the subrange
Factors	Selection of the transducer factors for the subrange

An overwritten transducer set remains stored in the background as long as the edited factor is stored with the *SAVE TRD SET* softkey or until the table is closed. A set overwritten by mistake can be restored by leaving the entry.

Name - Entry of name

A maximum of 8 characters is permissible for the name. The characters have to comply with the convention of DOS file names. The unit automatically stores all transducer sets with the extension .TDS.

If an existing name is changed, the set stored under the previous name is retained and will not be overwritten automatically with the new name. The previous set can be deleted at a later time using *DELETE FACTOR/SET*. Thus, sets can be copied.

IEC/IEEE bus command: CORR:TSET:SEL <name>

Unit - Selection of unit

The unit of the transducer set is selected from a selection box activated by the ENTER key.

The unit should be selected prior to the entry as it determines the settable transducer factors. The preset unit for new sets is "dB".
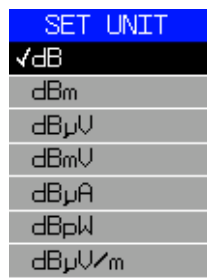
IEC/IEEE bus command: CORR:TSET:UNIT <string>

Break - Activation of query when changing a subrange

The sweep can be stopped if the user changes the subrange and selects a new subrange of the transducer. A message informs the user that the limit has been attained. He can continue the sweep or switch off the transducer.

The interruption is activated by setting Break to ON. Selection is by the ENTER key which toggles between ON and OFF (toggle function).

IEC/IEEE bus command: CORR:TSET:BRE ON|OFF

Start - Entry of start frequency of subrange
Stop - Entry of stop frequency of subrange

The individual subranges have to be linked without a gap. That is why the start frequency is already defined from the second subrange (= stop frequency of previous range).

IEC/IEEE bus command: CORR:TSET:RANG<1.10>
                                       <freq>,<freq>,<name>..

INS BEFORE RANGE   The *INS BEFORE RANGE* softkey copies the active column and inserts it to the right. The frequency limits can be edited.

IEC/IEEE bus command: --

INS AFTER RANGE   The *INS AFTER RANGE* softkey copies the active column and inserts it to the left. The frequency limits can be edited.

IEC/IEEE bus command: --

DELETE RANGE   The *DELETE RANGE* softkey deletes the marked subrange. The following subranges move left.

IEC/IEEE bus command: --

RANGES 1-5/6-10   The *RANGES 1-5/6-10* softkey switches between the display of ranges 1 to five and ranges 6 to 10.

IEC/IEEE bus command: --

Factors - Selection of factors for the subrange

The permissible transducer factors for the marked subrange can be selected in a selection box. Only factors matching with the unit of the set and fully covering the selected subrange are permissible.
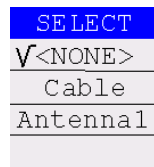
After each change of range limits, R&S ESU thus checks the factor list and, if required, rebuilds it.

After reducing the start frequency or increasing the stop frequency of a range it may happen that the factors defined for this range no longer fully cover the range. These factors are deleted for this range when the transducer factor table is opened next time.

A maximum of 4 transducer factors can be switched on at the same time in each subrange. If none of them is switched on, 0 dB is assumed as a factor for the whole subrange.

IEC/IEEE bus command: --

SAVE TRD SET   The *SAVE TRD SET* softkey saves the changed table in a file on the internal hard disk. If a transducer name with the same name already exists, a corresponding query is performed beforehand:

If the saved set is switched on, the new values will be used immediately.

IEC/IEEE bus command: -- (executed automatically)

Programming the Interface Configuration and Time Setup

The *GENERAL SETUP* softkey opens a submenu in which the general instrument parameters can be set up. In addition to the configuration of the digital interfaces (*IECBUS, COM*), the date and time may be entered.

The current settings are displayed in tabular form on the display screen where they may be edited.

GENERAL SETUP
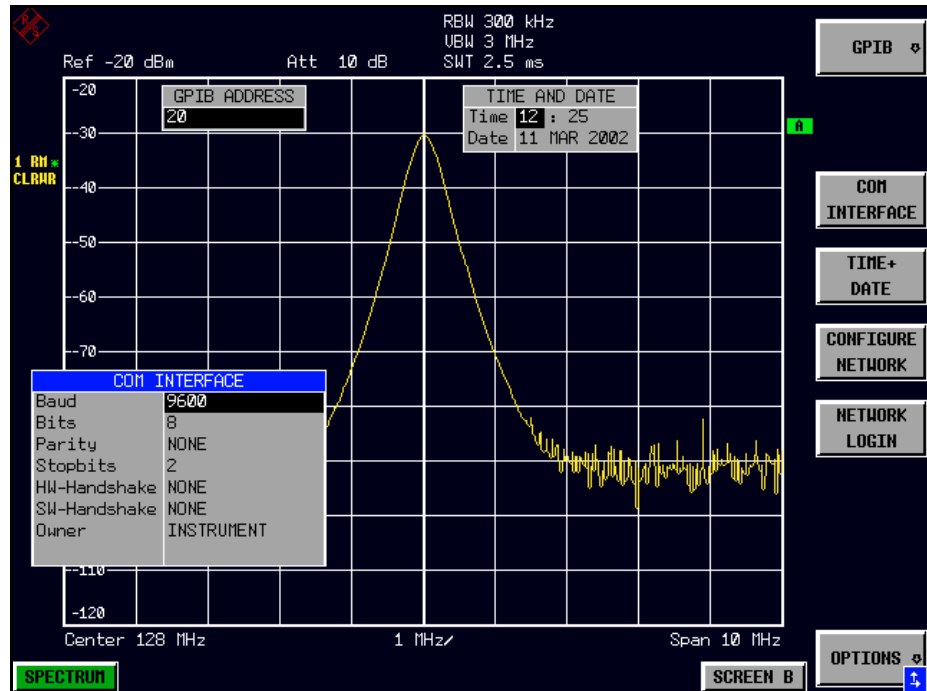
Selecting the IEC/IEEE-Bus Address

GPIB   The *GPIB* softkey opens a submenu for setting the parameters of the remote-control interface.

IEC/IEEE bus command: --

GPIB ADDRESS   The *GPIB ADDRESS* softkey enables the entry of the IEC/IEEE-bus address.

Valid addresses are 0 through 30. The default address is 20.

IEC/IEEE bus command: `SYST:COMM:GPIB:ADDR 20`

ID STRING FACTOR   The *ID STRING FACTORY* softkey selects the default response to the *IDN? query.

IEC/IEEE bus command: `--`

ID STRING USER   The *ID STRING USER* softkey opens an editor for entering a user-defined response to the *IDN? query.

Max. length of output string: 36 characters

IEC/IEEE bus command: `--`

GPIB LANGUAGE   The *GPIB LANGUAGE* softkey opens a list of selectable remote-control languages:

- SCPI
- 8560E
- 8561E
- 8562E
- 8563E
- 8564E
- 8565E
- 8566A
- 8566B
- 8568A
- 8568B
- 8591E
- 8594E
- 71100C
- 71200C
- 71209A

> **Note**
>
> For 8566A/B, 8568A/B and 8594E, command sets A and B are available. Command sets A and B differ in the rules regarding the command structure.
> Selecting a language different from "SCPI" will set the GPIB address to 18 if it was 20 before.
>
> Start / stop frequency, reference level and # of sweep points will be adapted to the selected instrument model.

On switching between remote-control languages, the following settings or changes will be made:

SCPI:

➢ The instrument will perform a PRESET.

8566A/B, 8568A/B, 8594E:

➢ The instrument will perform a PRESET.

➢ The following instrument settings will then be changed:

Model	# of Trace Points	Start Freq.	Stop Freq.	Ref Level	Input Coupling
8566A/B	1001	2 GHz	22 GHz	0 dBm	"DC (FSU/FSQ)
AC (FSP)"					
8568A/B	1001	0 Hz	1.5 GHz	0 dBm	AC
8560E	601	0 Hz	2.9 GHz	0 dBm	AC
8561E	601	0 Hz	6.5 GHz	0 dBm	AC
8562E	601	0 Hz	13.2 GHz	0 dBm	AC
8563E	601	0 Hz	26.5 GHz	0 dBm	AC
8564E	601	0 Hz	40 GHz	0 dBm	AC
8565E	601	0 Hz	50 GHz	0 dBm	AC
8594E	401	0 Hz	3 GHz	0 dBm	AC

> **Notes regarding switch over to 8566A/B and 8568A/B on ESU**
>
> • Switch-hitter of the "# of Trace Points" will not take place until the instrument is switched to the REMOTE mode. For manual operation (selected with *LOCAL* softkey), the number of sweep points (trace points) will always be set to 1251.
>
> • The stop frequency indicated in the table may be limited to the corresponding frequency of the R&S ESU, if required.

IEC/IEEE bus command: SYST:LANG "SCPI" | "8560E" |
                        "8561E" | "8562E" | "8563E" |
                        "8564E" | "8565E" | "8566A" |
                        "8566B" | "8568A" | "8568B" |
                        "8591E" | "8594E" | "71100C" |
                        "71200C" | "71209A"

User Port Configuration

The instrument provides a parallel interface, which is 8 bits wide. Over these ports, arbitrary bit patterns can be output or input.
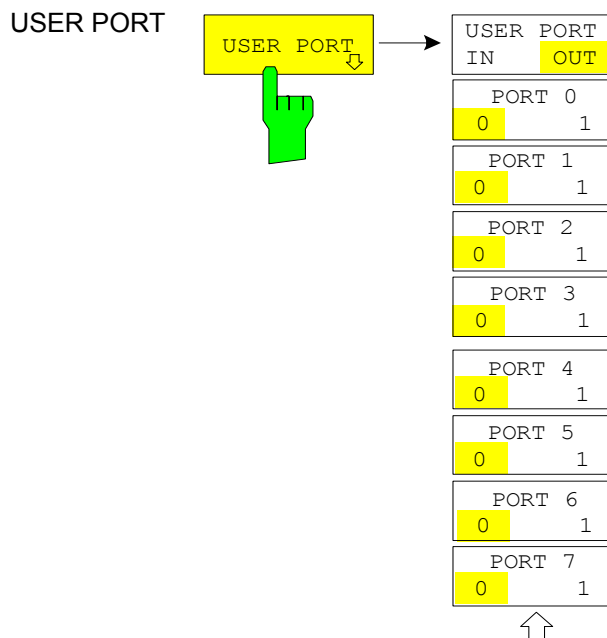
USER PORT

The *USER PORT* softkey opens the submenu for setting the direction of the data transmission and for entering the values of the individual ports.

USER PORT IN/OUT   The USER PORT IN/OUT determines in which direction the interface transmits data.

USER PORT (read operation)

The value is indicated in a window. A new readout is started by pressing *READ*. Pressing *OK* closes the window

```
┌─────────────────────┐
│   USER PORT INPUT   │
├─────────────────────┤
│       00000000      │
├──────────┬──────────┤
│   READ   │    OK    │
└──────────┴──────────┘
```
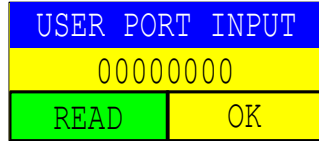
IEC/IEEE bus command: `INP:UPOR:STAT ON`
                          `INP:UPOR?`

USER PORT OUT (write operation)

The bit pattern selected with softkeys *PORT 0* to *PORT 7* is output.

IEC/IEEE bus command: `OUTP:UPOR:STAT ON`

PORT 0 0/1   The *PORT 0 0/1* to *PORT 7 0/1* softkeys determine the output value for port 1 to 7. These softkeys are only available for setting *USER PORT OUT*.

IEC/IEEE bus command: `OUTP:UPOR STAT ON`
                          `OUTP:UPOR #B10110010`

Serial Interface Configuration

COM INTERFACE   The *COM INTERFACE* softkey activates the *COM INTERFACE* table for entry of the serial interface parameters.

The following parameters can be configured in the table:

Baud rate	data transmission rate
Bits	number of data bits
Parity	bit parity check
Stop bits	number of stop bits
HW-Handshake	hardware handshake protocol
SW-Handshake	software handshake protocol
Owner	assignment to the measuring instrument or computer

```
┌──────────────────────────┐
│      COM INTERFACE       │
├──────────────┬───────────┤
│ Baud         │ 9600      │
│ Bits         │ 8         │
│ Parity       │ NONE      │
│ Stopbits     │ 2         │
│ HW-Handshake │ NONE      │
│ SW-Handshake │ NONE      │
│ Owner        │ INSTRUMENT│
│              │           │
└──────────────┴───────────┘
```

Baud **– Data transmission rate**

The ESU supports baud rates between 110 and 19200 baud. The default setting is 9600 baud.

```
 BAUD RATE
  19200
 √9600
  4800
  2400
  1200
  600
  300
  110
```
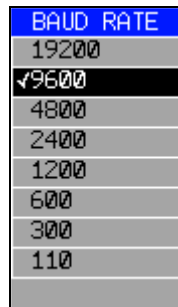
IEC/IEEE bus command: `SYST:COMM:SER:BAUD 9600`

Bits **– Number of data bits per word**

For the transmission of text without special characters, 7 bits are adequate. For binary data as well as for text with special characters, 8 bits must be selected (default setting).

```
 BITS
  7
 √8
```
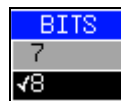
IEC/IEEE bus command: `SYST:COMM:SER:BITS 7`

Parity **– Bit parity check**

NONE   no parity check (default setting)

EVEN   even parity check

ODD   odd parity check

```
 PARITY
 √NONE
  EVEN
  ODD
```

IEC/IEEE bus command: `SYST:COMM:SER:PAR NONE`

Stop bits **– Number of stop bits**

Available are 1 and 2. The default setting is 1 stop bit.

```
 STOPBITS
  1
 √2
```

IEC/IEEE bus command: `SYST:COMM:SER:SBIT 1`

HW-Handshake **– Hardware handshake protocol**

The integrity of data transmission can be improved by the use of a hardware handshake mechanism, which effectively prevents uncontrolled transmission of data and the resulting loss of data bytes. For hardware handshake additional interface lines are used to transmit acknowledge signals with which the data transmission can be controlled and, if necessary, stopped until the receiver is ready to receive data again.

A prerequisite for using hardware handshaking is, however, that the interface lines (DTR and RTS) are connected on both transmitter and receiver. For a simple 3-wire connection, this is not the case and hardware handshake cannot be used here.

Default setting is *NONE*.

```
HW-HANDSHAKE
✓NONE
 DTR/RTS
```

IEC/IEEE bus command: `SYST:COMM:SER:CONT:DTR OFF`
                          `SYST:COMM:SER:CONT:RTS OFF`

SW-Handshake **– Software handshake protocol**

Besides the hardware handshake mechanism using interface lines, it is also possible to achieve the same effect by using a software handshake protocol. Here, control bytes are transmitted in addition to the normal data bytes. These control bytes can be used, as necessary, to stop data transmission until the receiver is ready to receive data again.

In contrast to hardware handshaking, software handshaking can be realized even for a simple 3-wire connection.

One limitation is, however, that software handshaking cannot be used for the transmission of binary data, since the control characters XON and XOFF require bit combinations that are also used for binary data transmission.

Default setting is *NONE*.

```
SW_HANDSHAKE
✓NONE
 XON/XOFF
```

IEC/IEEE bus command: `SYST:COMM:SER:PACE NONE`

Owner **– Assignment of the interface**

The serial interface can be assigned alternatively to the measuring instrument section or to the computer section.

If the interface is assigned to one section of the instrument, it is not available to the other section.

INSTRUMENT   The interface is assigned to the measuring instrument section. Outputs to the interface from the computer section are not possible will get lost.

OS   The interface is assigned to the computer section. It cannot be used by the measuring instrument section. This means that remote control of the instrument via the interface is not possible.

IEC/IEEE bus command: `--`

Setting Date and Time

TIME+DATE   The *TIME+DATE* softkey activates the entry of time and date for the internal real-time clock.
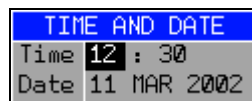
Time - Input of time

In the corresponding dialog box, the time is partitioned into two input fields so that hours and minutes can be entered independently.

IEC/IEEE bus command: `SYST:TIME 21,59`

Date - Input of Date

In the corresponding dialog box, the date is partitioned into 3 input fields so that day, month and year can be input separately.

For the selection of the month, pressing a unit key opens a list of abbreviations wherein the desired month can be selected.

IEC/IEEE bus command: `SYST:DATE 1999,10,01`

Configuration of Network Settings ESU

The instrument can be connected to an Ethernet LAN (local area network) by means of the LAN Interface ESU. This allows data transmission via the network and the use of network printers. The network card is able to handle both 10 MHz Ethernet IEEE 802.3 and 100 MHz Ethernet IEEE 802.3u.

For more details see the Quick Start Guide, appendix LAN Interface.

CONFIGURE NETWORK

The *CONFIGURE NETWORK* softkey opens the dialog box with the network settings.
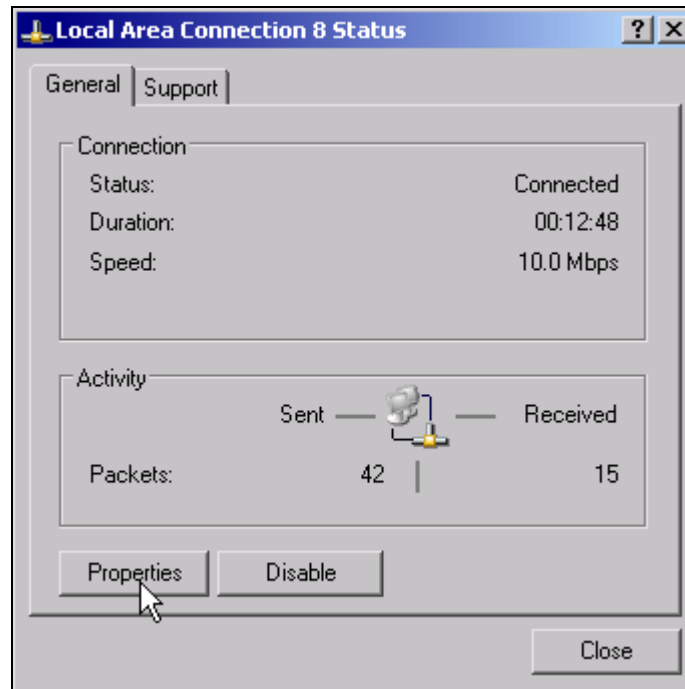
The softkey is used to modify an existing network configuration after the corresponding tabs are selected (see the quick Start Guide, appendix LAN Interface).

Notes

- A PC keyboard with trackball (or mouse instead) is required for the installation/configuration of the network support.

IEC/IEEE bus command: ――

NETWORK LOGIN The *NETWORK LOGIN* softkey opens the dialog box with the auto login settings.

When a network is installed, the preset user name 'Instrument' and the password 'instrument' can be adapted to a new user (see the Quick Start Guide, appendix LAN Interface).

With the 'Auto Login' option active, an automatic registration is performed during booting with the specified user name and password. Otherwise the Windows XP login request is displayed during booting.

Notes

• A PC keyboard with trackball (or additional mouse instead) is required for the installation/configuration of the network support.

• The softkey is only available with built-in LAN interface ESU.

IEC/IEEE bus command: --

Enabling Firmware Options

The *OPTIONS* softkey opens a submenu that allows license keys for firmware options to be entered. Previously installed options are displayed in a table that opens automatically.

OPTIONS

INSTALL OPTION

Softkey *INSTALL OPTION* opens the data entry for the license keycode of a firmware option.

On entry of a valid license key the message *OPTION KEY OK* is displayed in the status line and the firmware option appears in table *FIRMWARE OPTIONS*.

On entry of an invalid license key the message *OPTION KEY INVALID* is displayed in the status line.

IEC/IEEE bus command: --

REMOVE OPTION

Softkey *REMOVE OPTION* removes all firmware options from the instruments. Execution of this function must be confirmed in a message box in order to avoid removal of the firmware options by mistake.

IEC/IEEE bus command: --

Emulation of the Instrument Front Panel

SOFT FRONTPANEl   The *SOFT FRONTPANEL* softkey switches the display of the front-panel keys
                   on and off.

                   When the front-panel keys are displayed on the screen, the instrument can be
                   controlled by clicking the respective button with the mouse. This is especially
                   useful when the instrument in a different site is controlled via a remote-control
                   program, such as, for instance, the remote desktop of Windows XP, and the
                   screen contents are transferred to the controller via remote link (see the Quick
                   Start Guide, appendix LAN Interface).
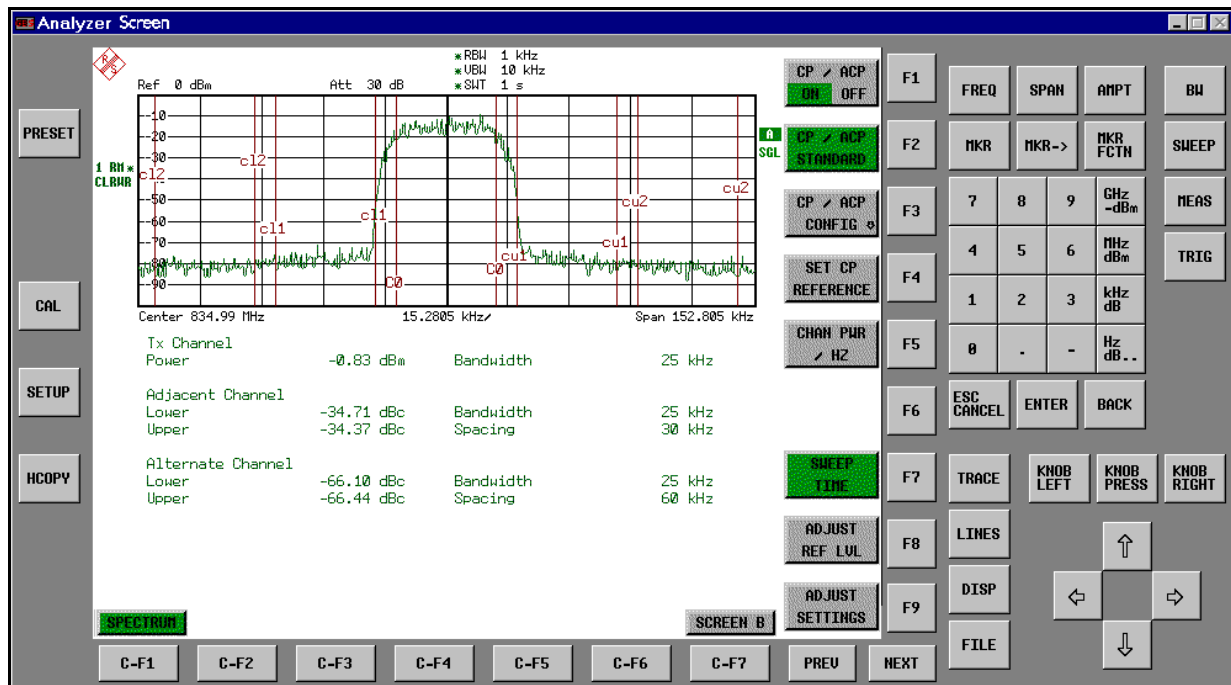
Display resolution

When the display of the front-panel keys is switched on, the screen resolution
of the instrument changes to 1024x768 pixels. Only a section of the total screen
is then displayed on the LC display, which will automatically be shifted on
mouse moves.

In order to obtain a complete display of the user interface, an external monitor
is to be plugged into the corresponding connector at the rear panel. Prior to
performing the resolution change the user is prompted for confirmation whether
the required monitor is connected.

Switching off the front-panel display restores the original screen resolution.

Key assignment

Button labels largely correspond to those of the front-panel keys. The rotation function of the rotary knob is assigned to the 'KNOB LEFT' and 'KNOB RIGHT' buttons, the press function (<ENTER>) to 'KNOB PRESS'.

The labels of the softkey buttons (F1 to F9) and of the hotkey buttons (C-F1 to C-F7) indicate that the keys can be operated directly by means of the corresponding function keys F1 to F9 or <CTRL>F1 to <CTRL>F7 of a PS/2 keyboard.

IEC/IEEE bus command: SYST:DISP:FPAN ON

System Information

The *SYSTEM INFO* softkey opens a submenu in which detailed information on module data, device statistics and system messages is displayed.

SYSTEM INFO
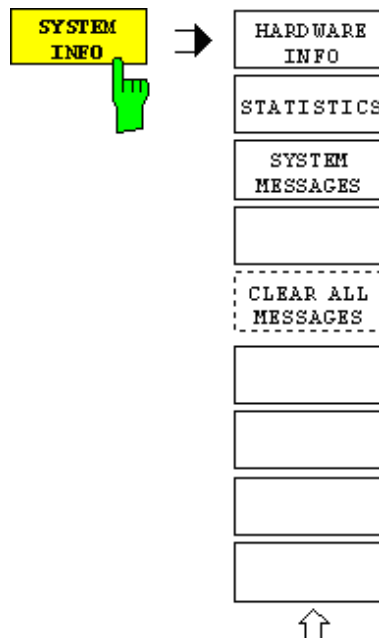
Display of Module Data

HARDWARE INFO   The *HARDWARE INFO* softkey opens a table in which the modules (INSTALLED COMPONENTS) installed in the instrument are listed together with the corresponding hardware revisions.

Table *HARDWARE INFO* consists of six columns:

SERIAL #	serial number
COMPONENT	name of module
ORDER #	order number
MODEL	model number of the module
REV	main modification index of the module
SUB REV	secondary modification index of the module

```
                          HARDWARE INFO
        COMPONENT          SERIAL #     ORDER #    MODEL  HWC  REV  SUB REV
   WBDET                 100427/005   1130.3086     05    00   04     12
   PRESELECT_EMI         999999/002   1093.7120     03    01   05     03
   MWC40_ESU             100044/042   1166.2096     42    01   08     00
   CPU-Board             050718/118   1091.3104     00    00   10     00
   MOTHERBOARD           101341/002   1302.7082     02    00   02     00
   MWC50_GS              100121/005   1166.2109     05    00   03     01
   DIPLEXER              100107/004   1162.1120     04    00   06     00
   YIG-FILTER            100056/042   1130.3963     42    00   10     00
   EXTENSION46           100161/002   1151.6010     02    00   04     00
   ESU                   900001/040   1302.6005     40    00   01     00
   MwcTempSensor         000000       0000.0000     00    00   00     00
   SYNTHESIZER           100695/002   1166.2209     02    03   02     04
   RF-CONVERTER          100844/002   1130.4047     02    01   03     11
   IF-FILTER             102358/003   1130.2296     03    10   06     15
   RF_ATTEN_50           100009/005   1046.5130     05    00   40     00
   PULSE_PWR_ATT         101440/001   1302.7047     02    00   02     00
```

Note

The screenshot lists the components of an ESU 40.

Display of Device Statistics

STATISTICS   The *STATISTICS* softkey opens the table *STATISTICS*. This table contains the model information, serial number and firmware version, and a list in which the operating time of the instrument, the power-on cycles as well as attenuator switching cycles are displayed.

```
      FIRMWARE VERSIONS - STATISTICS
Model                      ESU-40
Serial #                   100002/040

Firmware Rev.              3.83
BIOS Rev.                  V1.0-10-1
Specifications Version     01.00
Memory Size                512 MB

Operating Time (hours)     130
Power On Cycles            29

Attenuator Cycles
  Input RF/Cal             13
  5dB                      129
  10dB                     96
  20dB                     65
  40dB                     41
  AC/DC                    16
Preselector Cycles
  Bypass                   18
  PreAmp                   8
  150 kHz Switch           25
Pulse PWR Att Cycles
  Input RF/Cal             0
  Input AC/DC              16
  5dB Stage 1              8
  5dB Stage 2              20
  10dB                     12
```

IEC/IEEE bus command: --

For new delivered devices the specifications version (document of the hardware properties) is shown. For already delivered device dashes (--.--) are displayed.

Display of System Messages

SYSTEM
MESSAGES

The *SYSTEM MESSAGES* softkey opens a submenu including a table in which the generated system messages are displayed in the order of their occurrence. The most recent messages are placed at the top of the list.

The following information is available:

No   Device-specific error code

MESSAGE   Brief description of the message

COMPONENT   On hardware messages:

                 name of the affected module

            On software messages:

                 if needed, the name of the affected software components

DATE/TIME   Date and time of the occurrence of the message

Messages that have occurred since the last call to the *SYSTEM MESSAGES* menu are marked with an asterisk '*'.

The *CLEAR ALL MESSAGES* softkey is activated and allows clearing of the error buffer.

If the number of error messages exceeds the capacity of the error buffer, the message appearing first is "Message buffer overflow".

SYSTEM MESSAGES			
NO	MESSAGE	COMP.	DATE/TIME
107	Reference is Unlocked	DCON	07.MAR.02; 14:03:19
110	Error 110 size of block too big. Block id 10616	CDS	07.MAR.02; 10:38:45
110	Checksum error RF attenuator Block id 10616	CDS	07.MAR.02; 10:38:45

IEC/IEEE bus command: `SYST:ERR?`

CLEAR ALL
MESSAGES

The *CLEAR ALL MESSAGES* softkey deletes all messages in the table.

The softkey is only available when table *SYSTEM INFO* is active.

IEC/IEEE bus command: `SYST:ERR?`

Service Menu

The service menu offers a variety of additional functions which are used for maintenance and/or trouble shooting.

<table>
<tr>
<td>⚠️</td>
<td>

ATTENTION

The service functions are not necessary for normal measurement operation. However, incorrect use can affect correct operation and/or data integrity of the ESU.

Therefore, many of the functions can only be used after entering a password. They are described in the instrument service manual.

</td>
</tr>
</table>

SERVICE

INPUT RF
INPUTCAL
SELFTEST
SELFTEST RESULTS
ENTER PASSWORD
CAL GEN 128 MHZ
CAL GEN COMB
CAL GEN COMB RECT

The *SERVICE* softkey opens a submenu for selection of the service function.

The *INPUT RF* and *INPUT CAL* softkeys are mutually exclusive selection switches. Only one switch can be active at any one time.

General Service Functions

INPUT RF The *INPUT RF* softkey switches the input of the ESU to the input connector (normal position).

After *PRESET*, *RECALL* or ESU power on, the *INPUT RF* is always selected.

IEC/IEEE bus command: `DIAG:SERV:INP RF`

INPUTCAL The *INPUT CAL* softkey switches the RF input of the ESU to the internal calibration source (128 MHz) and activates the data entry of the output level of the calibration source. Possible values are 0 dB and –30 dB.

IEC/IEEE bus command: `DIAG:SERV:INP CAL;`
`DIAG:SERV:INP:CSO 0 DBM`

ENTER PASSWORD The *ENTER PASSWORD* softkey allows the entry of a password.

The ESU contains a variety of service functions which, if incorrectly used, can affect correct operation of the analyzer. These functions are normally not accessible and are only usable after the entry of a password (see instrument service manual).

IEC/IEEE bus command: `SYST:PASS "Password"`

CAL GEN 128 MHZ The *CAL GEN 128 MHZ* softkey selects a sinusoidal signal at 128 MHz as output signal for the internal calibration source. The internal pulse generator will be switched off.

IEC/IEEE bus command: `DIAG:SERV:INP:PULS OFF`

CAL GEN COMB The *CAL GEN COMB* softkey switches the internal pulse generator on and allows the pulse frequency to be entered.

Available pulse frequencies are 10 kHz, 62.5 kHz, 100 kHz, 1 MHz, 128 MHz, and 640 MHz.

CAL GEN COMB RECT The *CAL GEN COMB RECT* softkey switches the internal pulse generator on and allows the pulse frequency to be entered.

Available pulse frequencies are 5 kHz, 31.25 kHz, 50 kHz, 250 kHz, and 500 kHz.

IEC/IEEE bus command: DIAG:SERV:INP:RECT:STAT
DIAG:SERV:INP:RECT:PRAT

Selftest

SELFTEST The *SELFTEST* softkey initiates the selftest of the instrument modules.

With this function the instrument is capable of identifying a defective module in case of failure.

During the selftest a message box appears in which the current test and its result is shown. The test sequence can be aborted by pressing ENTER ABORT. All modules are checked consecutively and the test result (selftest PASSED or FAILED) is output in the message box.

IEC/IEEE bus command: `*TST?`

SELFTEST RESULTS   The *SELFTEST RESULTS* softkey calls the *SELFTEST* table in which the results of the module test are displayed.

In case of failure a short description of the failed test, the defective module, the associated value range and the corresponding test results are indicated.

```
                          SELFTEST RESULTS
Total Selftest Status: user mode ---PASSED---
Rohde&Schwarz,ESU-40,100002/040,3.83
Date (dd/mm/yyyy): 24/03/2006 Time: 14:27:26
Runtime: 01:06


Supply voltages wideband Detector [Volt]
test description     min       max       result    state
+6V                  5.50      6.60      6.16      PASSED
+8V                  7.60      9.20      8.26      PASSED
+12V                 11.39     13.20     12.32     PASSED
-12V                 -14.27    -10.45    -12.47    PASSED
-5V                  -5.97     -4.06     -5.04     PASSED
-6V                  -7.18     -4.86     -6.21     PASSED

Supply & ref. voltages IF-Filter [Volt]
test description     min       max       result    state
TEMPERATURE          0.20      70.20     39.80     PASSED
-5VREF               -5.30     -4.70     -5.00     PASSED
```

IEC/IEEE bus command: `DIAG:SERV:STE:RES?`

PAGE UP /   The *PAGE UP* or *PAGE DOWN* softkey sets the *SELFTEST RESULTS* table to
PAGE DOWN   the next or previous page.

IEC/IEEE bus command: `--`

Hardware Adjustment

Some of the ESU modules can be realigned. This realignment can become necessary after calibration due to temperature drift or aging of components (see service manual instrument).

ATTENTION

The realignment should be carried out by qualified personnel since the changes considerably influence the measurement accuracy of the instrument. This is the reason why the softkeys *REF FREQUENCY*, *CAL SIGNAL POWER* and *SAVE CHANGES* can only be accessed after entering a password.

Firmware Update

The installation of a new firmware version can be performed using a memory stick.

The installation program is called in the *SETUP* menu.

FIRMWARE UPDATE

The *FIRMWARE UPDATE* softkey opens the subdirectory for installing/ deinstalling new firmware versions.

IEC/IEEE bus command: --

FIRMWARE UPDATE

The *FIRMWARE UPDATE* softkey starts the installation program and leads the user through the remaining steps of the update

IEC/IEEE bus command: --

The firmware update is started as follows:

➢ Provide the files for the firmware update, e.g. on a memory stick.

➢ Call *SETUP* side menu via [SETUP][NEXT]

➢ Start the update via [FIRMWARE UPDATE]

RESTORE FIRMWARE

The *RESTORE FIRMWARE* softkey restores the previous firmware version

IEC/IEEE bus command: --

UPDATE PATH

The *UPDATE PATH* softkey is used to select the drive and directories under which the archive files for the firmware update are stored.

The firmware update can thus also be performed via network drives or USB memory sticks/USB-CD-ROM drives.

IEC/IEEE bus command: `"SYST:FIRM:UPD 'D:\USER\FWUPDATE'"`

External Noise Source

NOISE SRC ON/OFF

The *NOISE SRC ON/OFF* softkey switches on or off the supply voltage for an external noise source which is connected to the *NOISE SOURCE* connector on the rear panel of the instrument.

IEC/IEEE bus command: `DIAG:SERV:NSO ON`

Saving and Recalling Data Sets – FILE Key

Overview

The *FILE* key calls the following functions:

- Storage/loading functions for storing (*SAVE*) instrument settings such as instrument configurations (measurement/display settings, etc.) and measurement results from working memory to permanent storage media, or to load (*RECALL*) stored data into working memory.

- Functions for management of storage media (*FILE MANAGER*). Included are among others functions for listing files, formatting storage media, copying, and deleting/renaming files.

The ESU is capable of internally storing complete instrument settings with instrument configurations and measurement data in the form of data sets. The respective data are stored on the internal hard disk or, if selected, on a memory stick. The hard disk has the following name:

hard disk D: (hard disk C: is reserved for instrument software)

The configuration of the softkeys in the menu is shown in the following table:

SAVE		
RECALL		
EDIT PATH		
EDIT COMMENT		
ITEMS TO SAVE/RCL ⇩	SELECT ITEMS	
	ENABLE ALL ITEMS	
	DISABLE ALL ITEMS	
	DEFAULT CONFIG	
DATA SET LIST		
DATA SET CLEAR		
STARTUP RECALL		
FILE MANAGER ⇩	EDIT PATH	
	NEW FOLDER	
	COPY	
	RENAME	
	CUT	
	PASTE	
	DELETE	
	SORT MODE ⇩	NAME
		DATE
		EXTENSION
		SIZE
	2 FILE LISTS	
	Side menu	
	ASCII FILE EXPORT	
	DECIM SEP	
Side menu		
ASCII FILE EXPORT		
DECIM SEP		
DATA SET CLEAR ALL		

Storing a Device Configuration

Storing a Complete Device Configuration

The following steps are required to store a complete device configuration:

➢ Press the *FILE* key and then press the *SAVE* softkey.
The selection box for the device configuration will be opened:
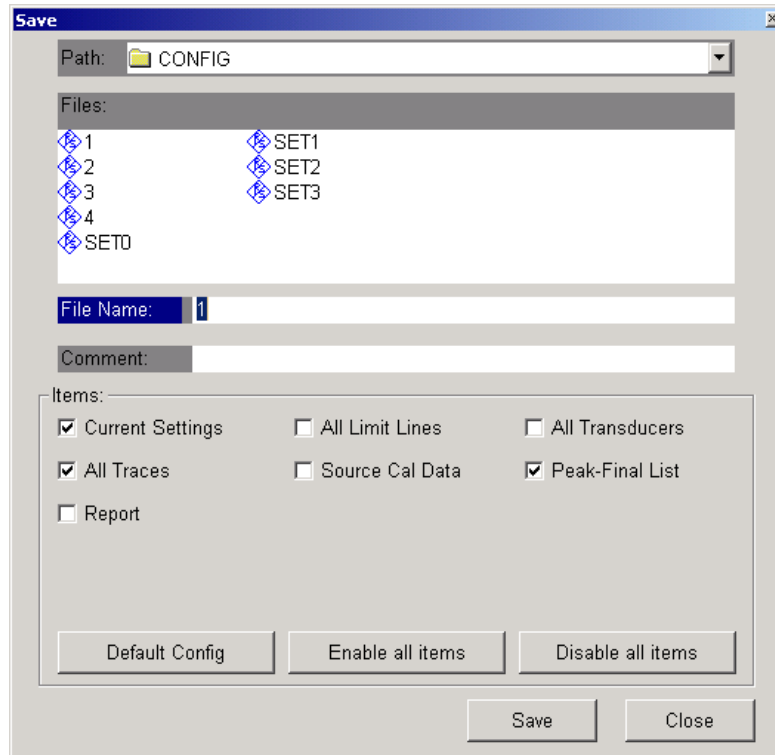
➢ Enter the name of the data set to be stored (in the simplest case, a digit from 0 to 9) and press *ENTER*. The data set will be stored and the dialog window closed.

The name of the data set may comprise letters and digits; if required, the desired directory may precede the name of the data set (the directory will then automatically be used for further SAVE and RECALL processes).

The help line editor, which can be opened by pressing the *CURSOR DOWN* key, is available for entering file names via the front-panel keypad.

For further information on the operation of this editor, see the Quick Start Guide, chapter "Basic Operation".

How to enter comments, change the path for the file to be stored and select the data set from a list is described under the associated softkeys *EDIT COMMENT*, *EDIT PATH* and *DATA SET LIST*.

The default path for the device configuration is D:\USER\CONFIG. The file names of the data sets have the extension .FSP.

Storing Parts of a Device Configuration

To store part of a data set (e.g. "All Transducers"), the partial data set has to be selected beforehand. The following steps are required:

➢ Press the FILE key and then the *SAVE* softkey.

➢ Press the *ITEMS TO SAVE/RCL* softkey. The entry focus moves to the first entry in the Items field.

➢ Use the rotary knob to move the entry focus to the desired entry in the Items field and select the partial data set by pressing the rotary knob or ENTER. The selection of already highlighted partial data sets can be cancelled by pressing the rotary knob / ENTER again.

Softkeys *ENABLE ALL ITEMS / DISABLE ALL ITEMS* are also available to select all partial data sets or to cancel the selection.

➢ Move the entry focus to the field *File Name* using the rotary knob and activate the text entry by pressing the rotary knob.

➢ Enter file names and store the data set with *ENTER*.

Loading a Data Set

A data set may be loaded in two different ways:

1. *Direct entry of data set name:*

   ➢ Press the *FILE* key and then press the *RECALL* softkey.

   ➢ Enter the name of the data set to be stored (in the simplest case, a digit from 0 to 9) and press *ENTER*. The data set will be loaded.

   The name of the data set may comprise letters and digits; if required, the desired directory may precede the name of the data set (the directory will then automatically be used for further SAVE and RECALL processes).

   The help line editor, which can be opened by pressing the *CURSOR DOWN* ⬇ key, is available for entering file names via the front-panel keypad.

   For further information on the operation of this editor, see the Quick Start Guide, chapter "Basic Operation".

2. *Selection of data set via a selection list:*

   ➢ Press the *FILE* key and then press the *RECALL* softkey.

   ➢ Press the *ITEMS TO SAVE/RCL* softkey.
   The list of available data sets will be selected:
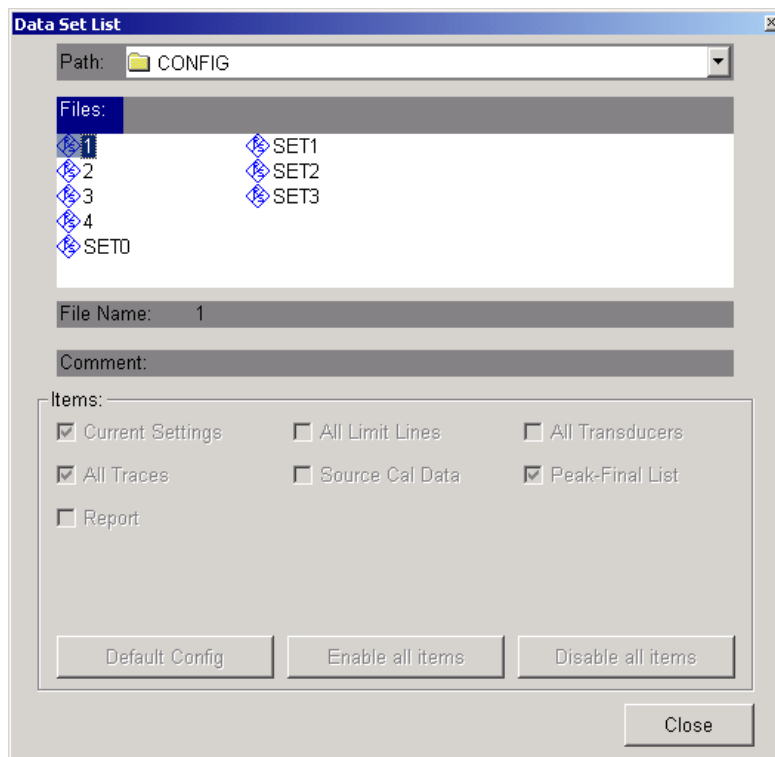
➢ Select the data set to be loaded with the rotary knob and confirm twice with *ENTER*. The data set will be loaded.

If the path for the device configuration is to be changed, this is done via the *EDIT PATH* softkey.

When loading device data, the settings of the unloaded partial data sets will remain unchanged. The R&S ESU recognizes which parts the loaded data set has and ignores selected but unavailable partial data sets.

Automatic Loading of a Data Set during Booting

When the R&S ESU is delivered, it will load the device setting last activated when the unit was switched off (provided that the unit was switched off via the *STANDBY* switch at the front panel, see the Quick Start Guide, chapter "Preparing for Use").

Moreover, the R&S ESU is also able to automatically load a user-defined data set. The following operating steps are required:

➢ Press the FILE key and then press the *RECALL* softkey.

➢ Press the *STARTUP RECALL* softkey.
The list of available data sets will be selected (see figure "Startup Recall dialog box" on page 4.313.)

➢ Select the data set to be loaded using the rotary knob and mark with *ENTER*.

Notes

• The selected data set will also be loaded when pressing the *PRESET* key.

• The *FACTORY* entry will load the last setting that was activated prior to switch-off when the unit is started after delivery.

➢ Close the dialog window by pressing *ESC* twice.

If the path is to be changed for the device configuration, this is done via the *EDIT PATH* softkey.

Copying Data Sets to Disk

The saved files of the data sets can be copied from one storage medium (e.g. drive D:) to another storage medium (e.g. drive F:) or to another directory using the functions found in the *FILE MANAGER* submenu. The file extension .FSP must not be changed.

Entering Text with the Help Line Editor

The help line editor is opened as soon as the *CURSOR DOWN* ⊙ key is pressed on a text entry field (*File Name, Comment)*:

A	B	C	D	E	F	G	H	I	J	K	L	M		1	2	3	4	5	6	7	8	9	0
N	O	P	Q	R	S	T	U	V	W	X	Y	Z		:	\	.	/	*	+	-	=		,
a	b	c	d	e	f	g	h	i	j	k	l	m		<	>	(	)	{	}	[	]	#	~
n	o	p	q	r	s	t	u	v	w	x	y	z		'	@	;	|	?	!	"	€	$	%
SPACE														«	»	BACK				EXIT			

The entry range consists of two parts:

• editing line

• character selection field

Die *CURSOR DOWN* ⊙ key is used to move from the editing line to the character selection field.

The navigation in the character selection field is by means of the rotary knob or the cursor keys ⊙, ⊙, ⊙, and ⊙.

The desired characters are transferred to the editing line by pressing the rotary knob or by pressing the *ENTER* key:

Default Spectrum																						
A	B	C	D	E	F	G	H	I	J	K	L	M	1	2	3	4	5	6	7	8	9	0
N	O	P	Q	R	S	T	U	V	W	X	Y	Z	:	\	.	/	*	+	-	=		,
a	b	c	d	e	f	g	h	i	j	k	l	m	<	>	(	)	{	}	[	]	#	~
n	o	p	q	r	s	t	u	v	w	x	y	z	'	@	;	|	?	!	"	€	$	%
				SPACE									«	»	BACK			EXIT				

The fields of the last line of the character selection field have special functions:

SPACE   adds a space to the editing line

<<   moves the cursor in the editing line by one character towards the left

>>   moves the cursor in the editing line by one character towards the right

BACK   deletes the character in front of the cursor

EXIT   stores the contents of the editing line and closes the help line editor

A return to the editing line is possible via the *CURSOR UP* ⇧ key (return from the top line of the character selection field).

Within the editing line, navigation is also performed by means of the rotary knob or the cursor keys ⇨ and ⇦.

Digits, decimal points and signs are directly entered into the editing line via the keys of the numeric block provided at the front panel. With a PC keyboard connected, letters and special characters can also be entered directly.

Editing is terminated via *ENTER* if the text is to be stored and via *ESC* if the text is to be discarded. The help line editor will be closed in both cases.

Config DAta		tracking generator settings (only with option tracking generator)	TCI
		active transducer set	.TS
		active transducer factors	.TF
		peak list or final measurement results	.FIN
Add config data	ALL TRANSDUCERS	all transducer sets and transducer factors	.TSA .TFA
	SOURCE CAL DATA	Setting for source calibration (only with option tracking generator)	.TS1 .TS2
		Correction data for source calibration (only with option tracking generator)	.TC1 .TC2

Description of the Individual Softkeys

SAVE   The *SAVE* softkey opens the dialog window for entering the data set to be stored.
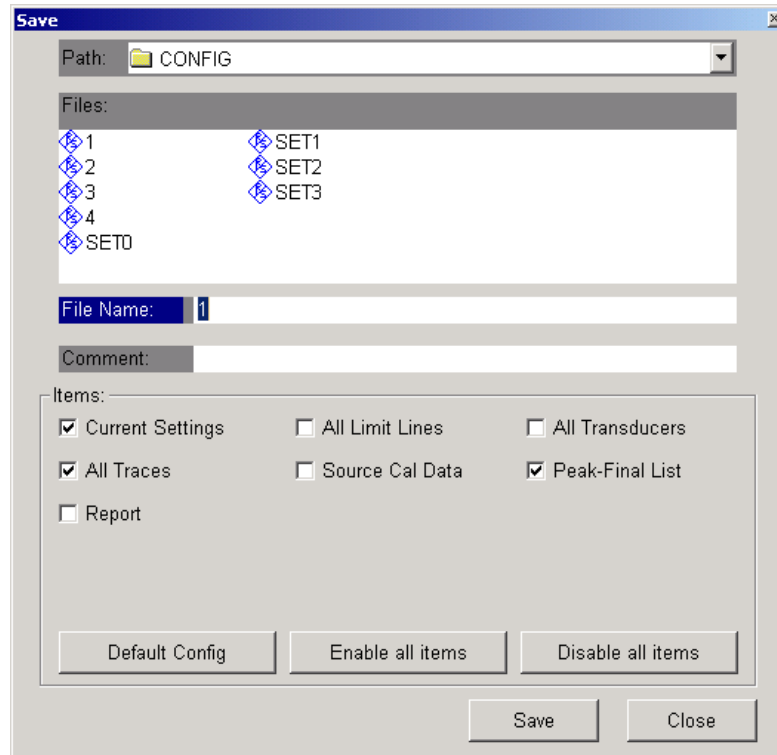
The *SAVE* table contains the entry fields for editing the data set:

Path   Directory in which the data set is stored.

Files   List of data sets already stored.

File Name   Name of data set.

                The name can be entered with or without drive name and directory; the drive name and directory, if available, will then appear in the PATH field. The extension of the data name is ignored.

Comment   Comment regarding the data set.

Items   Selection of settings to be stored.

IEC/IEEE bus command: `MMEM:STOR:STAT 1,"a:\test02"`

RECALL

The *RECALL* softkey activates the dialog window to enter the data set to be loaded.
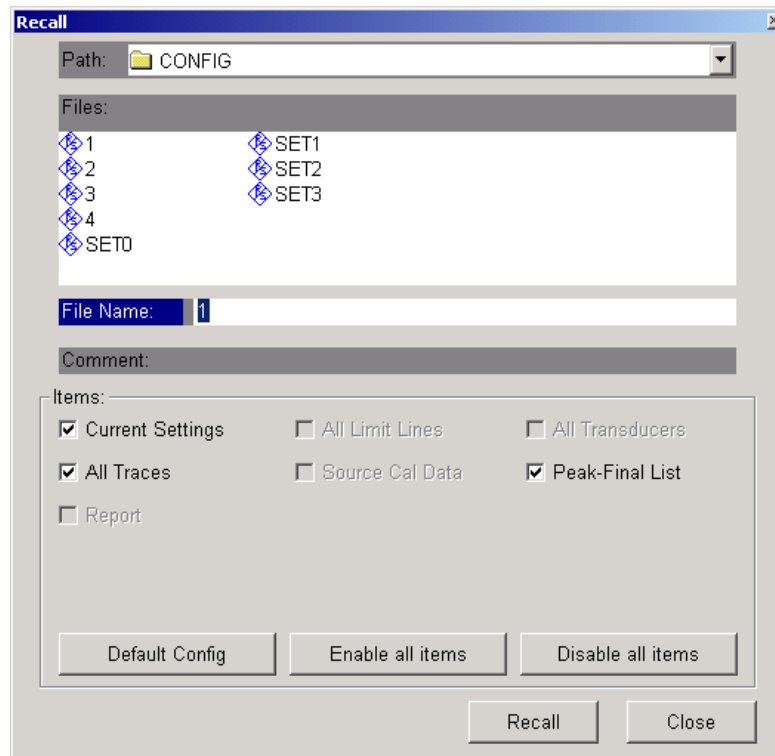
The *RECALL* table shows the current settings regarding the data set:

Path	Directory in which the data set is stored.
Files	List of stored data sets
File Name	Name of data set.

The name can be entered with or without drive name and directory. The drive name and directory will then appear in the Path field. A potential extension of the file name is ignored.

Comment	Comment regarding data set.

IEC/IEEE bus command: `MMEM:LOAD:STAT 1,"a:\test02"`

EDIT PATH   The *EDIT PATH* softkey activates the entry of a path name for the device configuration to be stored/to be loaded:
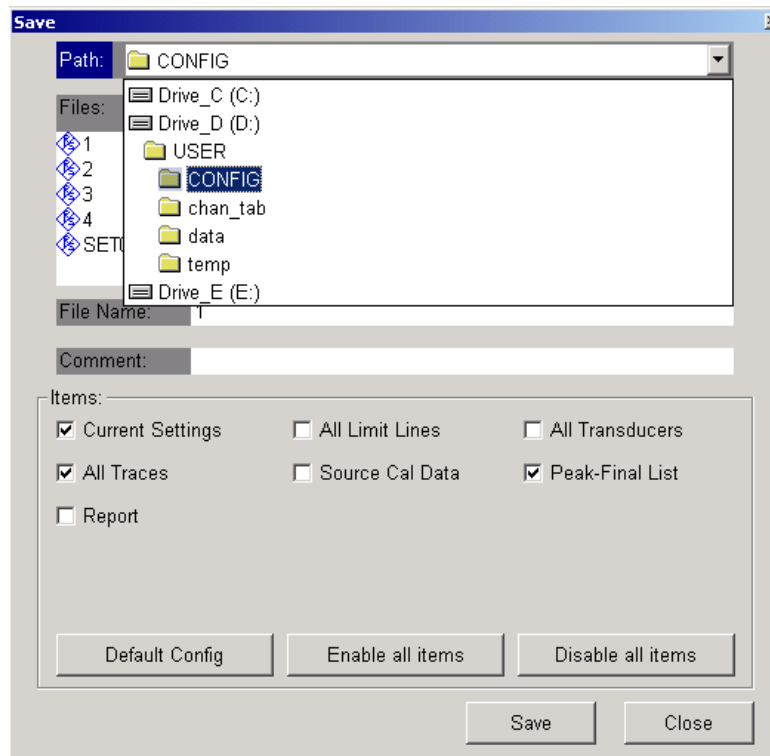
The desired directory is selected with the rotary knob or the *CURSOR UP / DOWN* key and is confirmed by pressing the rotary knob or the *ENTER* key.

Subdirectories are opened by the *CURSOR RIGHT* ⟦◊⟧ key and closed with the *CURSOR LEFT* ⟦◊⟧ key.

IEC/IEEE bus command: --

EDIT COMMENT   The *EDIT COMMENT* softkey activates the entry of commentary concerning the current data set. The help line editor is opened with *CURSOR DOWN*.

A total of 60 characters are available for this purpose.

> **Note**
>
> For further information on how to enter the comment text via the front panel of the unit, see the Quick Start Guide, chapter "Basic Operation."

IEC/IEEE bus command: MMEM:COMM "Setup for FM measurement"

ITEMS TO SAVE/   The *ITEMS TO SAVE/RCL* softkey opens a submenu for selecting the data
RCL   subsets.
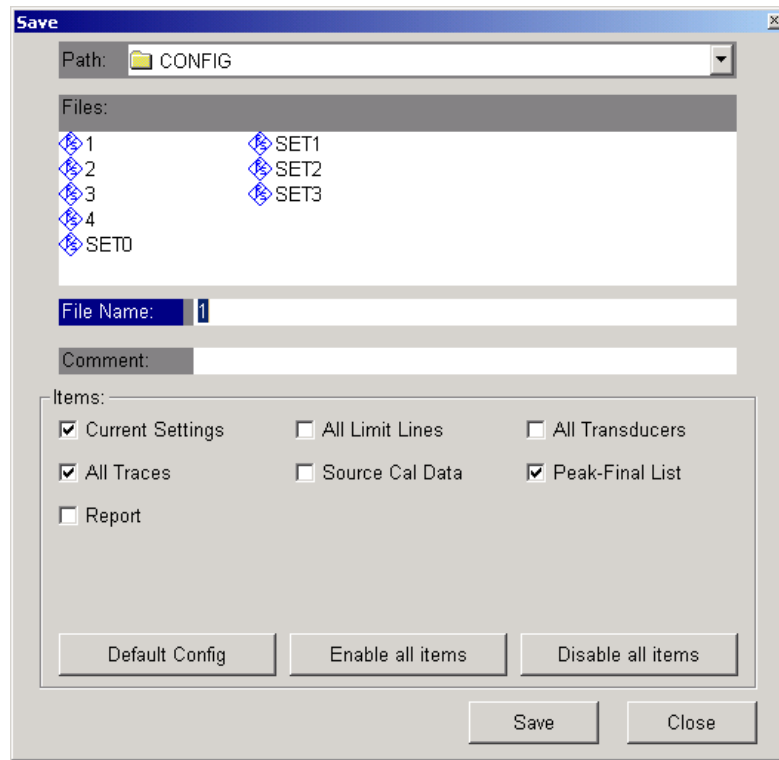
The *Save* dialog box offers the following selectable data subsets in the *Items* field:

Current Settings   These settings include:

- current configuration of general instrument parameters

- current measurement hardware settings

- active limit lines:

  A data set may contain maximum 8 limit lines for each window. It always contain the activated limit lines and the de-activated limit lines used last, if any. Consequently, the combination of the restored deactivated limit lines depends on the sequence of use with command `MMEM:LOAD`.

- the activated transducer factor

- user-defined color settings

- configuration for hardcopy output

- active transducer set:

  A data set may contain maximum 4 transducer factors. It always contain the activated factors and the factors used and de-activated last, if any. Consequently, the combination of the restored deactivated transducer factors depends on the sequence of use with the command `MMEM:LOAD`.

- peak list or final measurement results (receiver mode)

- settings of tracking generator (only with option tracking generator)

All Limit Lines	all limit lines
All Transducer	all transducer factors
All Transducers	all transducer
All Traces	all traces which are not blanked
Source Cal Data	correction data for tracking generator (only with options B9 / B10)

SELECT ITEMS   The *SELECT ITEMS* softkey moves the selection bar to the first line, left column of the *Items* field. An entry is selected. Position the entry focus to the corresponding partial data set using the cursor keys and then press the *ENTER* key in the desired line. The selection is cleared by pressing the key again.

IEC/IEEE bus command: `MMEM:SEL:HWS ON` (Current Settings)
                                      `MMEM:SEL:LIN:ALL ON` (All Limit Lines)
                                      `MMEM:SEL:TRAC ON` (All Traces)

IEC/IEEE bus command: `MMEM:SEL:SCD ON` (Source Cal Data)
                                      `MMEM:SEL:TRAN:ALL ON` (All Transducers)
                                      `MMEM:SEL:FIN ON` (Peak/Final List)

ENABLE ALL ITEMS   The *ENABLE ALL ITEMS* softkey marks all partial data sets.

IEC/IEEE bus command: `MMEM:SEL:ALL`

DISABLE ALL ITEMS   The *DISABLE ALL ITEMS* softkey deselects all partial data sets.

DEFAULT CONFIG   The *DEFAULT CONFIG* softkey establishes the default selection of the data subset to be saved and outputs *DEFAULT* in the *ITEMS* field of the *SAVE/ RECALL DATA SET* table.

IEC/IEEE bus command: `MMEM:SEL:DEF`

DATA SET LIST   The *DATA SET LIST* softkey sets the entry focus to the list *Files* of all available data sets. In addition, the *DATA SET CLEAR* softkey is displayed.
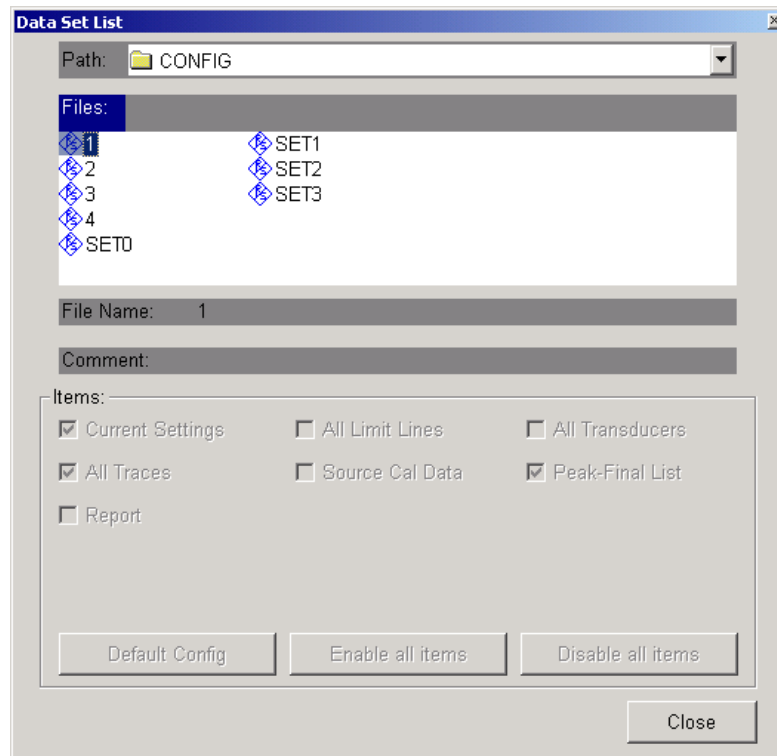
The list *Files* lists all data sets which are stored in the selected directory.

The *Comment* and *Items* fields in the *DATA SET CONTENTS* column indicate the saved data subsets and the comment for the currently selected data set.

IEC/IEEE bus command: --

DATA SET CLEAR   The *DATA SET CLEAR* softkey deletes the selected data set

IEC/IEEE bus command: `MMEM:CLE:STAT 1, "test03"`

STARTUP RECALL   The *STARTUP RECALL* softkey activates the selection of a data set which is automatically loaded when the instrument is powered on and after *PRESET*. For this purpose the Dialog *Startup Recall* is opened (analogously to *DATA SET LIST)*.
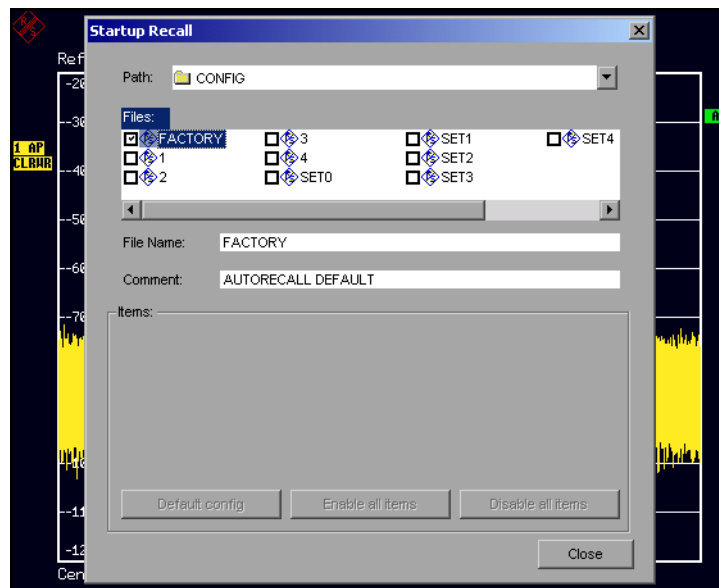
Fig. 4-27   *Startup Recall* dialog box

The field *Files* lists all data sets stored in the selected directory. The currently selected data set is checked.

In addition to the data sets stored by the user, the data set *FACTORY*, which specifies the settings of the instrument before it was last switched off (Standby), is always present (when unit is delivered).

To select a data set, the entry focus is set to the corresponding entry by means of the rotary knob and the data set is activated by pressing the rotary knob or the *ENTER* key.

If a data set other than *FACTORY* is chosen, this data set will be loaded when the unit is switched on or after pressing the *PRESET* key. Any settings can be assigned to the *PRESET* key.

IEC/IEEE bus command: `MMEM:LOAD:AUTO 1,"D:`
                                        `\user\config\test02"`

Operating Concept of File Managers

FILE MANAGER   The *FILE MANAGER* softkey opens a menu for managing storage media and files.
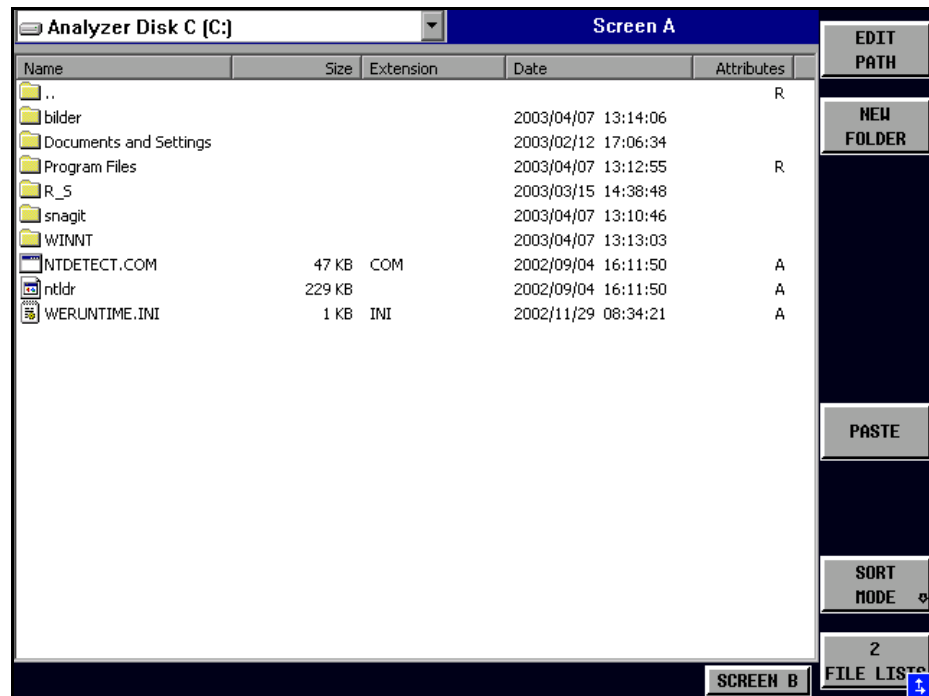
The designation and the letter of the current drive are displayed in the upper left corner of the File Manager dialog.

The table below shows the files of the current directory and potential subdirectories.

A file or a directory in the table is selected via cursor keys. The *ENTER* key is used to switch from one subdirectory to another. The softkeys *COPY, RENAME, CUT and DELETE* are only visible if the entry focus is set to a file and not to a directory.

The dots ".." open up the next higher directory.

EDIT PATH   The *EDIT PATH* softkey activates the input of the directory which will be used in subsequent file operations.

The new path is included in the *FILE MANAGEMENT* table.
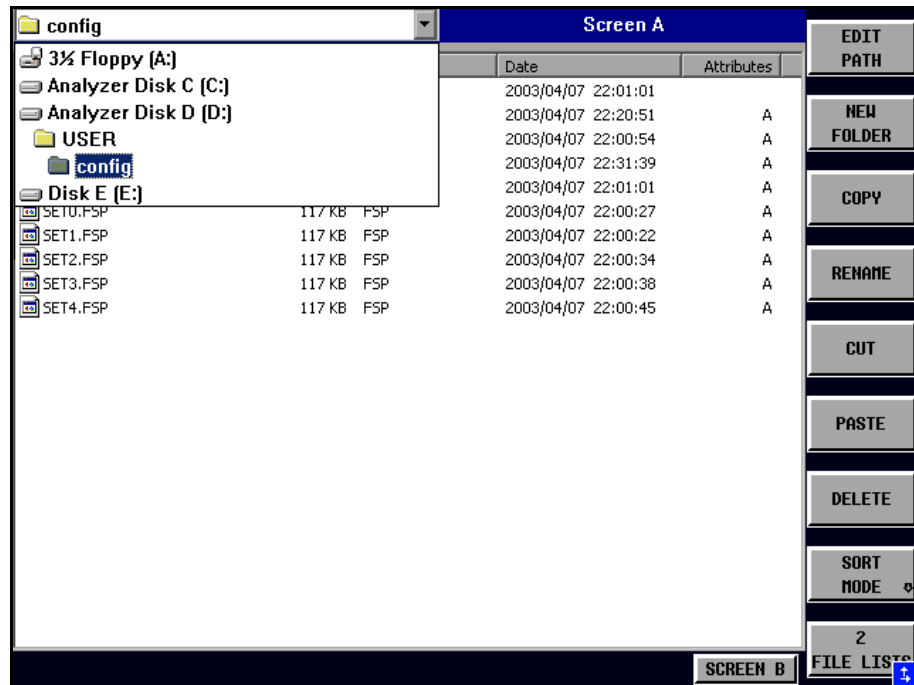
Use CURSOR UP / DOWN to select a drive and confirm your selection with ENTER.

Open subdirectories by using *CURSOR RIGHT*, and use *CURSOR LEFT* to close them again.

When you have found the subdirectory you looked for, mark it with *ENTER*.

IEC/IEEE bus command: `MMEM:MSIS "a:"`
                          `MMEM:CDIR "D:\user "`

NEW FOLDER   The *NEW FOLDER* softkey creates subdirectories.

The entry of an absolute path name (e.g. "\USER\MEAS") as well as the path relative to the current directory (e.g. "..\MEAS") is possible.

IEC/IEEE bus command: `MMEM:MDIR "D:\user\test"`

COPY   The *COPY* softkey opens the help line editor to enter the target directory for a copying process. The file is also copied into the clipboard and can be copied into a different directory at a later time by means of *PASTE.*
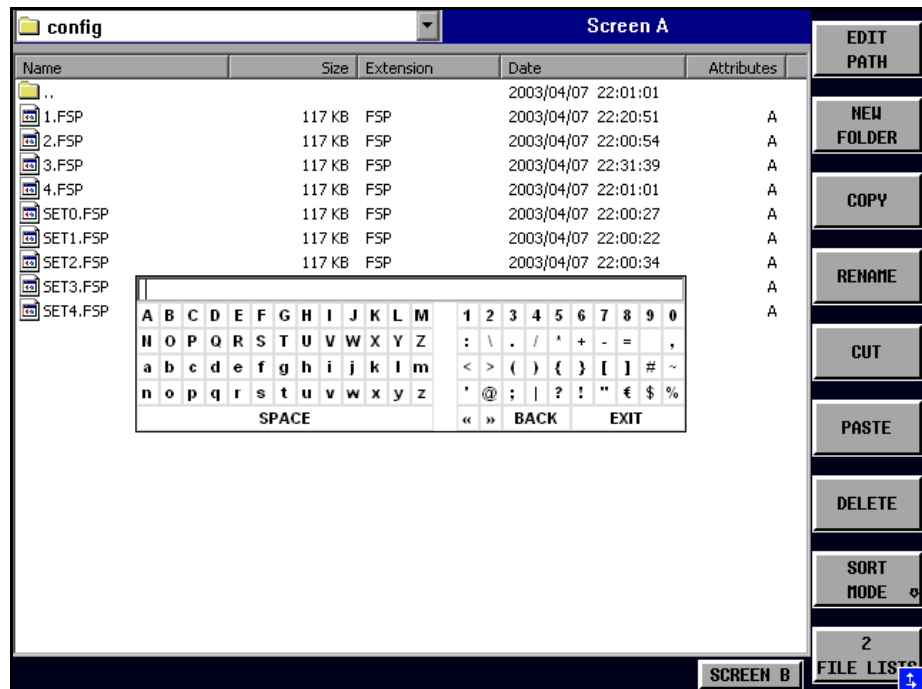
Files can also be copied to a different storage medium by indicating a certain drive letter (e.g. D:). The selected files or directories will be copied after terminating the entry with the ENTER key.

IEC/IEEE bus command: `MMEM:COPY "D:\user\set.cfg","a:"`

RENAME   The *RENAME* softkey opens the help line editor to rename a file or a directory (analogously to the *COPY* softkey).

IEC/IEEE bus command: `MMEM:MOVE "test02.cfg","set2.cfg"`

CUT   The *CUT* softkey shifts the selected file into the clipboard from where it can be copied into a different directory at a later time by means of *PASTE*.

Note

The file in the output directory will only be deleted if the *PASTE* softkey has been pressed.

IEC/IEEE bus command: `--`

PASTE   The *PASTE* softkey copies files from the clipboard to the current directory. The directory is changed by means of the cursor keys and subsequent pressing of *ENTER* or via the *EDIT PATH* softkey.

IEC/IEEE bus command: `--`

DELETE   The *DELETE* softkey deletes the selected file.

A confirmation query is displayed to avoid unintentional deletion of files.

IEC/IEEE bus command: MMEM:DEL "test01.hcp"
                          MMEM:RDIR "D:\user\test"

SORT MODE   The *SORT MODE* softkey opens the submenu to select the sorting mode for the displayed files.
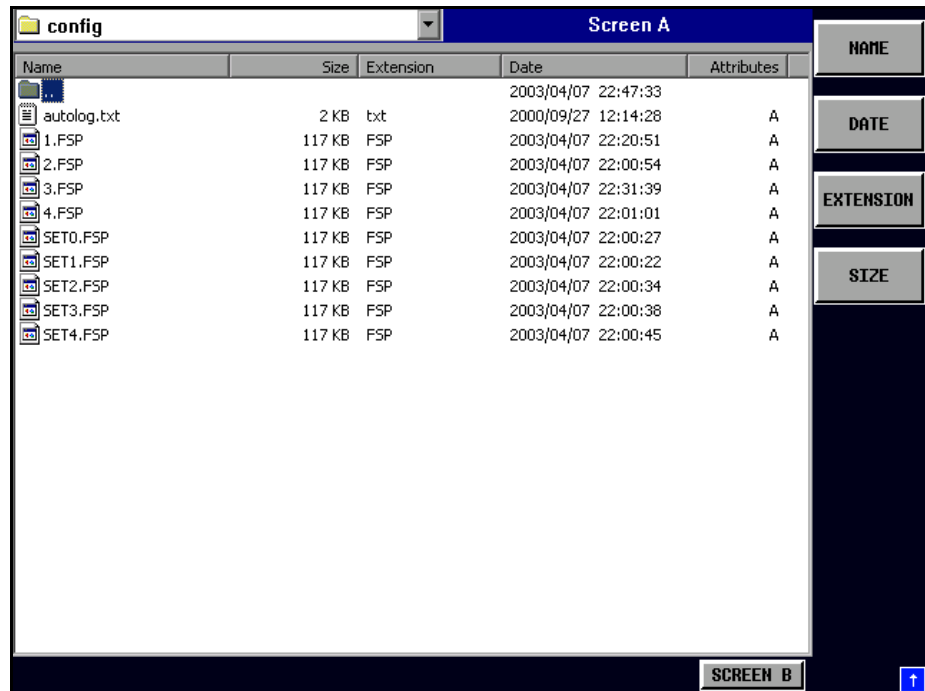
Directory names are located at the top of the list after the entry for the next higher directory level ("..").

IEC/IEEE bus command: --

2 FILE LISTS   The *2 FILE LISTS* softkey opens a second window for the File Manager. The entry focus can be moved between the two windows by means of *SCREEN A* and *SCREEN B* hotkeys.

Files can thus very easily be copied and shifted from one directory to the other.

> **Note**
>
> The second file list can also be opened in the Full Screen mode via *SCREEN B or SCREEN A* hotkey.

IEC/IEEE bus command: –

ASCII FILE EXPORT

The *ASCII FILE EXPORT* softkey stores the active trace in ASCII format, e.g. on a memory stick.

IEC/IEEE bus command: `FORM ASC;`
                                       `MMEM:STOR:TRAC 1,'TRACE.DAT'`

The file consists of a header, which contains important scaling parameters, and a data section, which contains the trace data.

The file header data comes in three columns separated by semicolons (;).

It has the following contents:

   parameter name; numerical value; default unit

The data section starts with the key word "Trace <n>", where <n> designates the number of the trace to be stored. This is followed by the measured data in columns separated by semicolons (;).

This format can be read by spreadsheet programs such as MS Excel. A semicolon (;) is to be defined as a separator between the cells of a table.

> **Note**
>
> Analysis programs may come in different language versions that require different notations of the decimal point. By means of the *DECIM SEP* softkey, a decimal point (.) or a comma (,) can be selected as decimal-point notation.

For a detailed description of the ASCII file format, refer to section "Selection and Setting of Traces – TRACE", "ASCII FILE EXPORT" on page 4.150 softkey.

DECIM SEP

By means of the *DECIM SEP* softkey, one can select between a decimal point (.) and a comma (,) as decimal-point notation for the ASCII FILE EXPORT function.

Due to the possibility of selecting between different decimal-point notations, different language versions of analysis programs (such as MS Excel) can be supported.

IEC/IEEE bus command: `FORM:DEXP:DSEP POIN`

DATA SET CLEAR ALL

The *DATA SET CLEAR ALL* softkey deletes all files containing device settings (data sets) in the selected directory.

IEC/IEEE bus command: `MMEMory:CLEar:ALL`

Measurement Documentation – HCOPY Key

The *HCOPY* key opens the *HARDCOPY* menu for starting and configuring the printout.
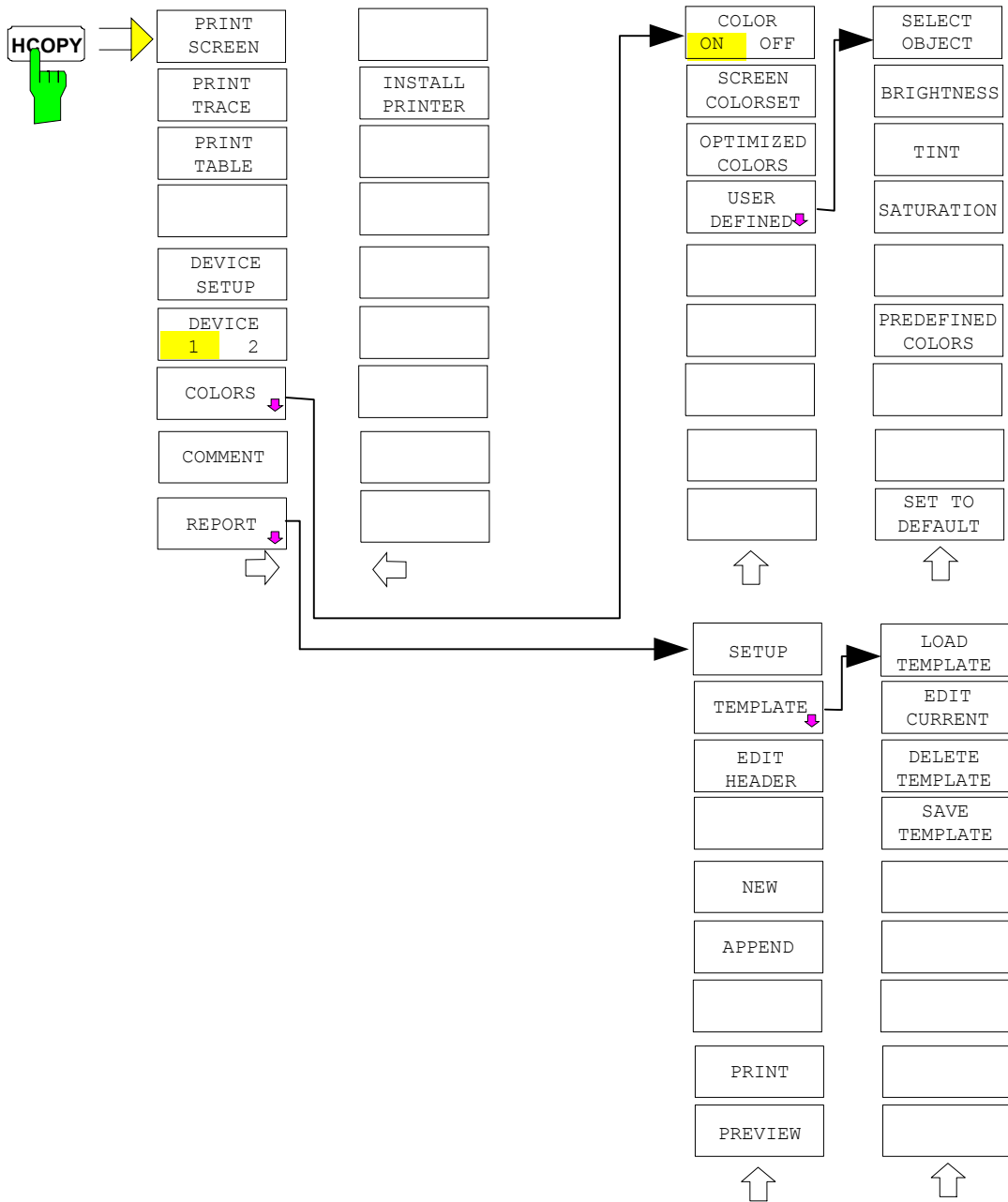
Pressing one of the softkeys *PRINT SCREEN, PRINT TRACE or PRINT TABLE* in the *HCOPY* menu initiates the print job. The printer parameters defined in the *DEVICE SETTINGS* menu are used for setting up the printer configuration. All of the display items to be printed are written to the printer buffer. Since the printer runs in the background, the instrument may be operated immediately after pressing the *PRINT* softkey.

With *PRINT SCREEN* selected, all the diagrams with traces and status displays are printed as they occur on the screen. Softkeys, open tables and data entry fields are not printed.

The *PRINT TRACE* function allows individual traces to be printed. With *PRINT TABLE,* tables can be printed.

The *DEVICE 1 / 2* softkeys are used for selecting and configuring the output interface. For detailed information refer to section "Selecting Alternative Printer Configurations" on page 4.326.

If the *PRINT TO FILE* option in the *DEVICE SETTINGS* table is selected, the printout is directed to a file. Upon pressing one of the *PRINT...* softkeys, the file name to which the output data is to be written is requested. An entry field is then opened for entering the file name. For detailed information refer to section "Selecting Printer, Clipboard and File Formats" on page 4.323.

The *COLORS* submenu allows switch over between black-and-white and color printouts (default), provided that the printer connected can produce color printouts. In addition, the colors are set in this submenu. For detailed information refer to section "Selecting Printer Colors" on page 4.326.

- SCREEN   Output in screen colors.
- OPTIMIZED (default)   Instead of light colors, dark colors are used for traces and markers: trace 1 blue, trace 1 black, trace 3 green, markers turquoise.
- USER DEFINED   This option enables the user to change the colors at will. It provides the same setting functions as the *DISPLAY – CONFIG DISPLAY – NEXT* menu.

Notes

- With *SCREEN* and *OPTIMIZED* selected, the background will always be white and the grid black. With *USER DEFINED*, these colors can be selected, too.

- Upon activation of the submenu, the color display is switched over to the selected printout colors. When the menu is quit, the original color setting is restored.

The *COMMENT SCREEN A / B* softkeys allow text to be added to the printout (date and time are inserted automatically).

The *REPORT* softkey is used to configure and print test reports. In contrast to the hardcopy which is restricted to the contents of the screen, the test report consists of more different items, such as a diagram, a header, a scan table and lists with measurement results. For detailed information refer to section "Configuring the Test Report" on page 4.329.

Use the *INSTALL PRINTER* softkey to install additional printer drivers. For detailed information refer to the following sections:

- "Installation of Plug&Play Printers" on page 4.334

- "Installation of Non-Plug&Play Printers" on page 4.335

- "Local Printer" on page 4.337

- "Network Printer" on page 4.343

PRINT SCREEN The *PRINT SCREEN* softkey starts the output of test results.

All the diagrams, traces, markers, marker lists, limit lines etc. are printed out as long as they are displayed on the screen. All the softkeys, tables and open data entry fields are not printed out. Moreover, comments, title, date, and time are output at the bottom margin of the printout.

IEC/IEEE bus command: `HCOP:ITEM:ALL`
                        `HCOP:IMM`

PRINT TRACE The *PRINT TRACE* softkey starts the output of all curves visible on the display screen without auxiliary information. Specifically, no markers or display lines are printed.

IEC/IEEE bus command: `HCOP:ITEM:WIND:TRAC:STAT ON`
                        `HCOP:IMM`

PRINT TABLE The *PRINT TABLE* softkey starts the output of all tables and info lists visible on the display screen without the measurement diagrams and other information lying behind.

IEC/IEEE bus command: `HCOP:ITEM:WIND:TABL:STAT ON`
                        `HCOP:IMM`

DEVICE SETUP The *DEVICE SETUP* softkey opens the dialog where the file format and the printer can be selected (see section "Selecting Printer, Clipboard and File Formats" on page 4.323).

IEC/IEEE bus command: `HCOP:DEV:LANG GDI;`
                        `SYST:COMM:PRIN:ENUM:FIRS?;`
                        `SYST:COMM:PRIN:ENUM:NEXT?;`
                        `SYST:COMM:PRIN:SEL <Printer>;`
                        `HCOP:PAGE:ORI PORT;`
                        `HCOP:DEST "SYST:COMM:PRIN";`
                        `HCOP:DEST "SYST:COMM:MMEM"`

DEVICE 1 / 2 The analyzer is able to manage two hardcopy settings independently of each other. They are selected via the *DEVICE 1 / 2* softkey, which displays also the associated setting if the *DEVICE SETUP* dialog is open.

IEC/IEEE bus command: `--`

COLORS The *COLORS* softkey gives access to the submenu where the colors for the printout can be selected (see section "Selecting Printer Colors" on page 4.326).

IEC/IEEE bus command: `--`

COMMENT The *COMMENT* softkey opens an entry field in which a comment of two lines (60 characters per line) can be entered for screen A or B.

If the user enters more than 60 characters, the excess characters appear on the second line on the print-out. At any point, a manual line-feed can be forced by entering the @ character.

The comment is printed below the diagram area. The comment text appears on the hardcopy, but not on the display screen.

If a comment should not be printed, it must be cleared.

If the instrument is reset by a click on the PRESET key, all entered comments are cleared.

Note

The *COMMENT* softkey opens the auxiliary line editor where the desired letters can be entered in the text field by means of rotary knob and cursor keys.

After clicking the *COMMENT* softkey, the auxiliary line editor can be reached with the ⬇ key. Pressing the rotary knob or the *ENTER* key inserts the selected characters in the text line.

After editing is completed, return to the text line with the ⬆ key and confirm the comment text with *ENTER*.

If the entered comment should be aborted, quit the auxiliary line editor with *ESC*.

Note

Only after the auxiliary line editor has been closed with *ESC* can the softkeys and hardkeys be operated again.

A detailed description of the auxiliary line editor can be found in the Quick Start Guide, chapter "Basic Operation".

IEC/IEEE bus command: `HCOP:ITEM:WIND2:TEXT 'Comment'`

INSTALL PRINTER   A certain number of printer drivers is already installed on the ESU.

The *INSTALL PRINTER* softkey opens the *Printers and Faxes* dialog where more printer drivers can be installed.

For details refer to the Quick Start Guide, appendix "Printer Interface".

IEC/IEEE bus command: `--`

Selecting Printer, Clipboard and File Formats

DEVICE SETUP   The *DEVICE SETUP* softkey opens the selection dialog for file format and printer.
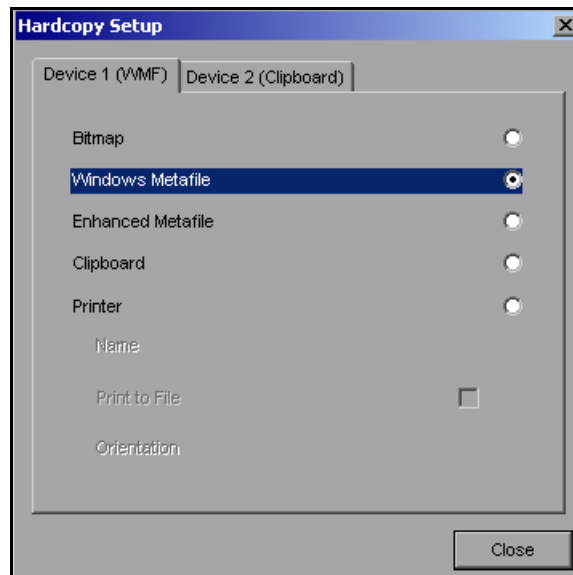
Navigation in the dialog is possible by turning the rotary knob; selection of an item is confirmed by pressing the rotary knob or the *ENTER* key.

The dialog is closed with ESC (alternatively, the *Close* button can be selected with the rotary knob and the dialog can be closed by pressing the rotary knob or with *ENTER)*.

File Formats

A file format is selected by turning the rotary knob 🔘 and then confirmed by pressing the rotary knob or the *ENTER* key.

The following file formats can be selected:

BITMAP   BMP format (non-compressed)

WINDOWS METAFILE   Vector format, supported as of Windows 3.1

ENHANCED METAFILE Vector format, supported as of Windows 95/98/ME/ NT/XP

When a file format is selected, printing to a file is automatic. The file name is queried when the *PRINT SCREEN, PRINT TRACE* and *PRINT TABLE* softkeys are pressed.

Clipboard

A clipboard is also selected with the rotary knob ⬤ and then confirmed by pressing the rotary knob or *ENTER* key.

After the *PRINT SCREEN, PRINT TRACE* or *PRINT TABLE* softkey has been pressed, printout is routed to the clipboard. With the aid of the "Process - Insert" function, the information in the clipboard can then be pasted into other programs, e.g. *Paint*, and subsequently processed.

Printer

A printer (also a preconfigured network printer) is selected by selecting *Printer* with the rotary knob ⬤ and then confirmed by pressing the rotary knob or the *ENTER* key.

After confirmation, the entries under *Name, Print to File* and *Orientation* are available for selection with the rotary knob.
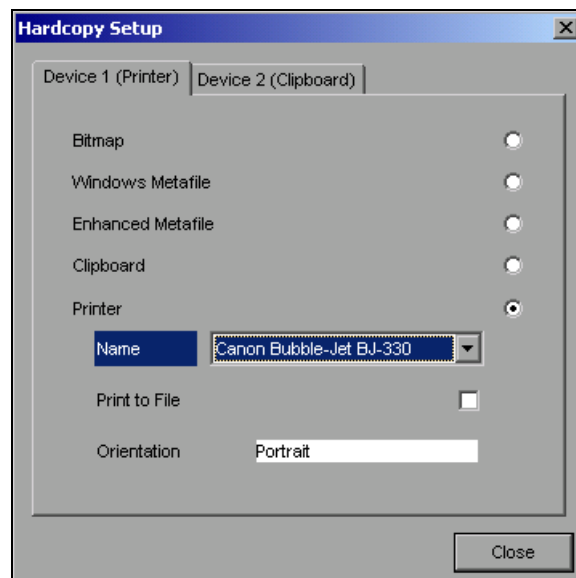
To select the printer type, select *Name* and open the selection list by pressing the rotary knob or *ENTER*.
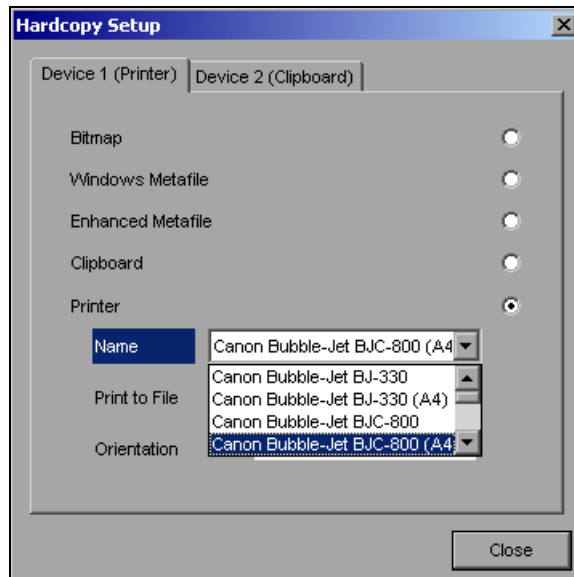
Select the desired printer (in the example "Cannon Bubble-Jet BJC800 (A4")
from the list by means of the rotary knob and confirm by pressing the rotary
knob or *ENTER*. This closes the list and the cursor is placed on the *Name* field
again.

Printing to a file is also possible. In this case select Print to File with the rotary
knob and activate or deactivate the associated list by pressing the rotary knob
or the *ENTER* key.

The printing format is selected under *Orientation*. In this case, too, pressing the
rotary knob or *ENTER* opens the selection list.
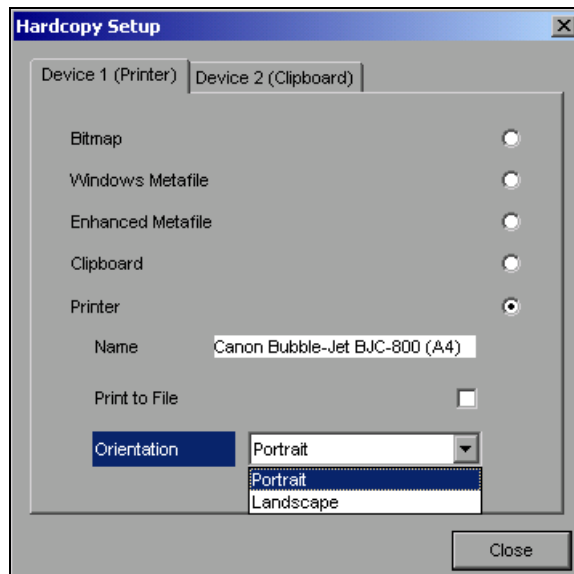
The desired format (here *Portrait*) is selected in the list with the rotary knob and
confirmed by pressing the rotary knob or *ENTER*. This closes the list and the
cursor is placed again on the *Orientation* field.

The dialog is then closed with *ESC* or by clicking the *Close* button.

> **Note**
>
> The installation of new printer types is described in the Quick Start Guide, appendix "Printer Interface".

Selecting Alternative Printer Configurations

The analyzer is capable of managing two independent hardcopy settings. This, for instance, permits fast switch over between printing to a file or by a printer.

DEVICE 1 / 2   A selection is made with the *DEVICE 1 / 2* softkey which also shows settings when the *DEVICE SETUP* dialog is open.

IEC/IEEE bus command: --

Selecting Printer Colors

COLORS   The *COLORS* softkey gives access to the submenu where the colors for the printout can be selected. To facilitate color selection, the selected color combination is displayed when the menu is entered. The previous colors are restored when the menu is exited.

IEC/IEEE bus command: --

COLOR ON OFF   The *COLOR ON OFF* softkey switches over from color output to black-and-white output. All color-highlighted areas are printed in white and all color lines in black. This improves the contrast on the printout. The default setting is COLOR ON.

IEC/IEEE bus command: HCOP:DEV:COL ON

SCREEN COLORS   The *SCREEN COLORS* softkey selects the current screen colors for the printout.

> **Note**
>
> The background is always printed in white and the grid in black.

IEC/IEEE bus command: HCOP:CMAP:DEF1

OPTIMIZED COLORS   The *OPTIMIZED COLORS* softkey selects an optimized color setting for the printout to improve the visibility of the colors on the hardcopy.

Trace 1 is blue, trace 2 black, trace 3 green, and the markers are turquoise.

The other colors correspond to the display colors of the *DISP – CONFIG DISPLAY – DEFAULT COLORS 1* softkey.

> **Note**
>
> The background is always printed in white and the grid in black.

IEC/IEEE bus command: `HCOP:CMAP:DEF2`

USER DEFINED   The *USER DEFINED* softkey opens a submenu for user-defined color selection (see submenu *USER DEFINED COLORS*).

IEC/IEEE bus command: `HCOP:CMAP:DEF3`

SELECT OBJECT   The *SELECT OBJECT* softkey allows picture elements to be selected to change their color setting. After selection, the *PREDEFINED COLORS*, *BRIGHTNESS*, *TINT* and *SATURATION* softkeys enable the user to change the colors or brightness, the hue and the color saturation of the element selected.

```
                SELECT DISPLAY OBJECT

√ Background
  Grid
  Function field + status field + data entry text
  Function field LED on
  Function field LED warn
  Enhancement label text
  Status field background
  Trace 1
  Trace 2
  Trace 3
  Marker
  Lines
  Measurement status + limit check pass
  Limit check fail
  Table + softkey text
  Table + softkey background
  Table selected field text
  Table selected field background
  Table + data entry field opaq titlebar
  Data entry field opaq text
  Data entry field opaq background
  3D shade bright part
  3D shade dark part
  Softkey state on
  Softkey state data entry
  Logo
```

IEC/IEEE bus command: `--`

BRIGHTNESS   The *BRIGHTNESS* softkey serves for determining the brightness of the graphic element selected.

A value between 0 and 100% can be entered.

IEC/IEEE bus command: `HCOP:CMAP5:HSL <hue>,<sat>,<lum>`

TINT   The *TINT* softkey serves for determining the hue of the element selected. The percentage entered refers to a continuous color spectrum from red (0%) to blue (100%).

IEC/IEEE bus command: `HCOP:CMAP5:HSL <hue>,<sat>,<lum>`

SATURATION   The *SATURATION* softkey serves for determining the saturation of the element selected.

A value between 0 and 100% can be entered.

IEC/IEEE bus command: `HCOP:CMAP5:HSL <hue>,<sat>,<lum>`

PREDEFINED COLORS   The *PREDEFINED COLORS* softkey opens a list from which predefined colors for the displayed elements can be selected:

```
              COLOR

      √ BLACK
        BLUE
        BROWN
        GREEN
        CYAN
        RED
        MAGENTA

        YELLOW
        WHITE
        GRAY
        LIGHT GRAY
        LIGHT BLUE
        LIGHT GREEN
        LIGHT CYAN
        LIGHT RED
        LIGHT MAGENTA
```

IEC/IEEE bus command: `HCOP:CMAP1 ... 26:PDEF <color>`

SET TO DEFAULT The *SET TO DEFAULT* softkey reactivates the default color setting (= *OPTIMIZED COLORS)*.

IEC/IEEE bus command: `--`

Configuring the Test Report

REPORT

SETUP	
TEMPLATE ⇩	LOAD TEMPLATE
	EDIT CURRENT
	DELETE TEMPLATE
	SAVE TEMPLATE
EDIT HEADER	
NEW	
APPEND	
PRINT	
PREVIEW	

The *REPORT* softkey opens a submenu for configuring and starting the printout of a test report. In contrast to the hardcopy which is restricted to the contents of the screen, the test report consists of more different items, such as a diagram, a header, a scan table, and lists with measurement results.

IEC/IEEE bus command: `HCOP:MODE TREP`

SETUP   The *SETUP* softkey opens the *Report Setup* dialog to select the file format and the printer.
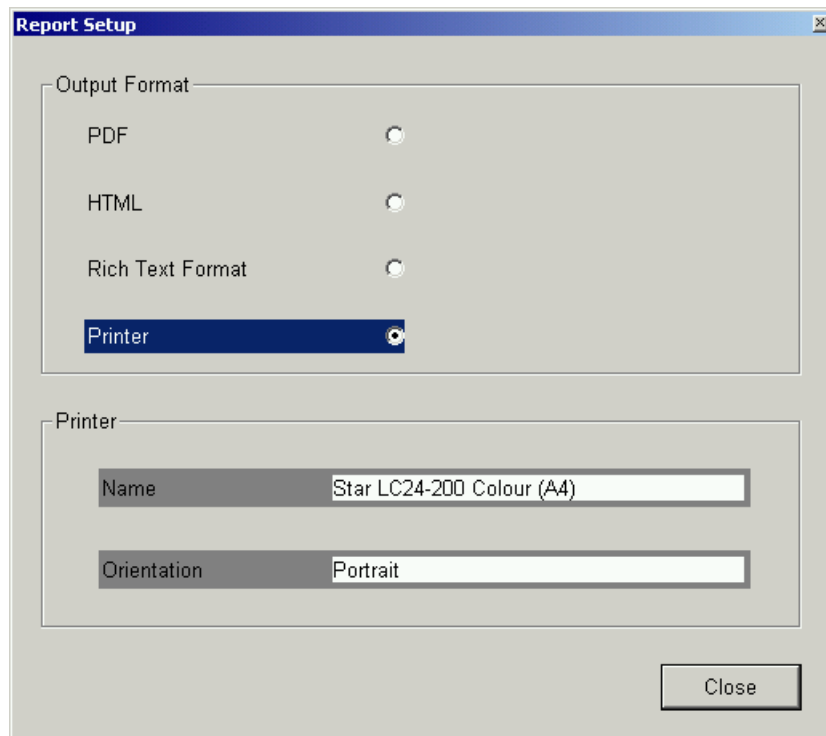
Under *Output Format*, select the file format by turning the rotary knob and then confirm by pressing the rotary knob or the *ENTER* key.

The following file formats are available:

• PDF

  Portable document format

• HTML

  Hypertext Markup Language 4.1, can be viewed with internet browsers

• Rich Text Format

  Can be read and edited by word processors

When a file format is selected, printing to a file is set automatically. The file name is queried when the *PRINT* softkey is pressed.

Under *Printer, select* a printer (also a preconfigured network printer) by selecting *Printer* with the rotary knob and then confirm by pressing the rotary knob or the *ENTER* key.

After confirmation, the entries in the *Name* and *Orientation* list are available for selection with the rotary knob.

IEC/IEEE bus command: `HCOP:DEV:LANG HTML | PDF | RTF`
                          `HCOP:DEV:LANG GDI;`
                          `SYST:COMM:PRIN:ENUM:FIRS?;`
                          `SYST:COMM:PRIN:ENUM:NEXT?;`
                          `SYST:COMM:PRIN:SEL <Printer>;`
                          `HCOP:PAGE:ORI PORT;`
                          `HCOP:DEST "SYST:COMM:PRIN"`

TEMPLATE   The *TEMPLATE* softkey defines the contents and the header of the test report in a template. Up to 20 templates can be stored for different layouts.

IEC/IEEE bus command: `HCOP:TREP:ITEM:TEMP:CAT?`

LOAD TEMPLATE   The *LOAD TEMPLATE* softkey opens a list of all defined layouts. Select the desired template using the rotary knob or the cursor keys and then confirm by pressing the *ENTER* key.
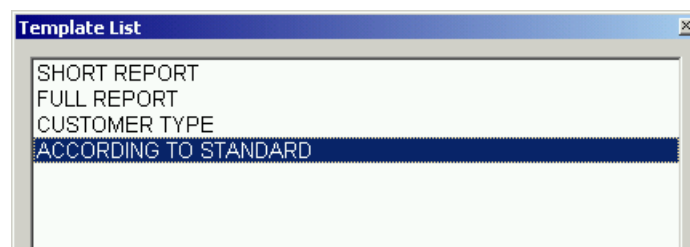
IEC/IEEE bus command: `HCOP:TREP:ITEM:TEMP:LOAD 'FULL`
                          `REPORT'`

EDIT CURRENT　　The *EDIT CURRENT* softkey opens the *Edit Current Template* dialog to edit the currently active template.

Under *Header Layout*, define the texts and the visibility of the single items on several pages (always, once or never can be set). A bitmap file can be selected as a logo which is printed right on top of the page.

Under *Report Content*, select the items to be printed.

OK generates a report.

Default sets the default layout and content.

Cancel aborts the report generation.

IEC/IEEE bus command:　　`HCOP:TREP:ITEM:HEAD:LINE:TITL 'Text'`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:HEAD:LINE:CONT ALW`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:LOGO:CONT ALW`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:HEAD:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:DIAG:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:FRES:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:PAG:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:SCAN:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:SRES:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:TDST:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:TRAN:STAT ON`
　　　　　　　　　　　　　　　`HCOP:TREP:ITEM:DEF`

DELETE TEMPLATE
:   The *DELETE TEMPLATE* softkey opens a list of all defined layouts. Select the template to be deleted using the rotary knob or the cursor keys and then confirm by pressing the *ENTER* key.

    IEC/IEEE bus command: `HCOP:TREP:ITEM:TEMP:DEL 'FULL REPORT'`

SAVE TEMPLATE
:   The *SAVE TEMPLATE* softkey opens a list of all defined layouts. Enter the name for the current template with an external keyboard or with the help line editor.

    IEC/IEEE bus command: `HCOP:TREP:ITEM:TEMP:SAVE 'FULL REPORT'`

EDIT HEADER
:   The *EDIT HEADER* softkey opens the *Edit Header* dialog to enter the contents of the header.

    IEC/IEEE bus command: `HCOP:TREP:ITEM:HEAD:LINE2:TEXT 'radiated test'`

NEW
:   The *NEW* softkey creates a new test report. The *Edit Header* dialog is displayed and the contents of the header can be edited. After pressing *OK* the report is created.

    If a previously created test report has not been printed or exported into a file, the following message is displayed: *Previous Report Will Be Lost*.

    IEC/IEEE bus command: `HCOP:TREP:NEW`

APPEND
:   The *APPEND* softkey appends a test report to the existing report. The *Edit Header* dialog is displayed and the contents of the header can be edited. It is possible to create reports that contain the results of several measurements. The report is stored in internal memory until it is printed.

    IEC/IEEE bus command: `HCOP:TREP:APP`

PRINT   The *PRINT* softkey prints or exports the previously created test report.

IEC/IEEE bus command: `HCOP:TREP:APP`

PREVIEW   With the *PREVIEW* softkey, the test report can be checked before printing.
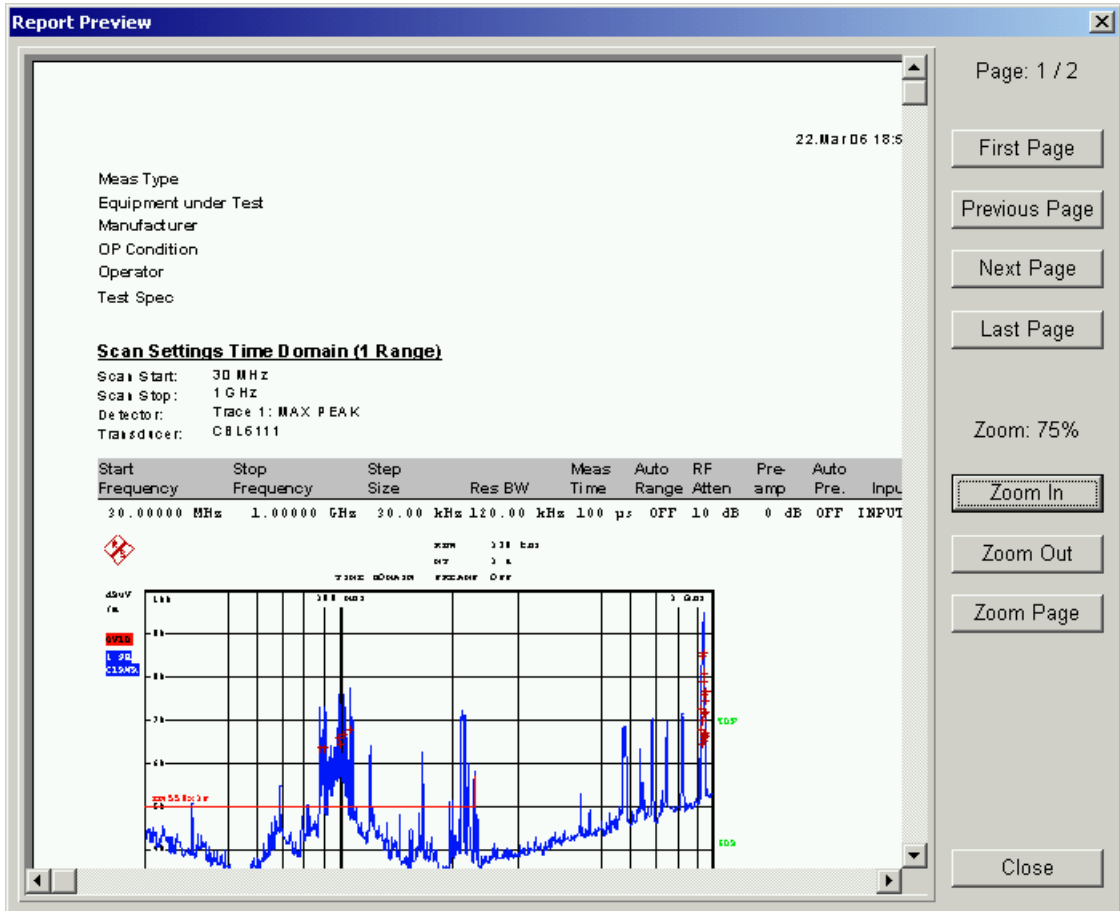
IEC/IEEE bus command: –

Installation of Plug&Play Printers

The installation of Plug&Play printers under Windows XP is quite simple:

After the printer is connected and switched on, Windows XP automatically recognizes it and installs its driver, provided the driver is included in the XP installation.

If the XP printer driver is not found, Windows XP prompts you to enter the path for the corresponding installation files. In addition to pre-installed drivers, a number of other printer drivers can be found in directory D:\I386.
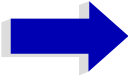
Note

When installing new printer drivers, you will be prompted to indicate the path of the new driver. This path may be on a memory stick or USB CD-ROM drive (see the Quick Start Guide, chapter "Preparing for Use").

Installation of Non-Plug&Play Printers

Note

The dialogs below can be operated either from the front panel or via mouse and keyboard (see the Quick Start Guide, chapter "Preparing for Use"). Mouse and PC keyboard are absolutely essential for configuring network printers.

INSTALL PRINTER   A new printer is installed via the *INSTALL PRINTER* softkey.
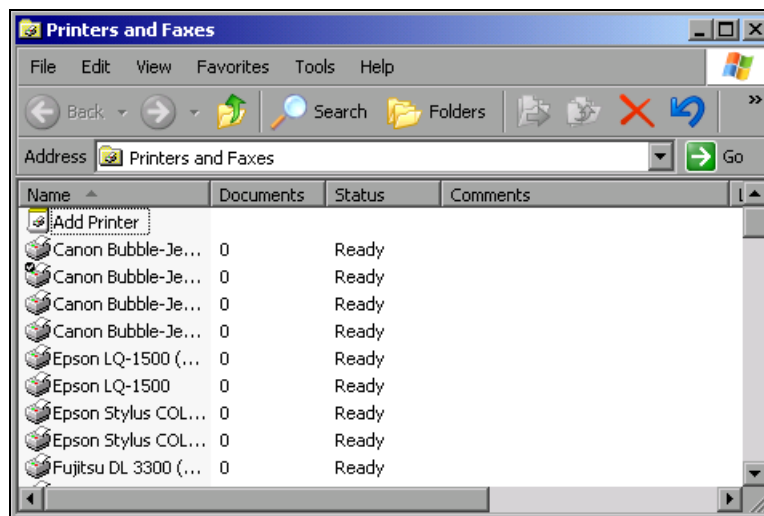
➢ Select *Add Printer* in the list using the rotary knob.

➢ Highlight the selected item with *CURSOR RIGHT* and press *ENTER* or the rotary knob to confirm the selection.

   The *Add Printer Wizard* is displayed.
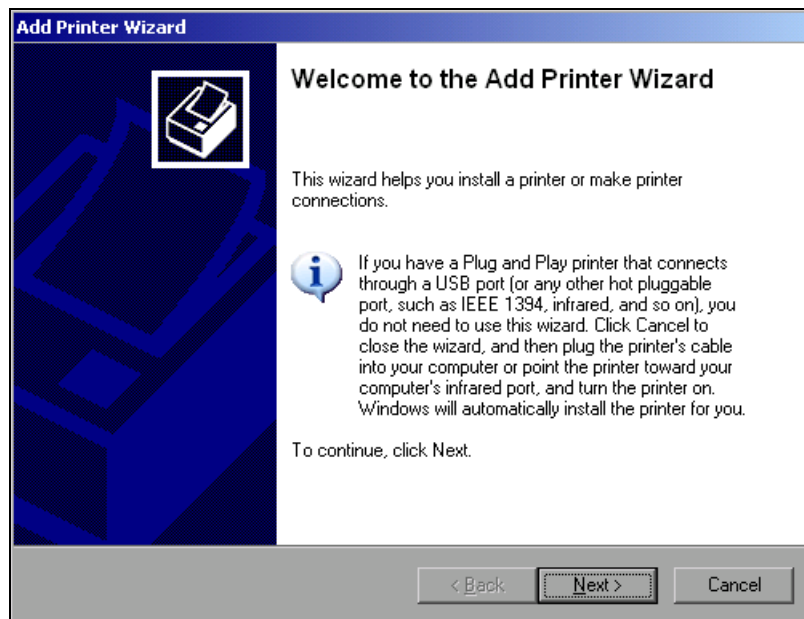
➢ Select *NEXT* with the rotary knob and press the rotary knob for confirmation.

Local or Network Printer can be selected.
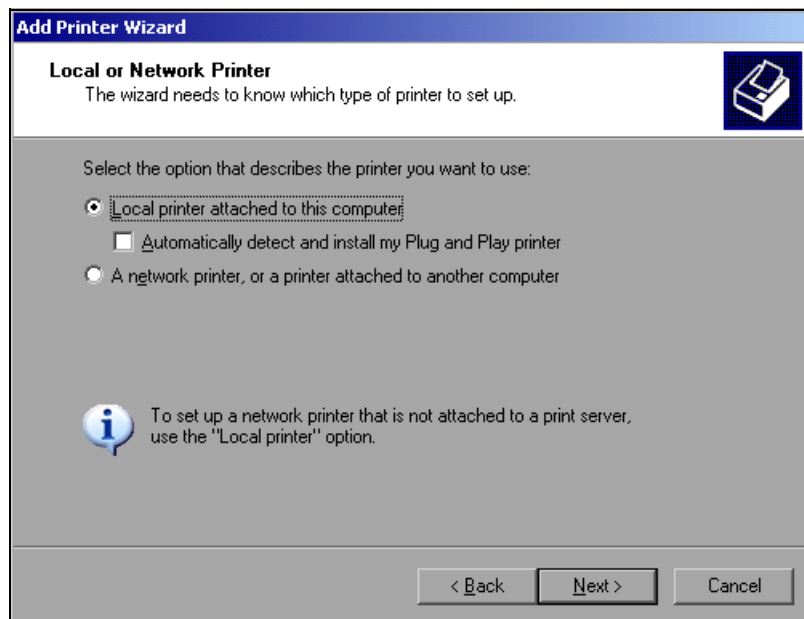
➢ To install a local printer, select *Local printer attached to this computer* with the rotary knob. Press the rotary knob for confirmation and continue with the section "Local Printer" on page 4.337.

➢ To install a network printer, select *A network printer or a printer attached to another computer.* Press the rotary knob for confirmation and continue with the section "Network Printer" on page 4.343.

Local Printer

In the example below, a Star LC24 printer is installed.
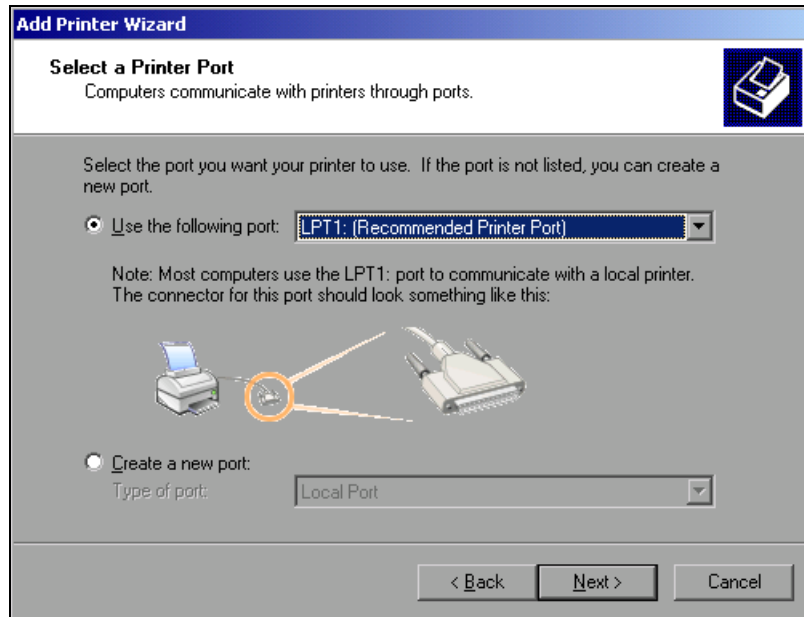
> ➢ To select the USB interface, open the list of ports by clicking the rotary knob. Select the printer port with rotary knob/arrow keys and confirm by pressing the rotary knob. The selection list is closed again.

> ➢ To select the LPT connector, the selection list need not be opened.

> ➢ Place the cursor on the *NEXT* button and confirm by pressing the rotary knob.

  The "Install Printer Software" dialog is opened.
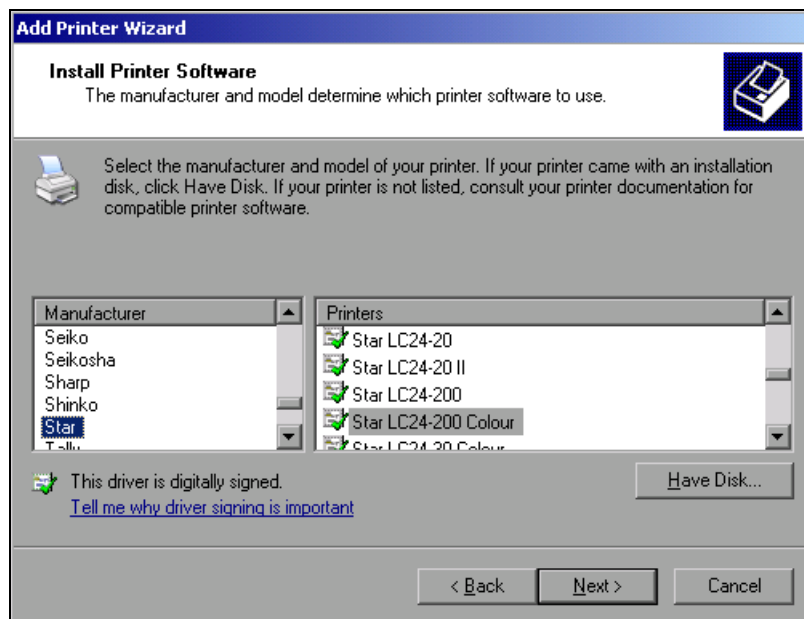
➢ Select the desired manufacturer ("Star") in the Manufacturer table using the up / down keys.
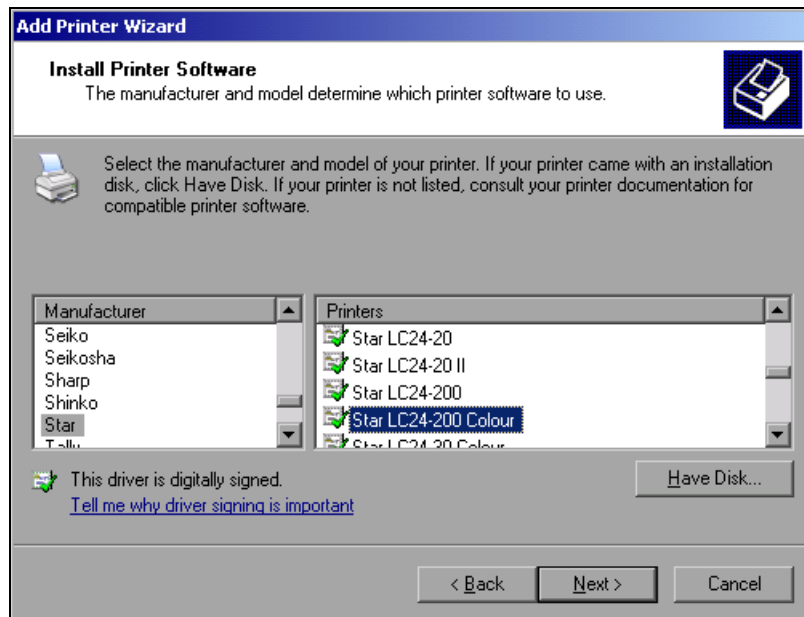
Go to the *Printers* list with the rotary knob.
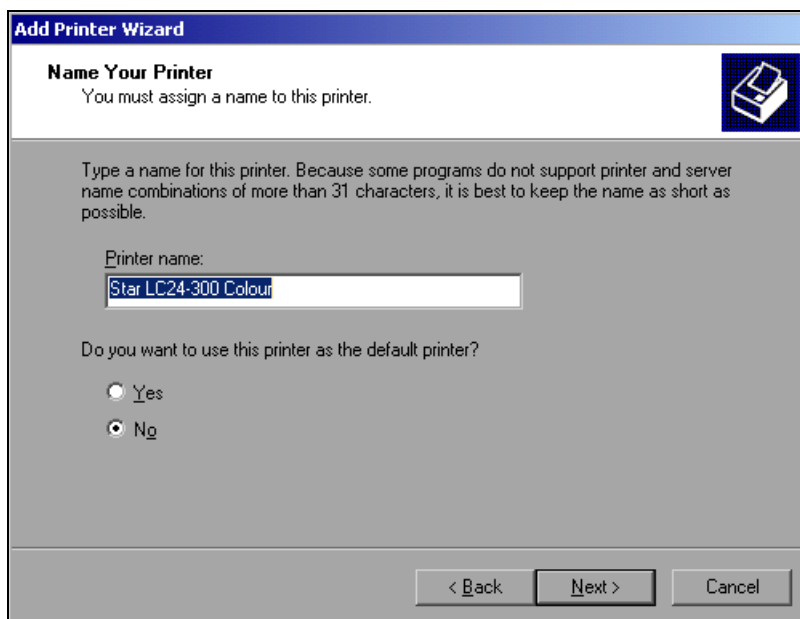
➢ Select the desired printer type (Star LC24-200 Color) using the up / down keys and confirm with *ENTER*.

Note

If the desired printer type is not in the list, the respective driver is not installed yet. In this case click the HAVE DISK button with the mouse key. You will be prompted to connect e.g. a memory stick with the corresponding printer driver. Press OK and select the desired printer driver.
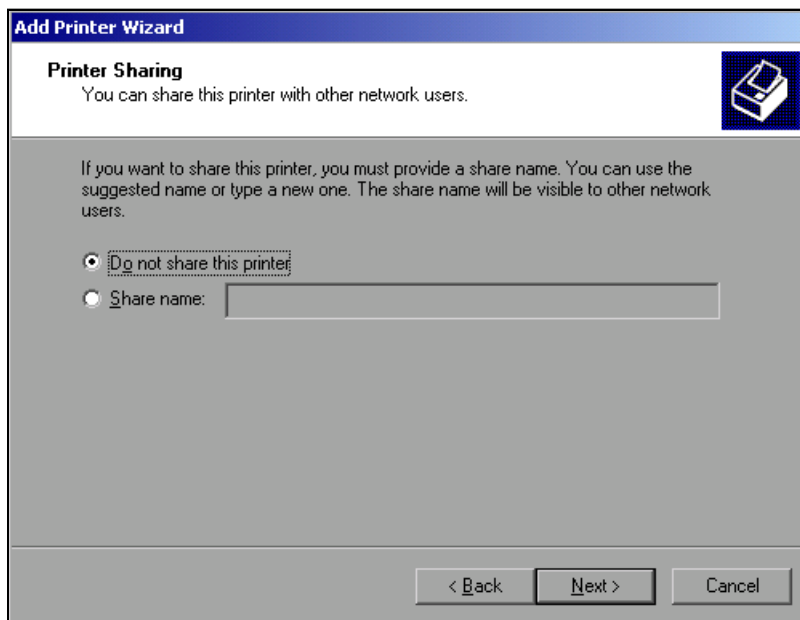
➢ The printer name can be changed as required in the *Printer name* entry field (max. 60 characters). A PC keyboard is required in this case.

➢ Use the rotary knob to select *Yes or No* for the default printer.

➢ Choose the desired status with the up /down keys.

➢ Confirm with *ENTER*.

    The *Printer Sharing* dialog is opened.

➢ Exit the dialog with *ENTER*.

The *Print Test Page* dialog is opened.
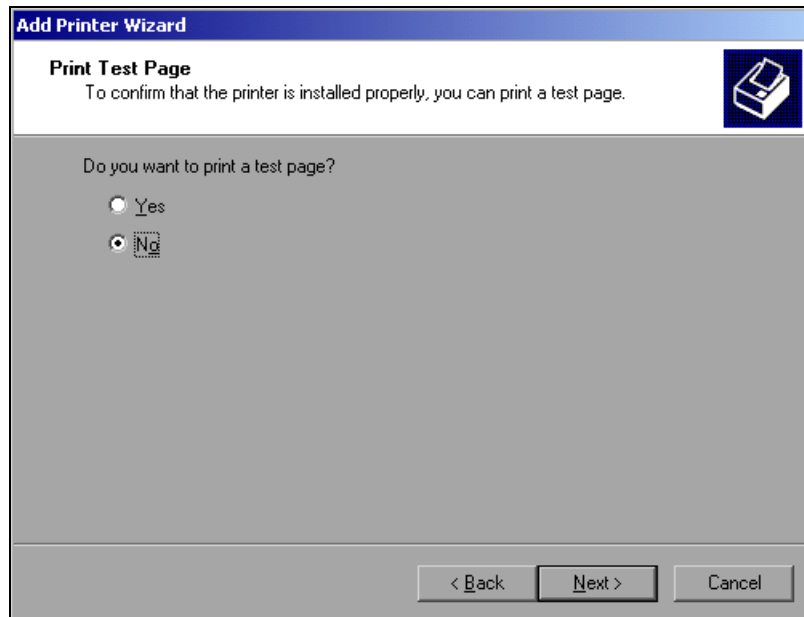
➢ Exit the dialog with *ENTER*.

The *Completing the Add Printer Wizard* dialog is opened.
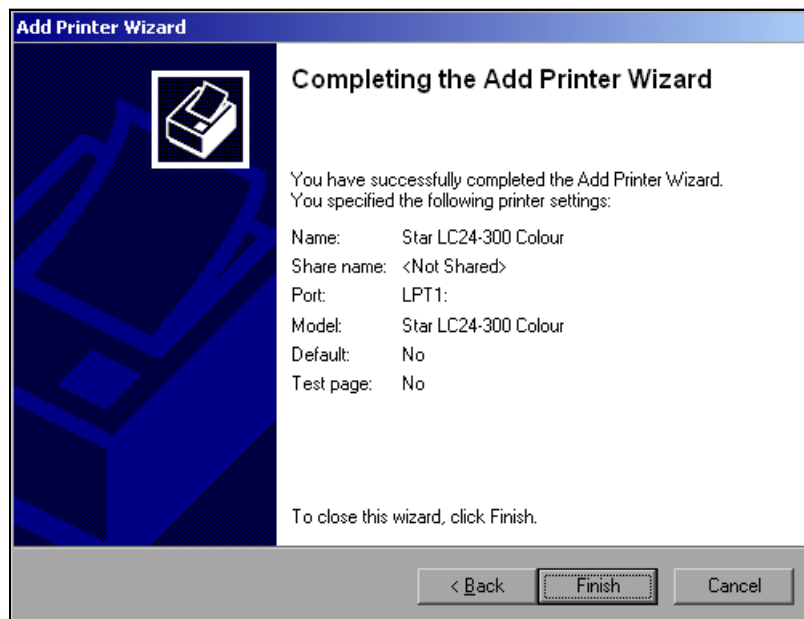
➢ Check the displayed settings and exit the dialog with *ENTER*.

The printer is installed. If Windows finds the required driver files, the installation is completed without any further queries.

If Windows cannot find the required driver files, a dialog is opened where the path for the files can be entered.
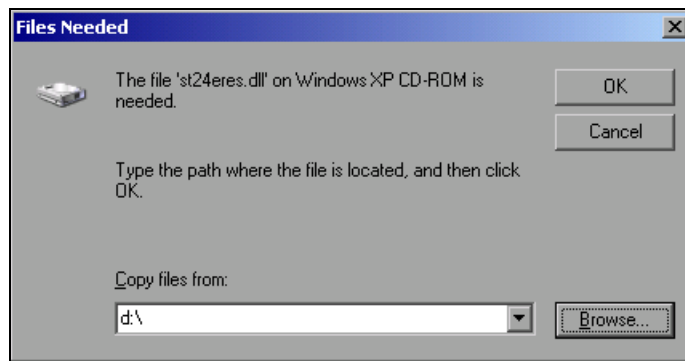
➢ Select the *Browse* button with the rotary knob and confirm with by pressing the rotary knob.

The *Locate File* dialog is opened.
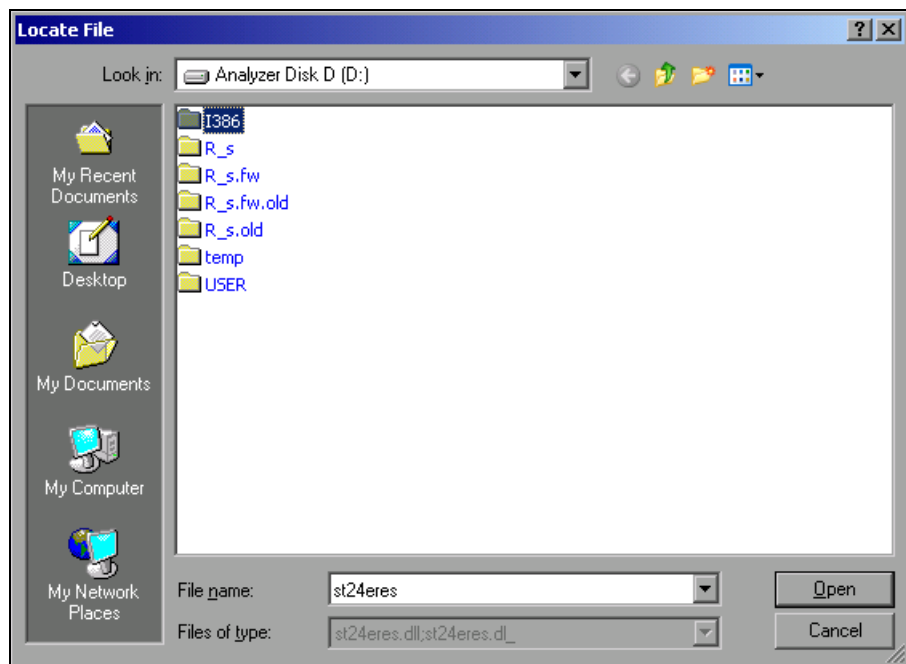
➢ Turn the rotary knob to select the directory and path D:\I386 and press it to confirm the selection.

If the selected item is not printed on a blue background, it must be marked with the cursor up / down keys before it can be activated by pressing the rotary knob.
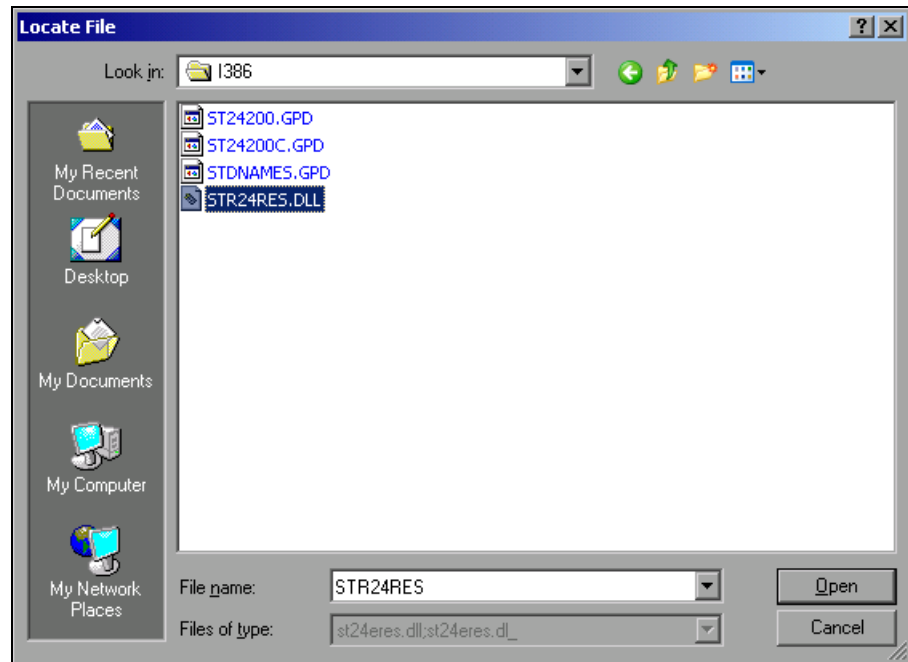
➢ Select the driver file with the rotary knob and confirm by pressing the rotary knob.

The file is included in the *Files Needed* dialog.

Note

If the desired file is not in the D:\I386 directory, e.g. a memory stick with the driver file is needed. In this case, exit the dialog with ESC and repeat the selection starting from the *Files Needed* dialog.
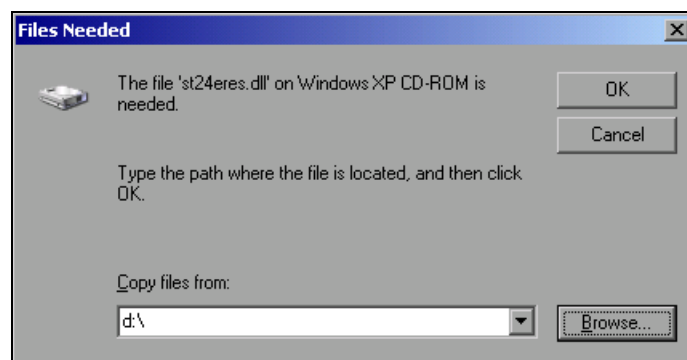
➢ Select the *OK* button with the rotary knob and press the rotary knob to confirm.

The installation is completed.

➢ Finally the instrument must be configured for printouts of the measurement screen with this printer. For details please refer to the *DEVICE SETUP* softkey in the hardcopy menu.

Network Printer

> **Note**
>
> For easy operation of the subsequent dialogs, connection of a PS/2 keyboard with trackball to the front panel is recommended. If no trackball is available, a USB mouse should be connected additionally to the rear panel (see the Quick Start Guide, chapter "Preparing for Use").

In the example below, a HP Laserjet 5 printer is installed as network printer. The Add Printer Wizard has already been opened as described in section "Installation of Non-Plug&Play Printers" on page 4.335
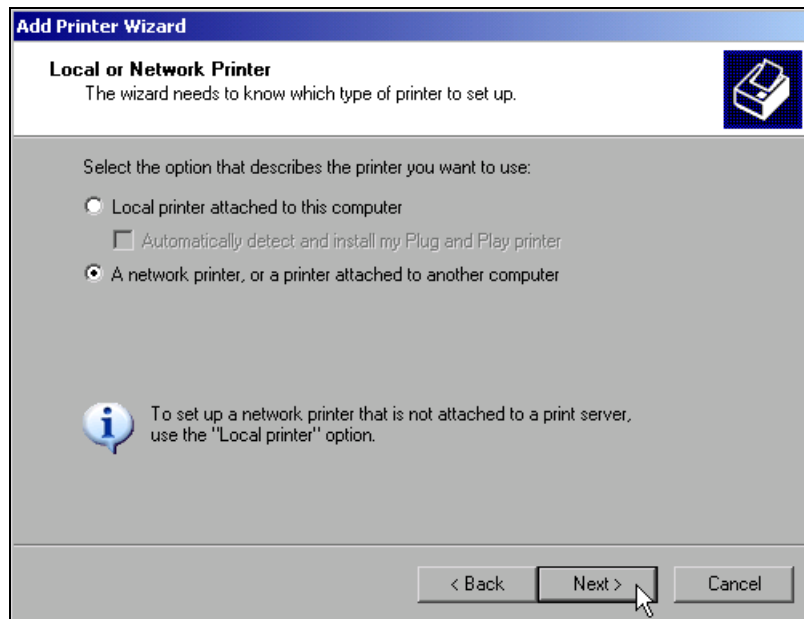
➢ To select a network printer, click the option "*A network printer or a printer attached to another computer*".

➢ Continue with *NEXT*.

Add Printer Wizard

Specify a Printer
If you don't know the name or address of the printer, you can search for a printer that meets your needs.

What printer do you want to connect to?

⊙ Browse for a printer

○ Connect to this printer (or to browse for a printer, select this option and click Next):

Name: [   ]

Example: \\server\printer

○ Connect to a printer on the Internet or on a home or office network:

URL: [   ]

Example: http://server/printers/myprinter/.printer

[< Back] [Next >] [Cancel]

➢ Click *Browse for a printer* and then *NEXT*.

A list of selectable printers is displayed.

Add Printer Wizard

Browse for Printer
When the list of printers appears, select the one you want to use.

Printer: [\\RS\P-MU0844-PQ.NW10.MUC.RSD.DE]

Shared printers:

| RS\P-MU0642-PQ.NW10.MUC.RSD. |
| RS\P-MU0718-PQ.NW10.MUC.RSD. |
| RS\P-MU0844-PQ.NW10.MUC.RSD. |
| RS\P-MU1070-PQ.NW10.MUC.RSD. |
| RS\P-MU1120-PQ.NW10.MUC.RSD. |
| RS\P-MU1140-PQ.NW10.MUC.RSD. |
| RS\P-MU1150-PQ.NW10.MUC.RSD. |

Printer information
Error: The specified user does not exist.

[< Back] [Next >] [Cancel]

➢ Mark the desired printer and select it with OK.
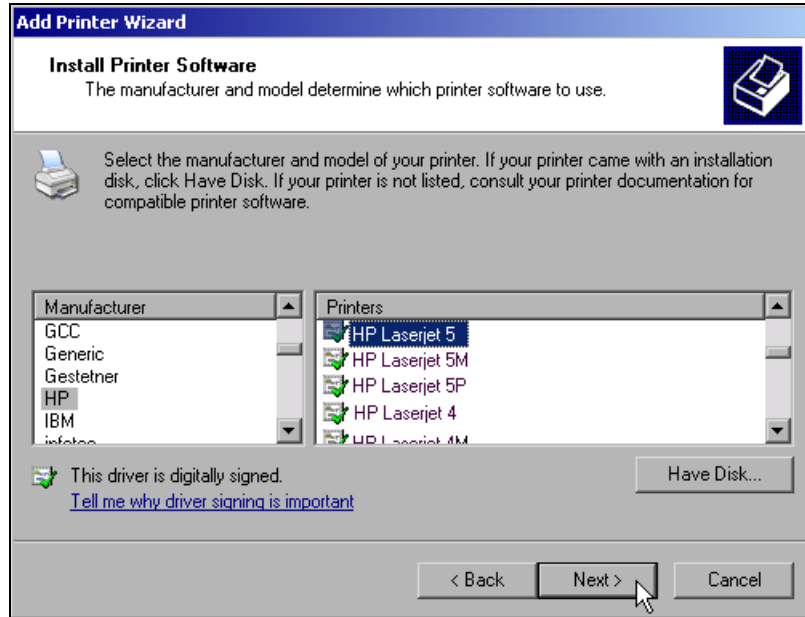
➢ Confirm the subsequent prompt to install a suitable printer driver with "OK". The list of available printer drivers is displayed.

The manufacturers are listed in the left-hand table, the available printer drivers in the right-hand table.

➢ Select the manufacturer from the *Manufacturers* table and then the printer driver from the *Printers* table.

Note

If the desired type of output device is not shown in the list, the driver has not yet been installed. In this case, click the *HAVE DISK* button. You will be prompted to connect a memory stick with the corresponding printer driver. Connect the memory stick, select *OK* and then choose the desired printer driver.

➢ Click *NEXT*.
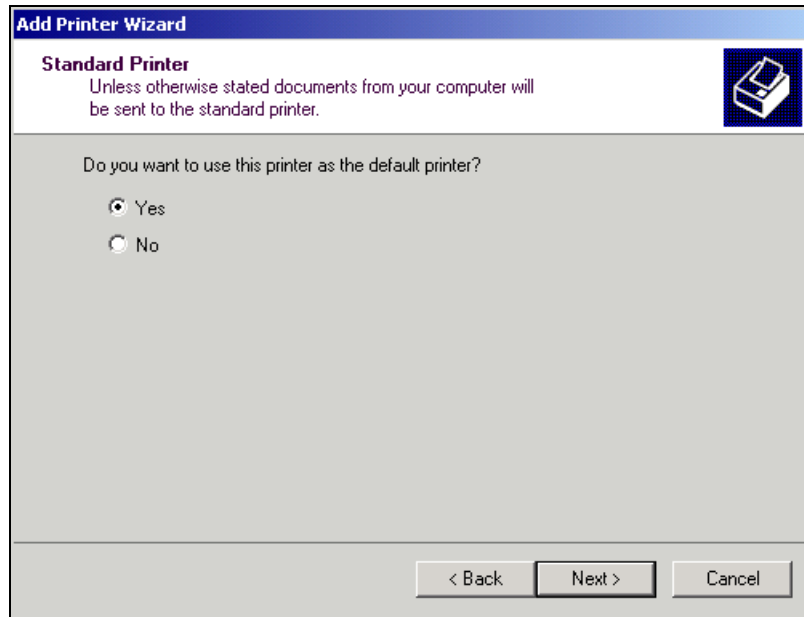
If one or more printers are already installed, a query is displayed whether the printer just installed should be used as the standard printer for the Windows XP applications. Default setting is *No*.
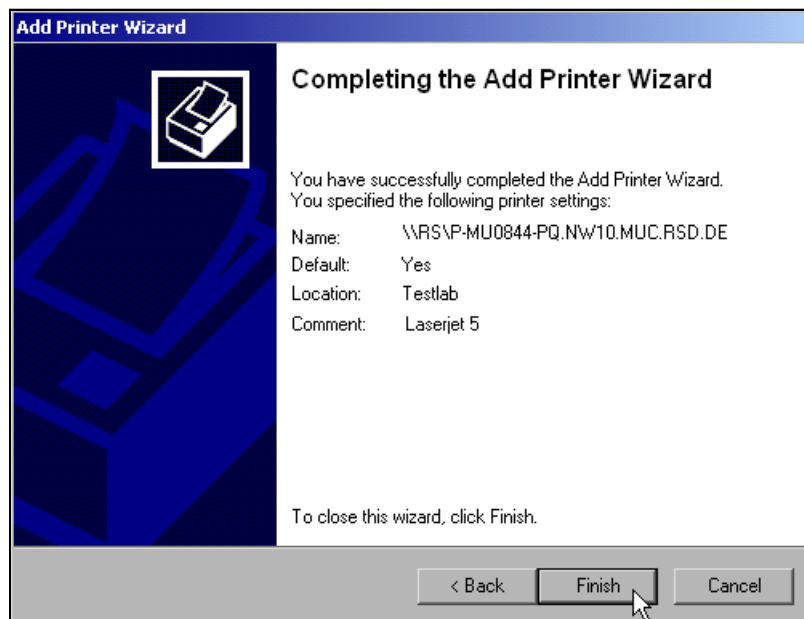
➢ Start the printer driver installation with *Finish*.

➢ Finally, the instrument has to be configured for printout with this printer using the DEVICE SETUP and *DEVICE 1/2* softkeys in the hardcopy main menu (see section "Selecting Printer, Clipboard and File Formats" on page 4.323).

Tracking Generator – Option R&S FSU-B9

During normal operation (without a frequency offset), the tracking generator emits a signal exactly at the input frequency of the ESU.

For frequency-converting measurements it is possible to set a constant frequency offset of ±200 MHz between the receive frequency of the ESU and the output signal of the tracking generator.

Moreover, an I/Q modulation or AM and FM modulation of the output signal can be provided using two analog input signals.

The output power is level-controlled and can be set in 0.1 dB steps in a range from -30 dBm to +5 dBm (-100 to + 5 dBm with option FSU-B12).

The tracking generator can be used in all operating modes. Acquisition of test setup calibration values (SOURCE CAL) and normalization using these correction values (*NORMALIZE*) is only possible in the *NETWORK* operating mode.

> **Note**
>
> The RF characteristics of some DUTs is especially sensitive concerning the input VSWR. In such cases insertion of 20 dB attenuation between the DUT and the tracking generator output is highly recommended.

The tracking generator is activated by means of the *NETWORK* hotkey in the hotkey bar at the bottom of the screen (for details refer to section "Mode Selection – Hotkey Bar" on page 4.10.)

Tracking Generator Settings

The *NETWORK* hotkey opens a menu for selecting the functions of the tracking generator.

```
NETWORK  →   ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │   SOURCE     │      │    CAL       │      │   EXT AM     │
             │ ON     OFF   │─────→│   TRANS      │─────→│              │
             └─────────────┘      └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │   SOURCE     │      │  CAL REFL    │      │              │
             │   POWER      │      │   SHORT      │      │              │
             └─────────────┘      └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │   POWER      │      │  CAL REFL    │      │   EXT FM     │
             │   OFFSET     │      │   OPEN       │      │              │
             └─────────────┘      └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │   SOURCE     │      │  NORMALIZE   │      │   EXT I/Q    │
             │   CAL        │      │              │      │              │
             └─────────────┘      └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │  FREQUENCY   │      │  REF VALUE   │      │              │
             │   OFFSET     │      │  POSITION    │      │              │
             └─────────────┘      └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │ MODULATION   │      │  REF VALUE   │      │              │
             │              │      │              │      │              │
             └─────────────┘      └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │   POWER      │      │   RECALL     │      │              │
             │   SWEEP      │      │              │      │              │
             └─────────────┘      └─────────────┘      └─────────────┘
option       ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
B10 only     │   EXT        │      │              │      │              │
             │   SOURCE     │      │              │      │              │
             └─────────────┘      └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
             │              │      │  SAVE AS     │      │ MODULATION   │
             │              │      │ TRD FACTOR   │      │   OFF        │
             └─────────────┘      └─────────────┘      └─────────────┘

             ┌─────────────┐      ┌─────────────┐
             │   EXT SRC    │      │  POWER SWP   │
             │ ON    OFF    │      │ ON    OFF    │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │   SELECT     │      │   START      │
             │  GENERATOR   │      │   POWER      │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │  FREQUENCY   │      │   STOP       │
             │   SWEEP      │      │   POWER      │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │              │      │              │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │              │      │              │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │  GEN REF     │      │              │
             │ INT    EXT   │      │              │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │              │      │              │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │              │      │              │
             └─────────────┘      └─────────────┘
             ┌─────────────┐      ┌─────────────┐
             │              │      │  SAVE AS     │
             │              │      │ TRD FACTOR   │
             └─────────────┘      └─────────────┘
```

Note

Additional softkeys are available in the displayed menus for controlling an external generator if option External Generator Control FSP-B10 is fitted. For detailed information see section "External Generator Control – Option R&S FSP-B10" on page 4.366.

SOURCE ON/OFF   The *SOURCE ON/OFF* softkey switches the tracking generator on or off. Default setting is *OFF*

Note:

- When the tracking generator is switched on the maximum stop frequency is limited to 3.6 GHz. This upper limit is automatically reduced by a frequency offset set up for the tracking generator.

- In order to meet the data sheet accuracy for measurements with active tracing generator the start frequency must be set to $\geq 3 \times$ Resolution Bandwidth.

- The minimum sweeptime for measurements with data sheet accuracy is 100 ms in frequency domain (span > 0 Hz). Selecting a sweeptime below this limit will result in the sweeptime indicator field SWT being supplied with a red asterisk and the message UNCAL being displayed.

- FFT filters (*FILTER TYPE FFT* in *BW* menu) are not available when the tracking generator is active.

IEC/IEEE bus command: `OUTP:STAT ON`

SOURCE POWER   The *SOURCE POWER* softkey allows the tracking generator output power to be selected.

The output power can be set in 0.1 dB steps from -30 dBm to +5 dBm (-100 to + 5 dBm with option FSU-B12).

If the tracking generator is off, it is automatically switched on when an output power value is entered.

The default output power is -20 dBm.

IEC/IEEE bus command: `SOUR:POW -20dBm`

POWER OFFSET   The *POWER OFFSET* softkey allows selection of a constant level offset for the tracking generator.

With this offset for example attenuators or amplifiers at the output connector of the tracking generator can be taken into account for the displayed output power values on screen or during data entry.

The valid range is -200 dB to +200 dB in 0.1 dB steps. Positive offsets apply to an amplifier and negative offsets to an attenuator subsequent to the tracking generator.

The default setting is 0 dB. Offsets <> 0 will display the enhancement label **LVL**.

IEC/IEEE bus command: `SOUR:POW:OFFS –10dB`

Transmission Measurement

This measurement will yield the transmission characteristics of a two-port network. The built-in tracking generator serves as a signal source. It is connected to the input connector of the DUT. The input of the ESU is fed from the output of the DUT.
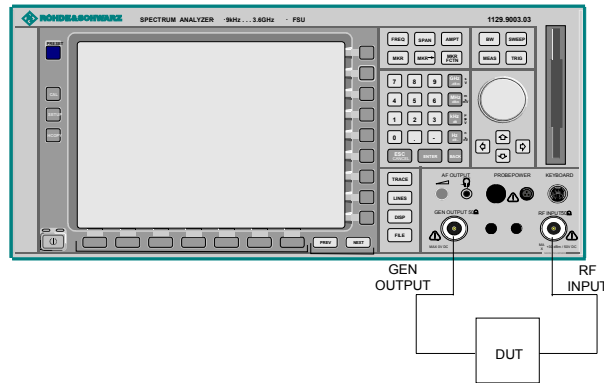
Fig. 4-2   Test setup for transmission measurement

A calibration can be carried out to compensate for the effects of the test setup (eg frequency response of connecting cables).

Calibration of Transmission Measurement
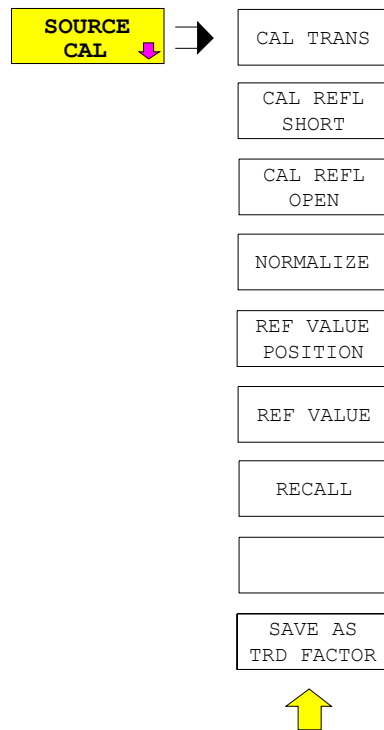
SOURCE CAL

The *SOURCE CAL* softkey opens a submenu comprising of the calibration functions for the transmission and reflection measurement.

The calibration of the reflection measurement (*CAL REFL...*) and its mechanisms are described in separate sections.

To carry out a calibration for transmission measurements the whole test setup is through-connected (THRU).

CAL TRANS　　The *CAL TRANS* softkey triggers the calibration of the transmission measurement.

It starts a sweep that records a reference trace. This trace is then used to calculate the difference for the normalized values.
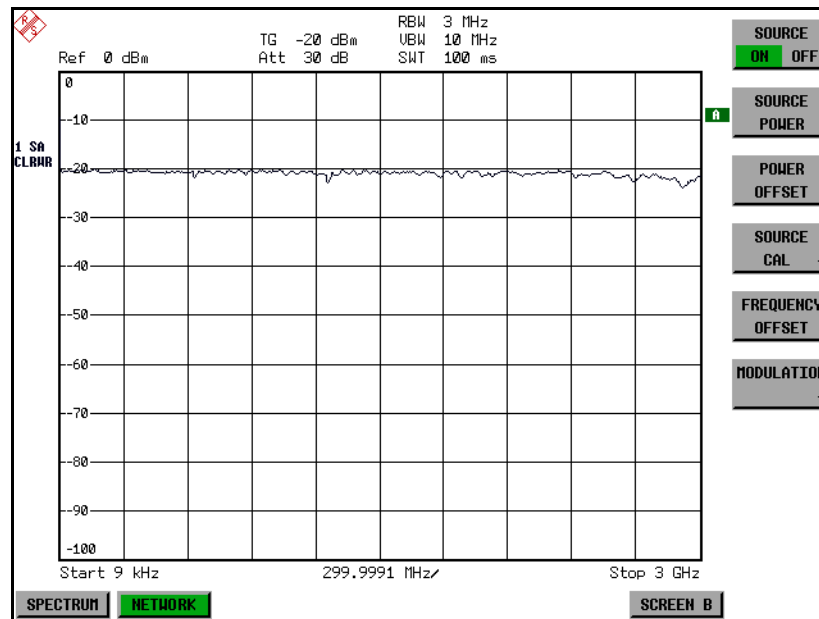
Fig. 4-3　　　Calibration curve for transmission measurement

During the calibration the following message is displayed:

After the calibration the following message is displayed:
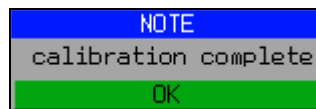
This message will be cleared automatically after approx. 3 seconds.

IEC/IEEE bus command:　　CORR:METH TRAN

Normalization

NORMALIZE   The *NORMALIZE* softkey switches the normalization on or off. The softkey is only available if the memory contains a correction trace.

It is possible to shift the relative reference point within the grid using the *REF VALUE POSITION* softkey. Thus, the trace can be shifted from the upper border of the grid to the vertical center of the grid:
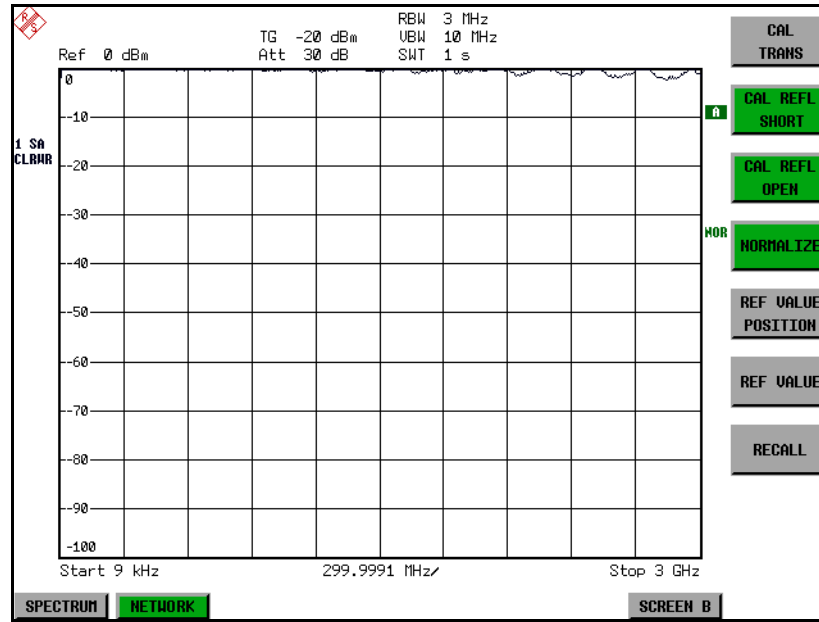
Fig. 4-4   Normalized display

In *SPLIT SCREEN* operation, the normalization is switched on in the currently active window. Different types of normalization can be active in the two windows.

Normalization is aborted when the *NETWORK* operating mode is quit.

IEC/IEEE bus command: CORR ON

REF VALUE POSITION   The *REF VALUE POSITION* softkey marks a reference position in the active window at which the normalization result (calculated difference with a reference trace) is displayed.

If no reference line is active, the softkey switches on a reference line and activates the input of its position. The line can be moved within the grid boundaries.

The reference line is switched off by pressing the softkey again.

The function of the reference line is explained in the section "Calibration Mechanism" on page 4.358.
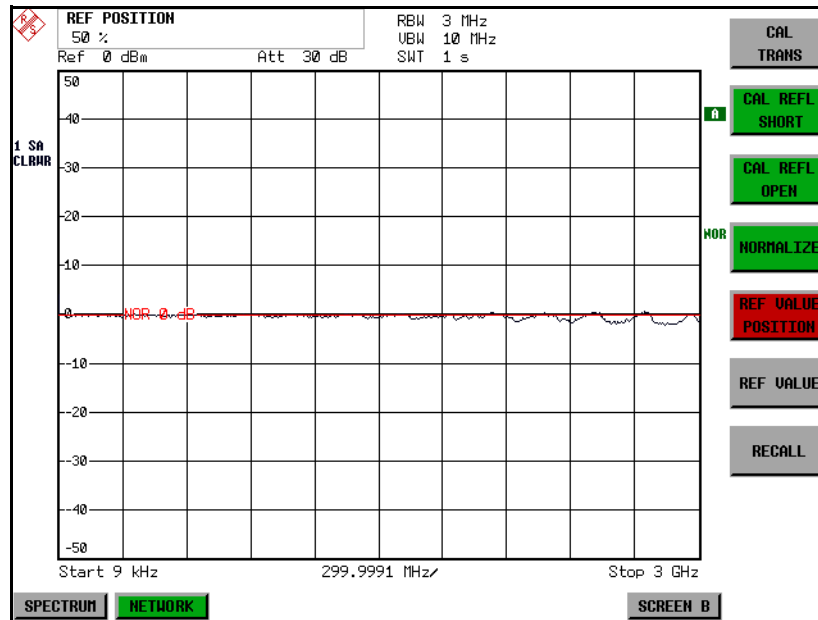
Fig. 4-5   Normalized measurement, shifted with *REF VALUE POSITION 50%*

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RPOS 10PCT`

REF VALUE   The *REF VALUE* softkey activates the input of a value which is assigned to the reference line.

With default settings the reference line corresponds to a difference of 0 dB between the currently measured trace and the reference trace. Setting the *REF VALUE* to a different value helps to compensate for changes to the level conditions in the signal path after the calibration data have been recorded. If eg after a source calibration a 10 dB attenuation is inserted into the signal path between DUT and ESU input, the measurement trace will be moved by 10 dB down. Entering a *REF VALUE* of –10 dB will then result in the reference line for difference calculation being moved by 10 dB down as well. This means that the measured trace will be placed on it, as displayed in Fig. 4-6.

REF VALUE always refers to the active window.
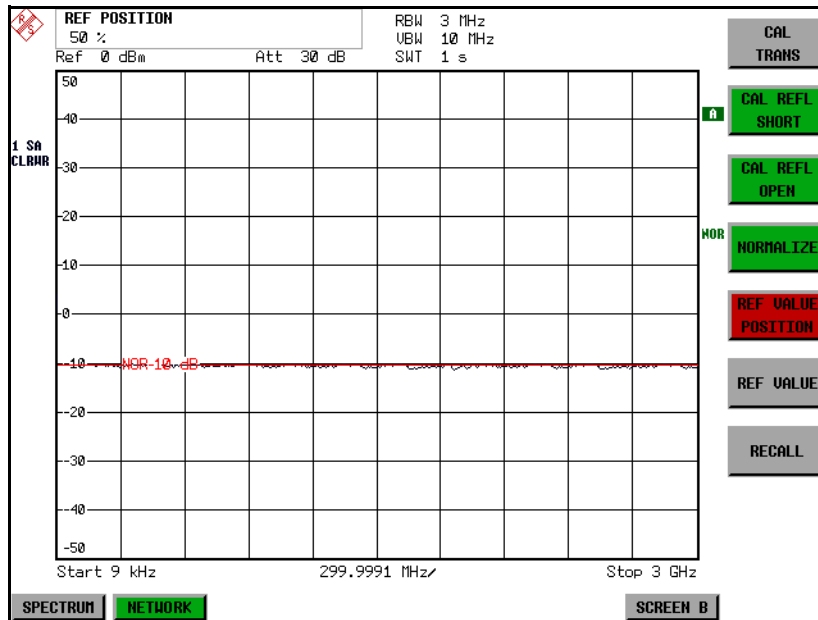
Fig. 4-6   Measurement with REF VALUE -10 dB and REF VALUE
            POSITION 50%

After the reference line has been moved by entering a *REF VALUE* of –10 dB
the deviation from the nominal power level can be displayed with high resolution
(eg 1 dB/div). The power is still displayed in absolute values, which means that
in the above example 1 dB below the nominal power (reference line) = 11 dB
attenuation.
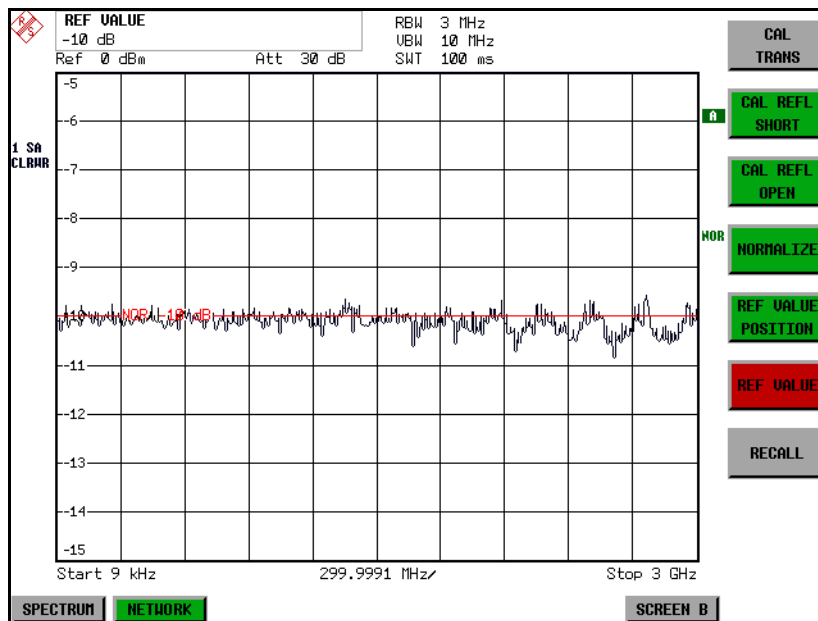
Fig. 4-7   Measurement of a 10dB attenuator pad with 1dB/DIV

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RVAL -10dB`

RECALL   The *RECALL* softkey restores the ESU settings that were used during source calibration.

This can be useful if device settings were changed after calibration (eg center frequency, frequency deviation, reference level, etc.).

The softkey is only available if:

• the NETWORK mode has been selected

• the memory contains a calibration data set.

IEC/IEEE bus command: `CORR:REC`

SAVE AS TRD   SAVE AS TRD FACTOR uses the normalized measurement data to generate a
FACTOR   transducer factor with up to 625 points. The trace data are converted to a transducer with unit dB after the transducer name has been entered. The number of points is defined by SWEEP COUNT. The frequency points are allocated in equidistant steps between start and stop frequency. The generated transducer factor can be further adapted in the *SETUP* menu – *TRANSDUCER*. The *SAVE AS TRD FACTOR* softkey is only available if normalization is switched on.

IEC/IEEE bus command: `CORR:TRAN:GEN <name>'`

Reflection Measurement

Scalar reflection measurements can be carried out by means of a reflection-coefficient measurement bridge.
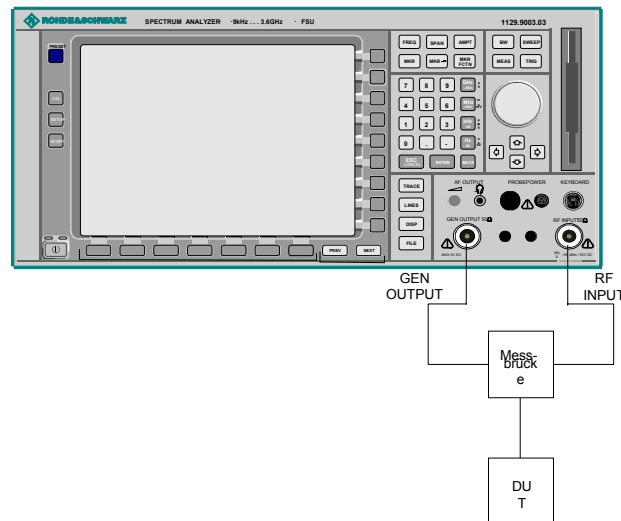
Fig. 4-8   Test Setup for Reflection Measurement

Calibration of Reflection Measurement

The calibration mechanism for reflection measurement is basically the same as the one used for transmission measurement.

CAL REFL OPEN   The *CAL REFL OPEN* softkey starts the open-circuit calibration. During calibration the following message is displayed:

IEC/IEEE bus command: `CORR:METH REFL`
                            `CORR:COLL OPEN`

CAL REFL SHORT   The *CAL REFL SHORT* softkey starts the short-circuit calibration.

If both calibrations (open circuit, short circuit) are carried out, the calibration curve is calculated by averaging the two measurements and stored in the memory. The order of the two calibration measurements is free.

After the calibration the following message is displayed:
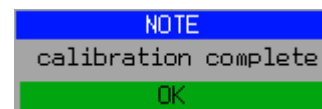
The message is cleared after approx. 3 seconds.

IEC/IEEE bus command: `CORR:METH REFL`

Calibration Mechanism

Calibration means a calculation of the difference between the currently measured power and a reference curve, independent of the selected type of measurement (transmission/reflection). The hardware settings used for measuring the reference curve are included in the reference data set.

Even with normalization switched on, the device settings can be changed in a wide area without stopping the normalization. This reduces the necessity to carry out a new normalization to a minimum.

For this purpose the reference data set (trace with 625 measured values) is stored internally as a table of 625 points (frequency/level).

Differences in level settings between the reference curve and the current device settings are taken into account automatically. If the span is reduced, a linear interpolation of the intermediate values is applied. If the span increases, the values at the left or right border of the reference data set are extrapolated to the current start or stop frequency, i.e. the reference data set is extended by constant values.

An enhancement label is used to mark the different levels of measurement accuracy. This enhancement label is displayed at the right diagram border when normalization is switched on and a deviation from the reference setting occurs. Three accuracy levels are defined:

Table 4-1   Measurement accuracy levels

Accuracy	Enhancement label	Reason/Limitation
High	NOR	No difference between reference setting and measurement
Medium	APX (approximation)	Change of the following settings: • coupling (RBW, VBW, SWT) • reference level, RF attenuation • start or stop frequency • output level of tracking generator • frequency offset of tracking generator • detector (max. peak, min. peak, sample, etc.) Change of frequency: • max. 625 points within the set sweep limits (corresponds to a doubling of the span)
-	Aborted normalization	• more than 624 extrapolated points within the current sweep limits (in case of span doubling)

Note

At a reference level (*REF LEVEL*) of -10 dBm and at a tracking generator output level of the same value the ESU operates without overrange reserve, i.e. the ESU is in danger of being overloaded if a signal is applied whose amplitude is higher than the reference line. In this case, either the message *OVLD* for overload is displayed in the status line or the display range is exceeded (clipping of the trace at the upper diagram border = Overrange).

Overloading can be avoided as follows:

• Reducing the output level of the tracking generator (*SOURCE POWER*, *NETWORK* menu)

• Increasing the reference level (*REF LEVEL*, *AMPT* menu)

Frequency-Converting Measurements

For frequency-converting measurements (eg on converter units) the tracking generator is able to set a constant frequency offset between the output frequency of the tracking generator and the receive frequency of the ESU.

Up to an output frequency of 200 MHz the measurement can be carried out in both inverted and normal positions.
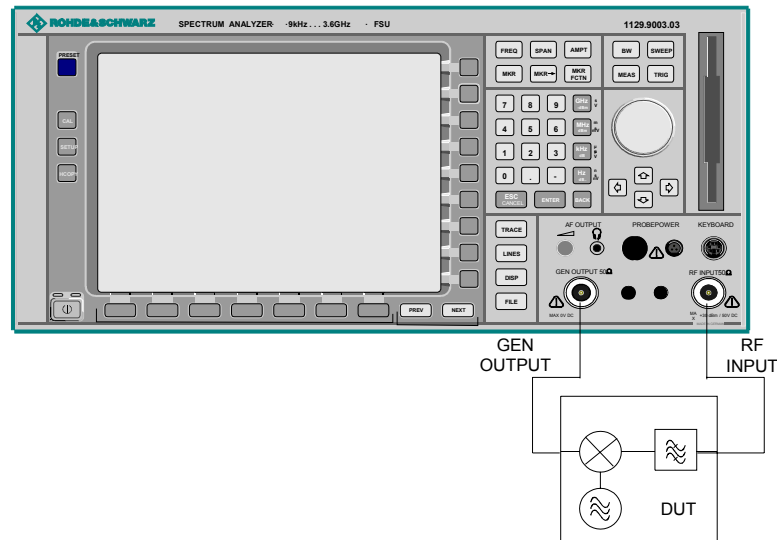
Fig. 4-9   Test setup for frequency converting measurements

FREQUENCY OFFSET

The *FREQUENCY OFFSET* softkey activates the input of the frequency offset between the output signal of the tracking generator and the input frequency of the ESU. Possible offsets are in a range of ±200 MHz in 0.1 Hz steps.

The default setting is 0 Hz. Offsets <> 0 Hz are marked with the enhancement label *FRQ*.

If a positive frequency offset is entered, the tracking generator generates an output signal above the receive frequency of the ESU. In case of a negative frequency offset it generates a signal below the receive frequency of the ESU. The output frequency of the tracking generator is calculated as follows:

   Tracking generator frequency = receive frequency + frequency offset.

IEC/IEEE bus command: `SOUR:FREQ:OFFS 50MHz`

External Modulation of the Tracking Generator

MODULATION

MODULATION

[MODULATION] →

EXT AM

EXT FM

EXT I/Q
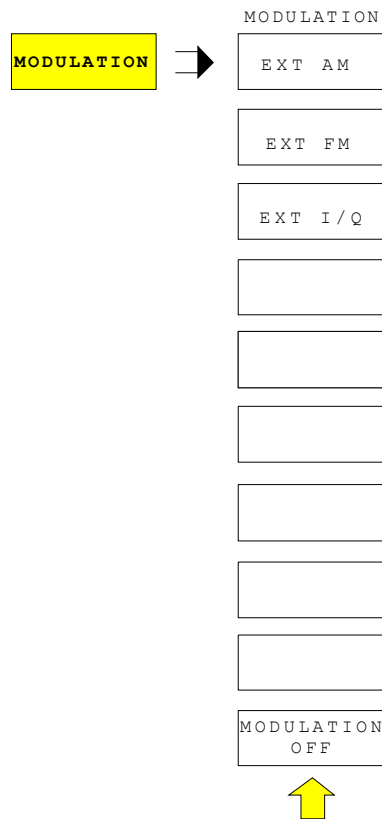
MODULATION OFF

The *MODULATION* softkey opens a submenu for selecting different modulation modes.

The time characteristics of the tracking generator output signal can be influenced by means of external signals (input voltage range -1 V to +1 V).

Two BNC connectors at the rear panel are available as signal inputs. Their function changes depending on the selected modulation:

• *TG IN I / AM* and

• TG IN Q / FM

The modulation modes can be combined with each other and with the frequency offset function up to a certain degree. The following table shows which modulation modes are possible at the same time and which ones can be combined with the frequency offset function.

Table 4-2   Simultaneous modes of modulation (tracking generator)

Modulation	Frequency offset	EXT AM	EXT FM	EXT I/Q
Frequency offset		●	●	●
EXT AM	●		●	
EXT FM	●	●		
EXT I/Q	●			

● = can be combined

EXT AM   The *EXT AM* softkey activates an AM modulation of the tracking generator output signal.

The modulation signal is applied to the *TG IN I / AM* connector. An input voltage of 1 V corresponds to 100% amplitude modulation.

Switching on an external AM disables the active I/Q modulation.

IEC/IEEE bus command: `SOUR:AM:STAT ON`

EXT FM   The *EXT FM* softkey activates the FM modulation of the tracking generator output signal.

The modulation frequency range is 1 kHz to 100 kHz, the deviation can be set in 1-decade steps in the range of 100 Hz to 10 MHz at an input voltage of 1 V. The phase deviation h should not exceed the value 100.

Phase deviation h = deviation / modulation frequency

The modulation signal is applied to the TG IN Q / FM connector.

Switching on an external FM disables the active I/Q modulation.

IEC/IEEE bus command: `SOUR:FM:STAT ON`
                                    `SOUR:FM:DEV  10MHz`

EXT I/Q   The *EXT I/Q* softkey activates the external I/Q modulation of the tracking generator.

The signals for modulation are applied to the two input connectors *TG IN I* and *TG IN Q* at the rear panel of the unit. The input voltage range is ±1 V into 50 Ω.

Switching on an external I/Q modulation disables the following functions:

– active external AM

– active external FM

Functional description of the quadrature modulator:
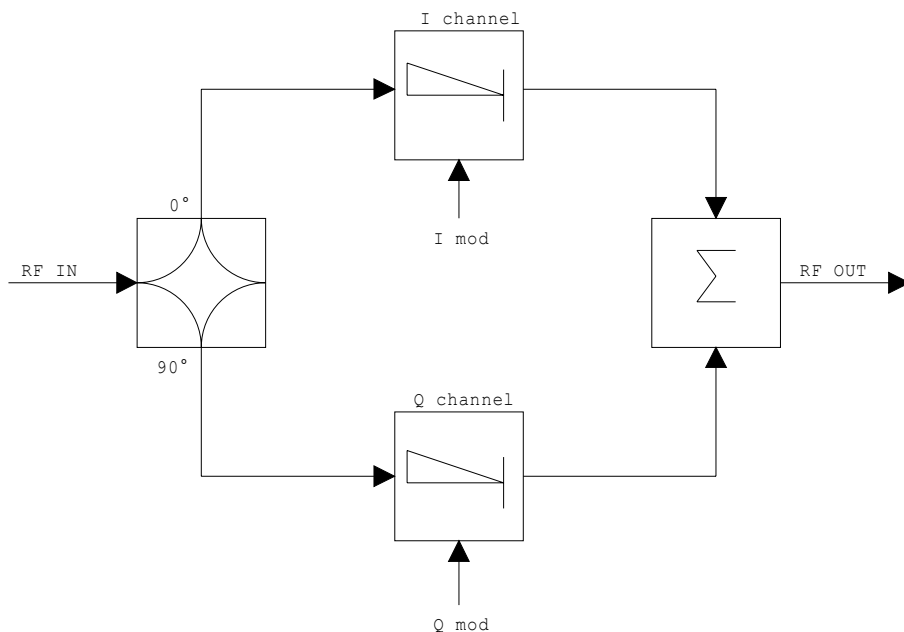
Fig. 4-10   I/Q modulation

I/Q modulation is performed by means of the built-in quadrature modulator. The RF signal is divided into two orthogonal I and Q components (in phase and quadrature phase). Amplitude and phase are controlled in each path by the I and Q modulation signal. By adding the two components an RF output signal is generated that can be controlled in amplitude and phase.

IEC/IEEE bus command: `SOUR:DM:STAT ON`

MODULATION OFF   The *MODULATION OFF* softkey switches off the modulation of the tracking generator.

IEC/IEEE bus command: `SOUR:AM:STAT OFF`
                                                   `SOUR:FM:STAT OFF`
                                                   `SOUR:DM:STAT OFF`

Power Offset of the Tracking Generator

POWER OFFSET

```
┌──────────┐        ┌──────────────┐
│  POWER   │   →    │ POWER SWP    │
│  SWEEP   │        │ ON    OFF    │
└──────────┘        ├──────────────┤
                    │   START      │
                    │   POWER      │
                    ├──────────────┤
                    │   STOP       │
                    │   POWER      │
                    ├──────────────┤
                    │              │
                    ├──────────────┤
                    │              │
                    ├──────────────┤
                    │              │
                    ├──────────────┤
                    │              │
                    ├──────────────┤
                    │              │
                    ├──────────────┤
                    │              │
                    └──────────────┘
```
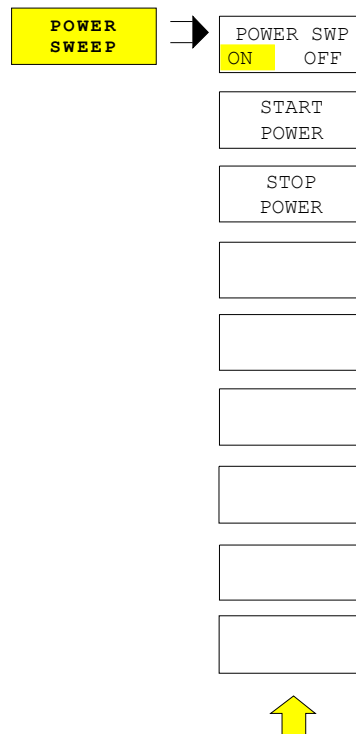
The *POWER OFFSET* softkey opens a submenu for activates or deactivates the power sweep.

POWER SWP ON/ OFF The softkey *POWER SWP ON/OFF* activates or deactivates the power sweep. If the power sweep is ON the enhancement label TGPWR is shown and the analyzer is set in zero span mode (span = 0Hz). During the sweep time of the zero span the power at the internal tracking generator is changed linear from start power to stop power. The start and stop power values are shown on the right side below the diagram.

IEC/IEEE bus command: `:SOUR:POW:MODE SWE`
                           `:SOUR:POW:MODE FIX`

START POWER The softkey *START POWER* defines the start power of the power sweep.

The start power can be set between -30 and +0 dBm for the R&S ESU and between -30 dBm and +5 dBm for the R&S FSU.

With the option FSU-B12 the power can be set between -100 and + 5 dBm.

IEC/IEEE bus command: `:SOUR:POW:STAR –20dBm`

STOP POWER   The softkey *STOP POWER* defines the stop power of the power sweep.

The stop power can be set between -30 and +0 dBm for the R&S ESU and between -30 dBm and +5 dBm for the R&S FSU. With the option FSU-B12 the power can be set between -100 and + 5 dBm.

The stop value can be smaller than the start value.

IEC/IEEE bus command: `:SOUR:POW:STOP -10dBm`

External Generator Control – Option R&S FSP-B10

The external generator control option permits to operate a number of commercially available generators as tracking generator on the ESU. Thus, scalar network analysis with the ESU is also possible outside the frequency range of the internal tracking generator when the appropriate generators are used.

The ESU also permits to set a frequency offset for frequency-converting measurements when external generators are used. For harmonics measurements or frequency-converting measurements, it is also possible to enter a factor, by which the generator frequency is increased or reduced compared with the receive frequency of the ESU. Only make sure that the resulting generator frequencies do not exceed the allowed setting range of the generator.

The level range to be set also depends on the generator used.

The generator is controlled via the – optional – second IECBUS interface of the ESU (= IEC2, supplied with the option) and, with some Rohde & Schwarz generators, additionally via the TTL synchronization interface included in the AUX interface of the ESU.

> **Note**
>
> The use of the TTL interface enables considerably higher measurement rates as pure IECBUS control, because the frequency stepping of the ESU is directly coupled with the frequency stepping of the generator.

Therefore, the frequency sweep differs according to the capabilities of the generator used:

• In the case of generators without TTL interface, the generator frequency is first set for each frequency point via IECBUS, then the setting procedure has to be completed before recording of measured values is possible.

• In the case of generators with TTL interface, a list of the frequencies to be set is entered into the generator before the beginning of the first sweep. Then the sweep is started and the next frequency point selected by means of the TTL handshake line TRIGGER. The recording of measured values is only enabled when the generator signals the end of the setting procedure via the BLANK signal. This method is considerably faster than pure IECBUS control.

With the *SELECT GENERATOR* softkey, a list of the supported generators with the frequency and level range as well as the capabilities used is included.

The external generator can be used in all operating modes. Recording of test setup calibration values (*SOURCE CAL*) and normalization with the correction values (*NORMALIZE*) are only possible in the *NETWORK* mode.

Note

In order to enhance measurement accuracy a common reference frequency should be used for both the ESU and the generator. If no independent 10 MHz reference frequency is available, it is recommended to connect the reference output of the generator with the reference input of the ESU and to enable usage of the external Reference on the ESU via *SETUP – REFERENCE EXT*.

Like the internal tracking generator, the external generator is activated by means of the hotkey bar: *MORE* hotkey - *NETWORK* hotkey (for details refer to section "Mode Selection – Hotkey Bar" on page 4.10).

External Generator Settings

The *NETWORK* hotkey opens the menu for setting the functions of the external generator.

```
  ┌──────────┐        ┌──────────┐        ┌──────────┐          ┌──────────┐
  │ NETWORK  │   →    │          │    →   │   CAL    │    →     │ EXT SRC  │
  └──────────┘        └──────────┘        │  TRANS   │          │ ON   OFF │
        ☟             ┌──────────┐        ├──────────┤          ├──────────┤
                      │  SOURCE  │        │ CAL REFL │          │  SELECT  │
                      │  POWER   │        │  SHORT   │          │ GENERATOR│
                      ├──────────┤        ├──────────┤          ├──────────┤
                      │  POWER   │        │ CAL REFL │          │FREQUENCY │
                      │  OFFSET  │        │   OPEN   │          │  SWEEP   │
                      ├──────────┤        ├──────────┤          ├──────────┤
                      │  SOURCE  │        │NORMALIZE │          │          │
                      │   CAL    │        ├──────────┤          ├──────────┤
                      ├──────────┤        │REF VALUE │          │          │
                      │FREQUENCY │        │ POSITION │          ├──────────┤
                      │  OFFSET  │        ├──────────┤          │ GEN REF  │
                      ├──────────┤        │REF VALUE │          │ INT  EXT │
                      │          │        ├──────────┤          ├──────────┤
                      ├──────────┤        │  RECALL  │          │          │
                      │          │        ├──────────┤          ├──────────┤
                      ├──────────┤        │          │          │          │
                      │   EXT    │        ├──────────┤          ├──────────┤
                      │  SOURCE  │        │ SAVE AS  │          │          │
                      ├──────────┤        │ TRD FACTOR│         └──────────┘
                      │          │        └──────────┘
                      └──────────┘
```
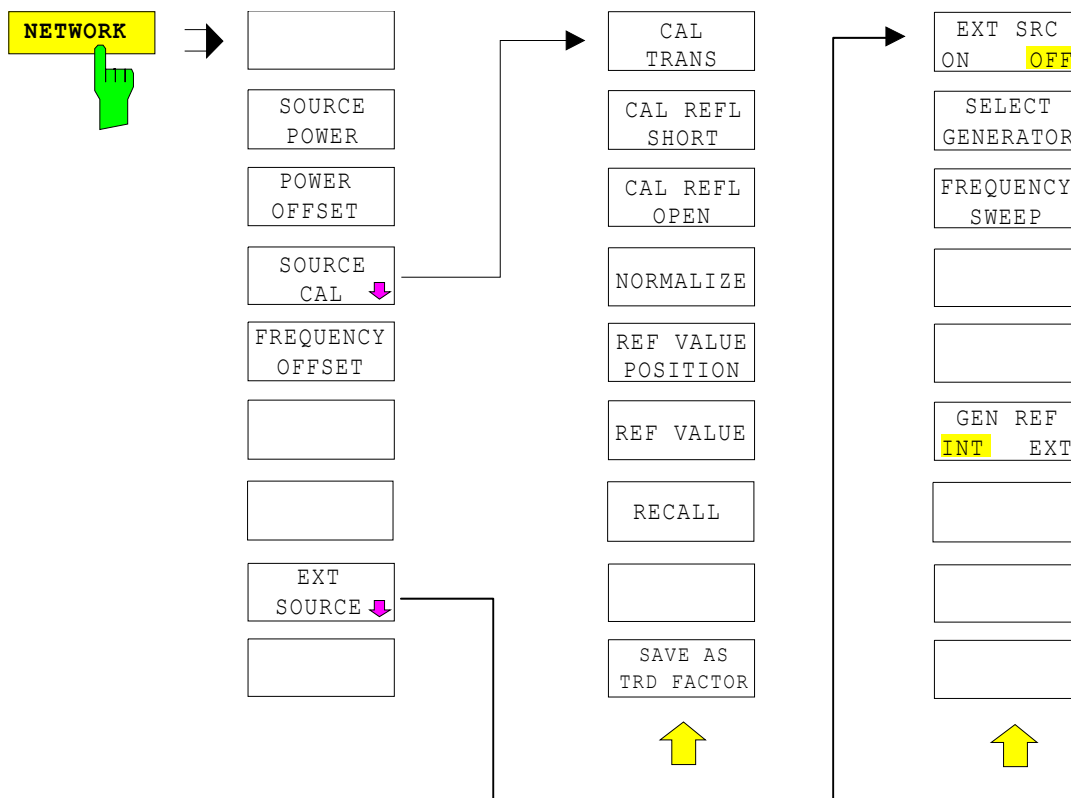
SOURCE POWER The *SOURCE POWER* softkey activates the entry of the generator output level. The value range depends on the selected generator.

If both option External Generator Control B10 and option Tracking Generator B9 are installed, the softkey will modify the output power of the generator currently in use.

The default output power is -20 dBm.

IEC/IEEE bus command: SOUR:EXT:POW –20dBm

POWER OFFSET The *POWER OFFSET* softkey activates the entry of a constant level offset of the generator. With this offset, attenuator pads or amplifiers connected to the output connector of the generator can be handled during the input and output of output levels.

The permissible setting range is -200 dB to +200 dB in steps of 0.1 dB. Positive offsets handle a subsequent amplifier and negative offsets an attenuator pad.

The default setting is 0 dB; offsets <> 0 are marked by the activated enhancement label *LVL*.

IEC/IEEE bus command: SOUR:POW:OFFS –10dB

Transmission Measurement

The transmission characteristic of a two-port network is measured. The external generator serves as a signal source. It is connected to the input connector of the DUT. The input of the analyzer is fed from the output of the DUT.

GEN OUTPUT   RF INPUT

DUT
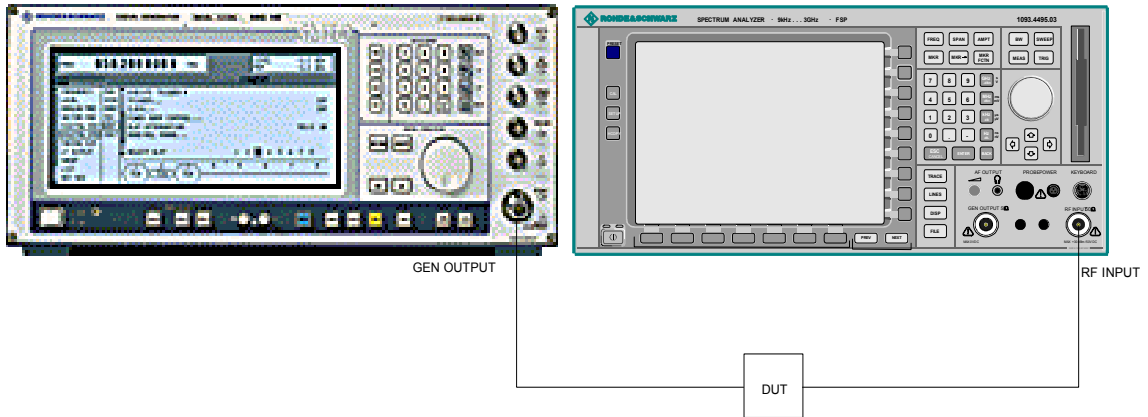
Fig. 4-28   Test setup for transmission measurement

A calibration can be carried out to compensate for the effects of the test setup (e.g. frequency response of connecting cables).

Calibration of Transmission Measurement
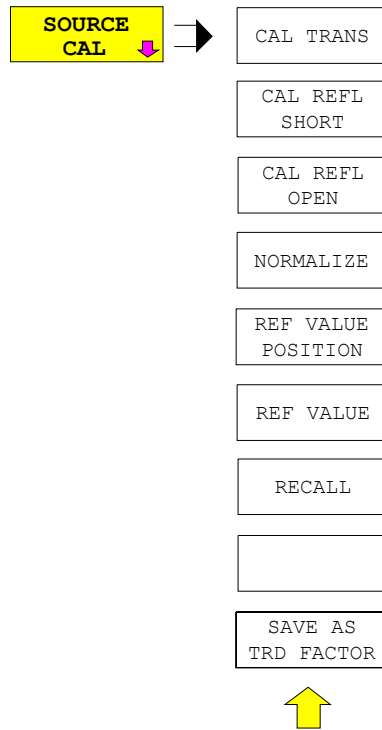
SOURCE CAL

The *SOURCE CAL* softkey opens a submenu comprising the calibration functions for the transmission and reflection measurement.

The calibration of the reflection measurement (*CAL REFL...*) and its functioning are described in separate sections.

To carry out a calibration for transmission measurements the whole test setup is through-connected (THRU).

CAL TRANS   The *CAL TRANS* softkey triggers the calibration of the transmission measurement.

It starts a sweep that records a reference trace. This trace is then used to obtain the differences to the normalized values.
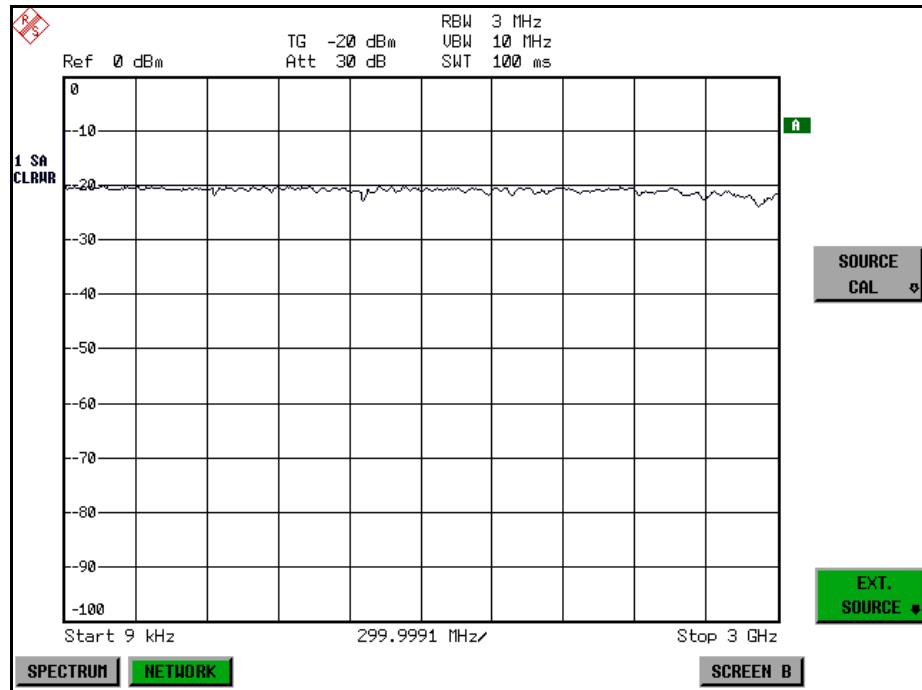
Fig. 4-29   Calibration curve for transmission measurement

During the calibration the following message is displayed:

After the calibration sweep the following message is displayed:
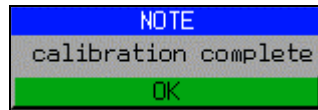
This message is cleared after approx. 3 seconds.

IEC/IEEE bus command: CORR:METH TRAN

Normalization

NORMALIZE   The *NORMALIZE* softkey switches normalization on or off. The softkey is only available if the memory contains a correction trace.

It is possible to shift the relative reference point within the grid using the *REF VALUE POSITION* softkey. Thus, the trace can be shifted from the top grid margin to the middle of the grid:
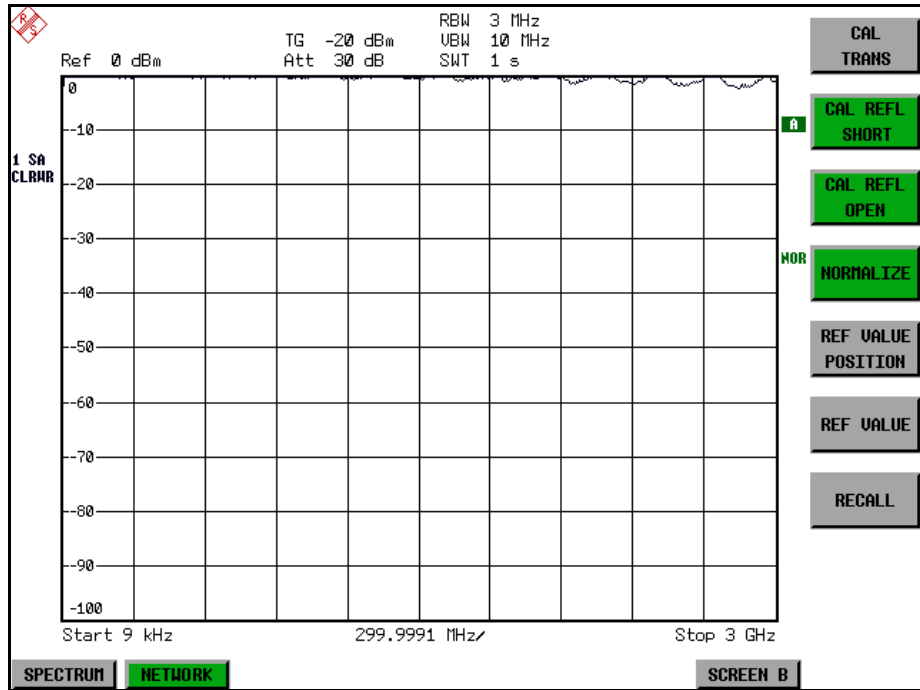
Fig. 4-30   Normalized display

In the *SPLIT SCREEN* setting, the normalization is switched on in the current window. Different normalizations can be active in the two windows.

Normalization is aborted when the *NETWORK* mode is quit.

IEC/IEEE bus command: CORR ON

REF VALUE
POSITION

The *REF VALUE POSITION* softkey (reference position) marks a reference position in the active window on which the normalization (difference formation with a reference curve) is performed.

When pressed for the first time, the softkey switches on the reference line and activates the input of its position. The line can be shifted within the grid limits.

The reference line is switched off by pressing the softkey again.

The function of the reference line is explained in the section "Calibration Mechanism" on page 4.376.
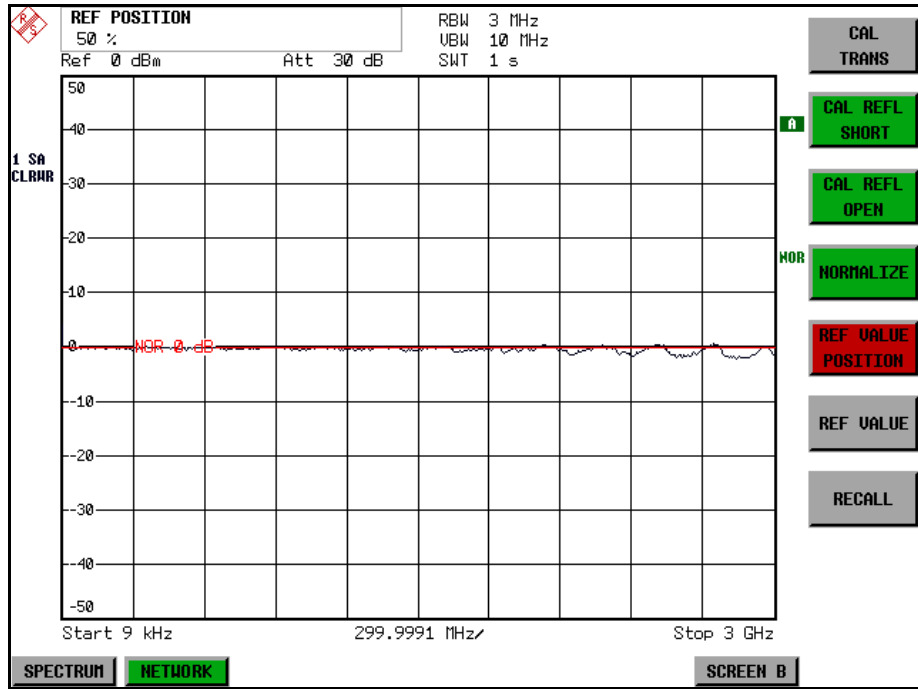
Fig. 4-31   Normalized measurement, shifted with *REF VALUE POSITION 50%*

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RPOS 10PCT`

REF VALUE

The *REF VALUE* softkey activates the input of a level difference which is assigned to the reference line.

In the default setting, the reference line corresponds to a level difference of 0 dB. If e.g. a 10-dB attenuator pad is inserted between DUT and analyzer input between recording of the calibration data and normalization, the trace will be shifted down by 10 dB. By entering a *REF VALUE* of –10 dB the reference line for difference formation can also be shifted down by 10 dB so that it will again coincide with the trace (see Fig. 4-32).
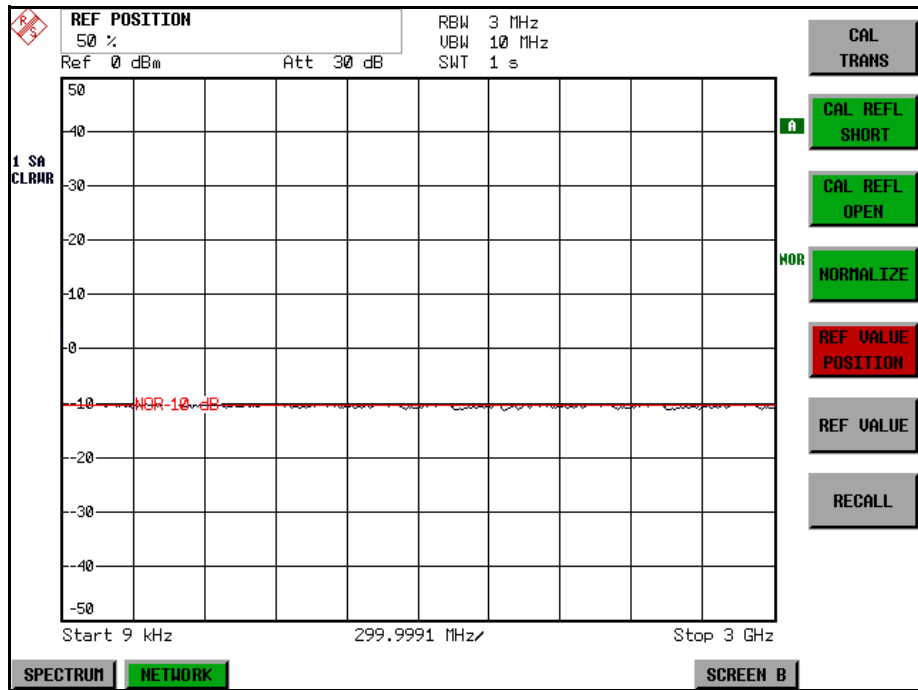
Fig. 4-32   Measurement with REF VALUE -10dB and REF VALUE POSITION 50%

After the reference line has been shifted by entering *REF VALUE* –10 dB, departures from the nominal value can be displayed with high resolution (e.g. 1 dB / Div.). The absolute measured values are still displayed, in the above example, 1 dB below nominal value (reference line) = 11 dB attenuation.
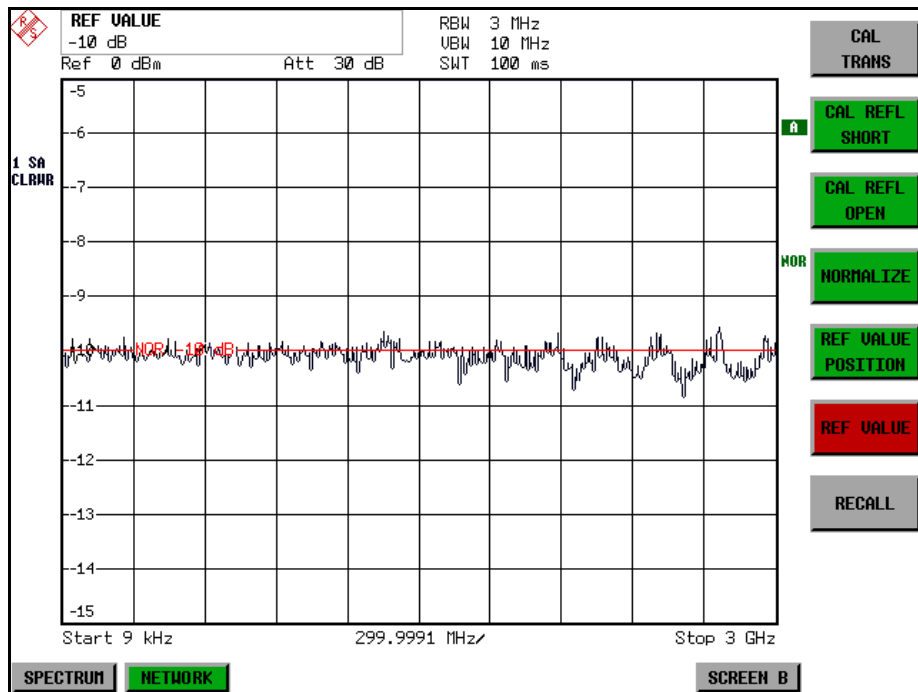
Fig. 4-33   Measurement of a 10-dB attenuator pad with 1dB/DIV

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RVAL -10dB`

RECALL   The *RECALL* softkey restores the instrument setting with which the calibration was carried out.

This can be useful if the device setting was changed after calibration (e.g. center frequency setting, frequency deviation, reference level, etc.).

The softkey is only available if:

- the *NETWORK* mode has been selected

- the memory contains a calibration data set.

IEC/IEEE bus command: `CORR:REC`

SAVE AS TRD FACTOR   SAVE AS TRD FACTOR uses the normalized measurement data to generate a transducer factor with up to 625 points. The trace data are converted to a transducer with unit dB after the transducer name has been entered. The number of points is defined by SWEEP COUNT. The frequency points are allocated in equidistant steps between start and stop frequency. The generated transducer factor can be further adapted in the menu SETUP – TRANSDUCER. SAVE AS TRD FACTOR is only available if normalization is switched on.

IEC/IEEE bus command: `CORR:TRAN:GEN <name>'`

Reflection Measurement

Scalar reflection measurements can be carried out by means of a reflection-coefficient bridge.
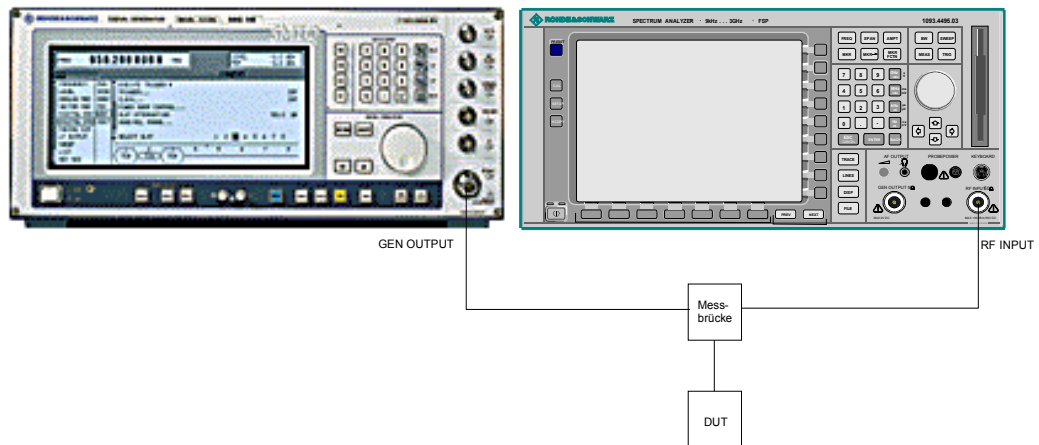
Fig. 4-34   Test setup for reflection measurement

Calibration of Reflection Measurement

The calibration mechanism essentially corresponds to that of the transmission measurement.

CAL REFL OPEN   The *CAL REFL OPEN* softkey starts the open-circuit calibration. During calibration the following message is displayed:

IEC/IEEE bus command: CORR:METH REFL
                         CORR:COLL OPEN

CAL REFL SHORT   The *CAL REFL SHORT* softkey starts the short-circuit calibration.

If both calibrations (open circuit, short circuit) are carried out, the calibration curve is formed by averaging the two measurements and stored in the memory. The order of measurements is optional.

After the calibration the following message is displayed:
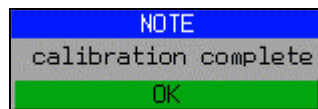
The display is cleared after approx. 3 seconds.

IEC/IEEE bus command: CORR:METH REFL
                         CORR:COLL THR

Calibration Mechanism

Calibration means a calculation of the difference between the currently measured power and a reference curve, independent of the selected type of measurement (transmission/reflection). The hardware settings used for measuring the reference curve are included in the reference data set.

Even with normalization switched on, the device settings can be changed in a wide area without stopping the normalization. This reduces the necessity to carry out a new normalization to a minimum.

For this purpose, the reference data set (trace with 625 measured values) is stored as a table with 625 points (frequency/level). Differences in level settings between the reference curve and the current device settings are taken into account automatically. If the span is reduced, a linear interpolation of the intermediate values is applied. If the span increases, the values at the left or right border of the reference data set are extrapolated to the current start or stop frequency, i.e. the reference data set is extended by constant values.

An enhancement label is used to mark the different levels of measurement accuracy. This enhancement label is displayed at the right diagram border when normalization is switched on and a deviation from the reference setting occurs. Three accuracy levels are defined:

Table 4-1   Measurement accuracy levels

Accuracy	Enhancement label	Reason/Limitation
High	NOR	No difference between reference setting and measurement
Medium	APX (approximation)	Change of the following settings: • coupling (RBW, VBW, SWT) • reference level, RF attenuation • start or stop frequency • output level of tracking generator • frequency offset of tracking generator • detector (max. peak, min. peak, sample, etc.) Change of frequency: • max. 501 points within the set sweep limits (corresponds to a doubling of the span)
-	Aborted normalization	• more than 500 extrapolated points within the current sweep limits (in case of span doubling)

Note

At a reference level (*REF LEVEL*) of -10 dBm and at a tracking generator output level of the same value the analyzer operates without overrange reserve, i.e. the analyzer is in danger of being overloaded if a signal is applied whose amplitude is higher than the reference line. In this case, either the message *OVLD* for overload is displayed in the status line or the display range is exceeded (clipping of the trace at the upper diagram border = Overrange).

Overloading can be avoided as follows:

- Reducing the output level of the tracking generator (*SOURCE POWER*, *NETWORK* menu)

- Increasing the reference level (*REF LEVEL*, *AMPT* menu)

Frequency-Converting Measurements

For frequency-converting measurements (e.g. on converters) the external generator is able to set a constant frequency offset between the output frequency of the generator and the receive frequency of the analyzer and, in addition, the generator frequency as a multiple of the analyzer.

GEN OUTPUT   RF INPUT

DUT
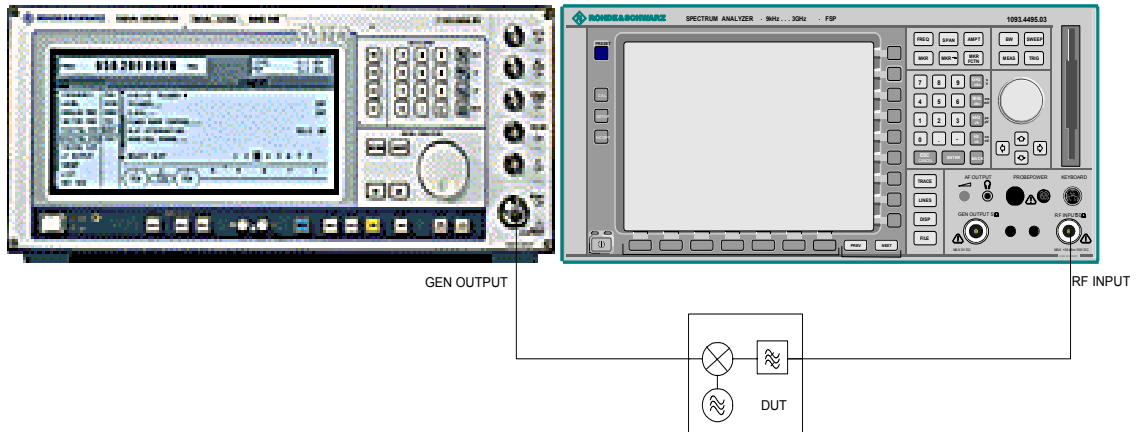
Fig. 4-35   Test setup for frequency-converting measurements

FREQUENCY OFFSET

The *FREQUENCY OFFSET* softkey activates the input of the frequency offset between the output signal of the generator and the input frequency of the analyzer. The value range depends on the selected generator.

The default setting is 0 Hz. Offsets <> 0 Hz are marked with the enhancement label *FRQ*.

If a positive frequency offset is entered, the tracking generator generates an output signal above the receive frequency of the "analyzer. In case of a negative frequency offset it generates a signal below the receive frequency of the analyzer. The output frequency of the generator is calculated as follows:

    Generator frequency = receive frequency + frequency offset

IEC/IEEE bus command: `SOUR:EXT:FREQ:OFFS 1GHZ`

Configuration of an External Generator

EXT SOURCE

EXT SOURCE ⬇	→

EXT SRC ON **OFF**
SELECT GENERATOR
FREQUENCY SWEEP
GEN REF **INT** EXT
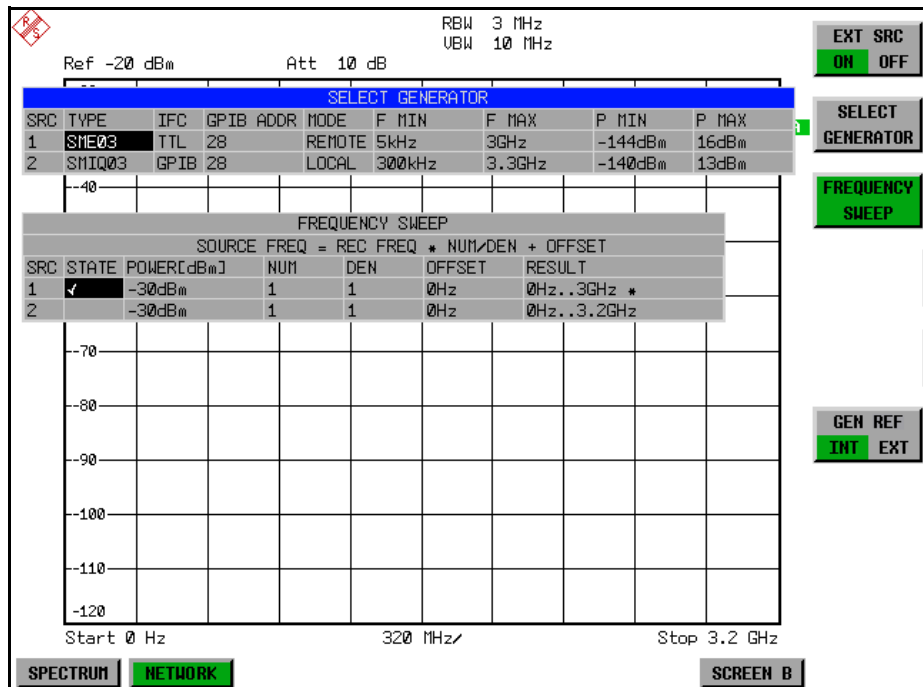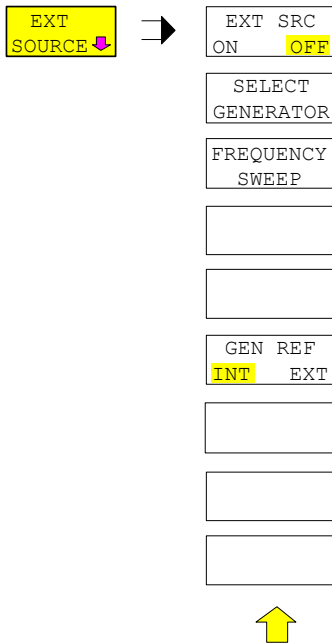
The *EXT SOURCE* softkey opens a submenu for configuration of the external generator.

The ESU is able to manage two generators, one of which can be active at the time.

EXT SRC ON / OFF   The *EXT SRC ON / OFF* softkey switches the external generator on or off.

It can only be switched on successfully if the generator has been selected by means of *SELECT GENERATOR* and configured correctly by means of *FREQUENCY SWEEP*. If one of these conditions is not fulfilled, an error message will be output.

> **Notes**
>
> When switching on the external generator by means of *EXT SRC ON*, the ESU switches off the internal tracking generator and starts programming the generator settings via the IEC/IEEE-bus interface IEC2.
>
> Programming requires takeover of the IEC/IEEE-bus control at this interface by the ESU. To avoid any access conflicts, ensure that no other controller is connected to the IEC2 interface or the external generator when selecting *EXT SRC ON*.
>
> The maximum stop frequency is limited to the maximum generator frequency. This upper limit is automatically reduced by the set frequency offset of the generator and a set multiplication factor.
>
> With the external generator switched on, the FFT filters (*FILTER TYPE FFT* in the menu *BW*) are not available.
>
> If an error occurs on the IEC/IEEE bus when programming the external generator, the generator will automatically be switched off and the following error message will be output:

```
SYSTEM MESSAGE
IEC2 handshake error!
      OK
```

> When the external generator is switched off using *EXT SRC OFF*, the IEC/IEEE-bus control is handed over again at the IEC2 interface, i.e. a different controller will then take over the control of the signal generator.

IEC/IEEE bus command: SOUR:EXT ON

SELECT
GENERATOR

The *SELECT GENERATOR* softkey opens a table for selection of the generator and definition of IECBUS address and control interface.

The table permits configuration of two generators so that switching between two different configurations is easily possible.

IEC/IEEE bus command: SOUR:AM:STAT ON

SRC	TYPE	IFC	GPIB ADDR	MODE	F MIN	F MAX	P MIN	P MAX
1	SME03	TTL	28	REMOTE	5kHz	3GHz	-144dBm	16dBm
2	SMIQ03	GPIB	28	LOCAL	300kHz	3.3GHz	-140dBm	13dBm

The individual fields contain the following settings:

- *SRC*

  Index of generator selected

- *TYPE*

  The field opens the list with the available generators:

EXT SRC TYPE
SMHU
SMIQ02
SMIQ02E
SMIQ03
SMIQ03E
SMP02
SMP03
SMP04
SMP22

After completion of the selection, the remaining fields of the table are filled with the generator characteristics.

A list of generator types supported by the ESU is to be found in section "List of Generator Types Supported by the ESU" on page 4.383.

- *IFC*

  This field selects the interface type of external generator 1 or 2. The following types are available:

  – *GPIB*: IECBUS only, suitable for all generators of other manufacturers and some Rohde & Schwarz instruments

  – *TTL*: IECBUS and TTL interface for synchronization, for most of the Rohde & Schwarz generators, see table above.

  The two operating modes differ in the speed of the control: Whereas, with pure IECBUS operation, each frequency to be set must be individually transferred to the generator, additional use of the TTL interface permits to program a total frequency list at once and subsequently perform the frequency stepping via TTL handshake, which is a big advantage in terms of speed.

> **Note**
>
> Generators equipped with the TTL interface can also be operated with IECBUS (= GPIB) only.
>
> Only one of the two generators can be operated with TTL interface at a time. The other generator must be configured for IECBUS (GPIB).

- *GPIB ADDR*

  IECBUS address of the respective generator. Addresses from 0 to 30 are possible.

- *MODE*

  Operating mode of generator. The generator activated using the *FREQUENCY SWEEP* softkey is automatically set to remote mode (REMOTE), the other to manual mode (LOCAL).

- *F MIN F MAX*

  Frequency range of generator. Select the start and stop frequency of the ESU in a way that the specified range is not exceeded. If the start frequency lies below *F MIN*, the generator is only switched on when *F MIN* is reached. If the stop frequency lies above F MAX, it is limited to F MAX when the generator is switched on using the *EXT SRC ON/OFF* softkey.

- *P MIN P MAX*

  Level range of generator. This field defines the allowed input range for the *POWER* column in the *FREQUENCY SWEEP* table.

IEC/IEEE bus command: `SYST:COMM:RDEV:GEN2:TYPE 'SME02'`
                          `SYST:COMM:RDEV:GEN:LINK TTL`
                          `SYST:COMM:GPIB:RDEV:GEN1:ADDR 28`

List of Generator Types Supported by the ESU
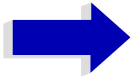
> **Note**
>
> There is a minimum version requirement of the R&S SMU firmware. Please install V1.10 or higher on the R&S SMU!

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
SME02	TTL	5 kHz	1.5 GHz	-144	+16
SME03	TTL	5 kHz	3.0 GHz	-144	+16
SME06	TTL	5 kHz	6.0 GHz	-144	+16
SMG	GPIB	100 kHz	1.0 GHz	-137	+13
SMGL	GPIB	9 kHz	1.0 GHz	-118	+30
SMGU	GPIB	100 kHz	2.16 GHz	-140	+13
SMH	GPIB	100 kHz	2.0 GHz	-140	+13
SMHU	GPIB	100 kHz	4.32 GHz	-140	+13
SMIQ02B	TTL	300 kHz	2.2 GHz	-144	+13
SMIQ02E	GPIB	300 kHz	2.2 GHz	-144	+13
SMIQ03B	TTL	300 kHz	3.3 GHz	-144	+13
SMIQ03E	GPIB	300 kHz	3.3 GHz	-144	+13
SMIQ04B	TTL	300 kHz	4.4 GHz	-144	+10
SMIQ06B	TTL	300 kHz	6.4 GHz	-144	+10
SML01	GPIB	9 kHz	1.1 GHz	-140	+13
SML02	GPIB	9 kHz	2.2 GHz	-140	+13
SML03	GPIB	9 kHz	3.3 GHz	-140	+13
SMR20	TTL	1 GHz	20 GHz	-130 [2]	+11 [2]
SMR20B11 [1]	TTL	10 MHz	20 GHz	-130 [2]	+13 [2]
SMR27	TTL	1 GHz	27 GHz	-130 [2]	+11 [2]
SMR27B11 [1]	TTL	10 MHz	27 GHz	-130 [2]	+12 [2]
SMR30	TTL	1 GHz	30 GHz	-130 [2]	+11 [2]
SMR30B11 [1]	TTL	10 MHz	30 GHz	-130 [2]	+12 [2]
SMR40	TTL	1 GHz	40 GHz	-130 [2]	+9 [2]
SMR40B11 [1]	TTL	10 MHz	40 GHz	-130 [2]	+12 [2]
SMR50	TTL	1 GHz	50 GHz	-130 [2]	+9 [2]

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
SMR50B11 [1]	TTL	10 MHz	50 GHz	-130 [2]	+12 [2]
SMR60	TTL	1 GHz	60 GHz	-130 [2]	+9 [2]
SMR60B11 [1]	TTL	10 MHz	60 GHz	-130 [2]	+12 [2]
SMP02	TTL	10 MHz	20 GHz	-130 [3]	+17 [3]
SMP03	TTL	10 MHz	27 GHz	-130 [3]	+13 [3]
SMP04	TTL	10 MHz	40 GHz	-130 [3]	+12 [3]
SMP22	TTL	10 MHz	20 GHz	-130 [3]	+20 [3]
SMT02	GPIB	5.0 kHz	1.5 GHz	-144	+13
SMT03	GPIB	5.0 kHz	3.0 GHz	-144	+13
SMT06	GPIB	5.0 kHz	6.0 GHz	-144	+13
SMV03	GPIB	9 kHz	3.3 GHz	-140	+13
SMU200A	TTL	100 kHz	2.2 GHz	-145	+13
SMU02B31	TTL	100 kHz	2.2 GHz	-145	+19
SMU03 [4]	TTL	100 kHz	3 GHz	-145	+13
SMU03B31	TTL	100 kHz	3 GHz	-145	+19
SMU04	TTL	100 kHz	4 GHz	-145	+13
SMU04B31	TTL	100 kHz	4 GHz	-145	+19
SMU06	TTL	100 kHz	6 GHz	-145	+13
SMU06B31	TTL	100 kHz	6 GHz	-145	+13
SMX	GPIB	100 kHz	1.0 GHz	-137	+13
SMY01	GPIB	9 kHz	1.04 GHz	-140	+13
SMY02	GPIB	9 kHz	2.08 GHz	-140	+13
HP8340A	GPIB	10 MHz	26.5 GHz	-110	10
HP8648	GPIB	9 kHz	4 GHz	-136	10
HP ESG-A Series 1000A, 2000A, 3000A, 4000A	GPIB	250 kHz	4 GHz	-136	20
HP ESG-D SERIES E4432B	GPIB	250 kHz	3 GHz	-136	+10

[1] Requires the option SMR-B11 to be fitted.

[2] Maximum/minimum power depends on presence of Option SMR-B15/-B17 and set frequency range. For more details see SMR data sheet.

[3] Maximum/minimum power depends on presence of Option SMP-B15/-B17 and set frequency range. For more details see SMP data sheet.

FREQUENCY
SWEEP

The *FREQUENCY SWEEP* softkey opens a table for setting the generator level as well as the multiplier and the offset used to derive the generator frequency from the analyzer frequency.

This table also permits configuration of two generators so that switching between two different configurations is easily possible.

FREQUENCY SWEEP					
SOURCE FREQ = REC FREQ * NUM/DEN + OFFSET					
SRC	STATE	POWER[dBm]	NUM	DEN	OFFSET	RESULT
1	✓	−30dBm	1	1	0Hz	0Hz..3GHz *
2		−30dBm	1	1	0Hz	0Hz..3.2GHz

The individual fields contain the following settings:

- *SRC*

  Index of selected generator

- *STATE*

  Selects the active generator. Only one generator can be active at a time. The operating mode of the active generator is set to remote control in the SELECT GENERATOR table.

- *POWER*

  Permits to enter the generator level within the limits P MIN to P MAX of the *SELECT GENERATOR* table.

- *NUM*

  Numerator,

- *DEN*

  Denominator,

- *OFFSET*

  Offset, used to derive the generator frequency from the current frequency of the ESU according to the following formula:

$$F_{Generator} = \left| F_{Analyzer} * \frac{Numerator}{Denominator} + F_{Offset} \right|$$

Note that the frequencies resulting from start and stop frequency of the ESU do not exceed the allowed generator range:

- If the start frequency lies below F MIN, the generator is only switched on when F MIN is reached.

- If the stop frequency lies above F MAX, the generator is switched off. When the generator is subsequently switched on using the *EXT SRC ON/OFF* softkey, the stop frequency is limited to F MAX.

- If the stop frequency lies below F MIN, the generator is switched off and the following error message output:

ERROR
GENERATOR RANGES EXEEDED; EXT GEN SWITCHED OFF.

  – In the time domain (Span = 0 Hz) the generator frequency is derived from the set receive frequency of the ESU using the calculation formula.

For the sake of clarity, the formula is also displayed in the table.

The offset setting can be used to sweep in the reverse direction. This can be achieved by setting a **negative** offset in the formula above:

Example for reverse sweep:

$F_{AnalyzerStart}$ = 100 MHz

$F_{AnalyzerStop}$ = 200 MHz

F_{Offset} = -300 MHz

Numerator = Denominator = 1

$\rightarrow F_{GeneratorStart}$ = 200 MHz

$\rightarrow F_{GeneratorStop}$ = 100 MHz

If the offset is adjusted in a way that the sweep of the generator crosses the 0 Hz Frequency, it is indicated by the additional statement "via 0 Hz".

Example for reverse sweep via 0 Hz

$F_{AnalyzerStart}$ = 100 MHz

$F_{AnalyzerStop}$ = 200 MHz

F_{Offset} = -150 MHz

Numerator = Denominator = 1

$\rightarrow F_{GeneratorStart}$ = 50 MHz

$\rightarrow F_{GeneratorStop}$ = 50 MHz via 0 Hz

IEC/IEEE bus command: `:SOUR:EXT:FREQ:NUM 1`
            `:SOUR:EXT:FREQ:DEN 1`
            `:SOUR:EXT:FREQ:OFFS -300MHZ`

- *RESULT*

  The frequency range of the generator resulting from the calculation formula. An asterisk (*) after the upper limit indicates that the stop frequency of the ESU must be adapted when the generator is switched on in order not to exceed its maximum frequency. In the following illustration, this is true for the upper generator at a stop frequency of 3.2 GHz of the ESU, whereas the lower generator does not yet require an adaptation:

SOURCE FREQ = REC FREQ * NUM/DEN + OFFSET

	NUM	DEN	OFFSET	RESULT
	1	1	0Hz	0Hz..3GHz *
	1	1	0Hz	0Hz..3.2GHz

IEC/IEEE bus command: `SOUR:EXT:POW -30dBm`
            `SOUR:EXT:FREQ:NUM 4`
            `SOUR:EXT:FREQ:DEN 3`
            `SOUR:EXT:FREQ:OFFS 100MHZ`

GEN REF INT / EXT   The *GEN REF INT / EXT* softkey switches over the reference oscillator of the generator (switch over between internal and external reference source). Selection *EXT* allows connecting the external generator to an external reference frequency source. The internal reference source is selected as the default setting.

IEC/IEEE bus command: `SOUR:EXT1:ROSC INT`

LAN Interface

Using the LAN Interface, the instrument can be connected to an Ethernet LAN (Local Area Network). Thus it is possible to transfer data via the network and use network printers. In addition, the instrument can be remote-controlled via network. The network card allows both for a 10 MHz Ethernet IEEE 802.3 and a 100 MHz Ethernet IEEE 802.3u.

Connecting the Instrument to the Network

> ⚠️ **ATTENTION**
>
> Before connecting the instrument to the network it is recommended to contact the network administrator, in particular larger LAN installations are affected. Faults in the connection may have a negative effect on the entire network.

The instrument is connected to a network hub of the desired LAN segment via a commercially-available RJ45 cable (not supplied with the instrument) at the instrument rear panel. Since RJ45 provides no bus but a star network topology, no other precautions need to be taken for the connection.

The connection procedure does not produce any disturbances in the network traffic. Disconnection from the network is easily possible provided that there is no more data traffic from and to the instrument.

Installing the Software

The data transfer in the network takes place in data blocks, called packets. In addition to the useful data, further information on the operation, i.e. protocol data (transmitter, receiver, type of data, sequence), is transferred in the packets. For processing the protocol information, suitable drivers must be installed. For the network services (file transfer, directory services, printing in the network) a network operating system needs to be installed.

Notes:

- The WINDOWS files required for the installation of network drivers, protocols or services are included in the directory "D:\I386".

- A PC keyboard with trackball (or an additional mouse instead) is required for the installation.

Installation of Drivers for the Network Card

.The network-card drivers do not have to be installed under Windows XP. It is sufficient to connect the network cable to the "LAN-Interface" connector at the rear of the unit. Windows XP will automatically recognize the network link and will activate the required drivers.

Note

If the original factory setting is required at a later time, i.e. when the unit is to be operated with a different network configuration at a different site, this base configuration can be restored as described below.

➢ Switch the unit off and on again.

➢ In the Boot menu, select the entry "Analyzer Firmware Backup" with the cursor keys and confirm with *ENTER*. The device is started from the backup partition and opens a selection window with available device configurations:

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* INSTUMENT RESTORE PROCEDURE V 1.4 (c) RSD 2002            *
*                                                           *
* Note:                                                     *
* The presence of the LAN-interface requires               *
* a restore process different from the standard firmware    *
* restore (due to the necessary network drivers).          *
*                                                           *
* The following 3 selections will NOT destroy user defined  *
* limit lines and transducer data                          *
*                                                           *
* Press 1 to perform standard system RESTORE               *
* press 2 to perform system RESTORE with LAN interface     *
* press 3 to ABORT system RESTORE                          *
*                                                           *
* The following selection will DESTROY user defined        *
* limit lines and transducer data                          *
*                                                           *
* Press 4 to perform standard system RESTORE               *
* (destroys user limit lines and transducers !)            *
* press 5 to perform system RESTORE with LAN interface,     *
* (destroys user limit lines and transducers !)            *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

➢ Press 1. Windows XP is newly installed on the analyzer partition of the hard disk with LAN support and device firmware. The device may boot several times. At the end of the installation procedure, the device firmware will be restarted.

The unit is again ready for operation. The configuration of the network protocols then has to be performed according to the following sections.

Configuration of Available Network Protocols (TCP/IP Protocol)

When the unit is delivered, the TCP/IP network protocol is factory-set with the IP address 10.0.0.10 and the subnet mask 255.255.255.0. The steps required to change this configuration and to install further network protocols are described in this and the following sections.
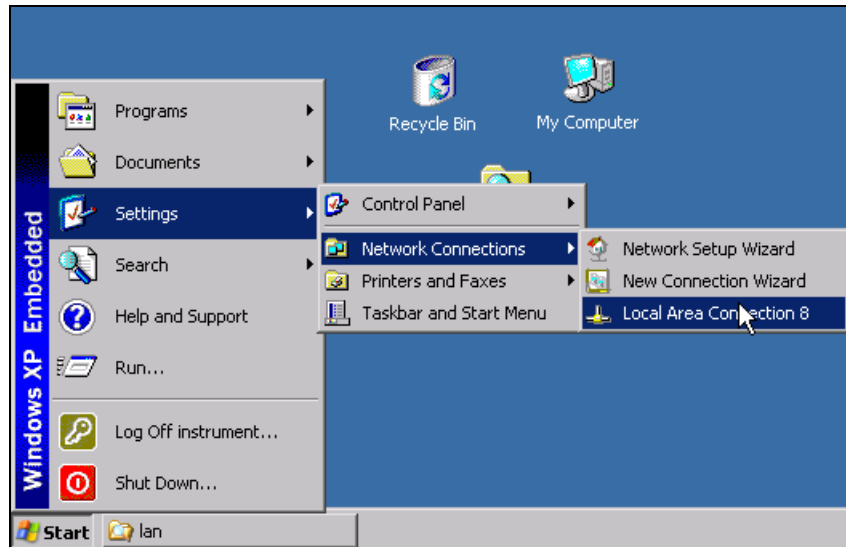
➢ Open the Windows XP start menu with the Windows key or *CTRL+ESC.*

➢ Click *Settings - Network Connections - Local Area Connection*.

The *Local Area Connection Status* dialog will be opened.

Note

Windows XP appends numbers to the name *Local Area Connection Status* (e.g. *Local Area Connection Status 8*) if the configuration is created with the *New Connection Wizard*. These numbers are irrelevant for the following configurations and are therefore not mentioned in the text.
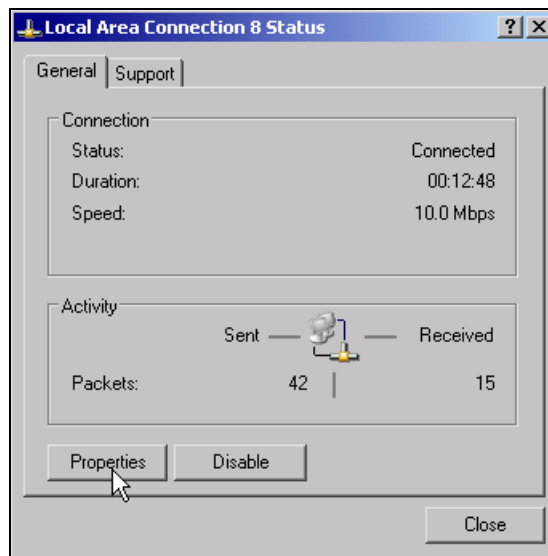
➢ Click the *Properties* button.
The dialog box with the available network protocols will be opened.
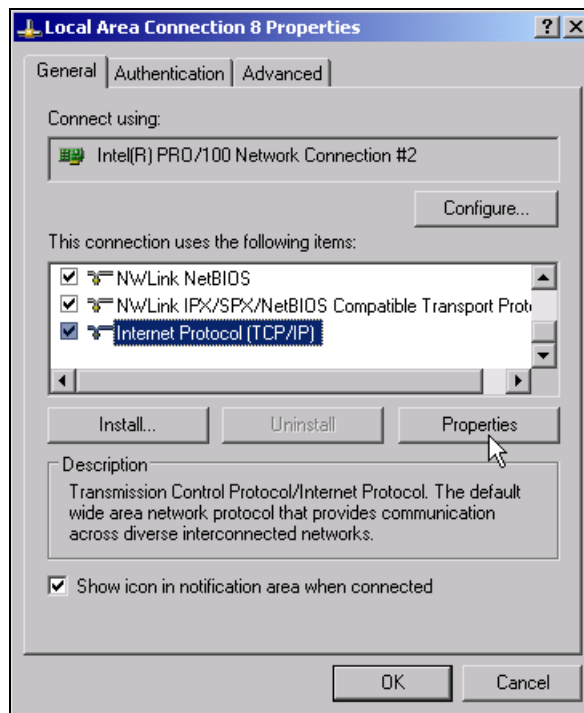
➢ Click the desired network protocol (in the example: TCP/IP).

➢ Click the *Properties* button.

The dialog box with the settings of the selected network protocol will be opened.
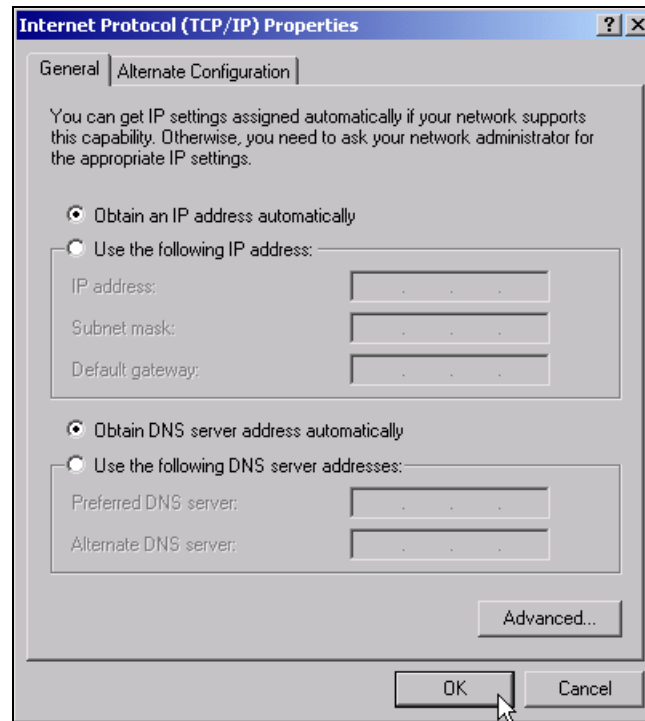
➢ If the IP address is to be automatically requested by a DHCP server, click *Obtain an IP address automatically.*

Note

Your network administrator knows whether your network has a DHCP server.

➢ Click *OK*. Windows will store the configuration.
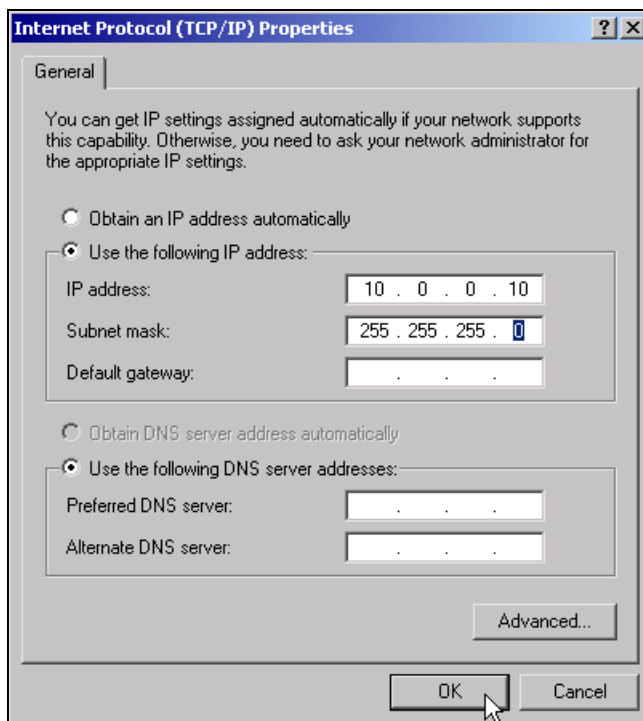
➢ If a predefined IP address is to be set (since no DHCP server is available in the network), click *Use the following IP address*.

➢ Enter the IP address.

➢ Enter the required mask.

Note

Your network administrator knows which IP addresses and subnet masks are suitable for your network.

➢ Click *OK*. Windows checks whether the entered settings are correct and stores the configuration.
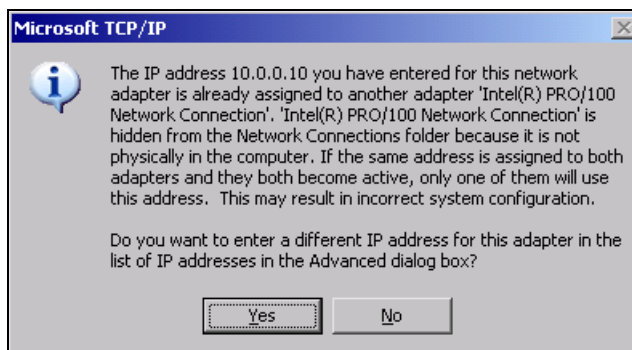
If an invalid IP address or subnet mask was entered, a corresponding error message will be displayed together with a question as whether a different address or mask is to be entered.

➢ Click *Yes*.

The dialog for entering the TCP/IP parameters will again be opened.

If all settings are correct, the request to start the unit again will be displayed depending on the changed settings.
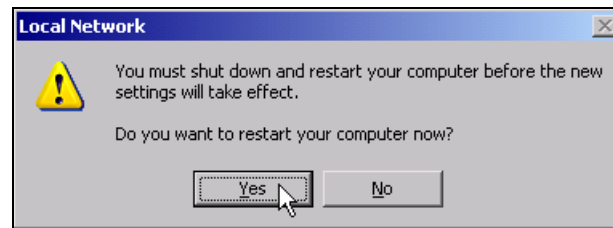
➢ Click *Yes*.

Windows will restart the system.

Installation of Further Network Protocols and Services (e.g. Novell Netware Support)

Note

The network administrator knows the protocols to be used. The TCP/IP protocol has to be installed for the RSIB protocol and the VXI11 support. The support for the Novell netware is additionally installed in the following example.
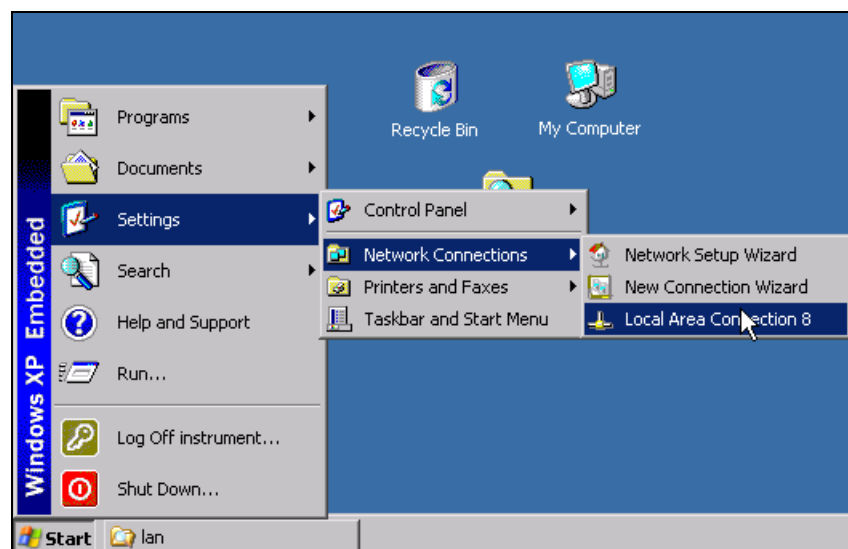
➢ Open the Windows XP start menu using the Windows key or *CTRL+ESC.*

➢ Click *Settings - Network Connections - Local Area Connection*.

The *Local Area Connection Status* dialog will be opened.

Note

Windows XP appends numbers to the name *Local Area Connection Status* (e.g. *Local Area Connection Status 8*) if the configuration is created with the *New Connection Wizard*. These numbers are irrelevant for the following configurations and are therefore not mentioned in the text.
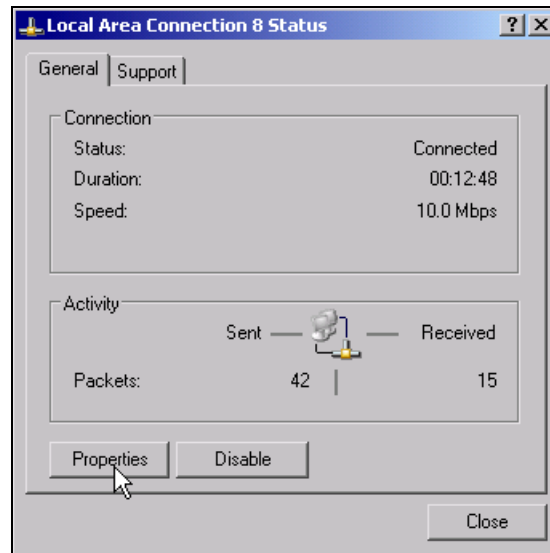
➢ Press the *Properties* button.

The window with the available network protocols will be opened.
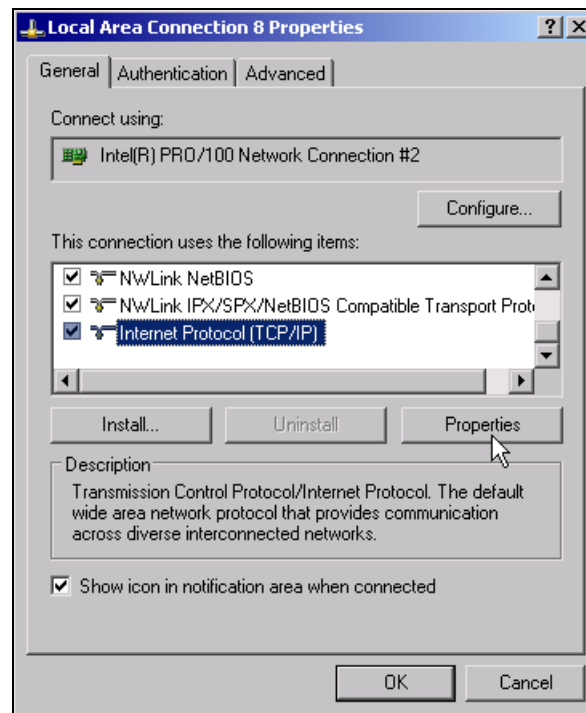
➢ Click the *Install* button.

The list of installable network components will be opened.
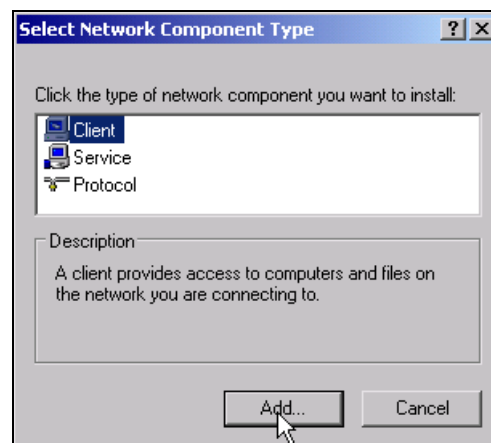
➢ Select *Client*.

➢ Click the *Add...* button.

The list of available network protocols will be opened.
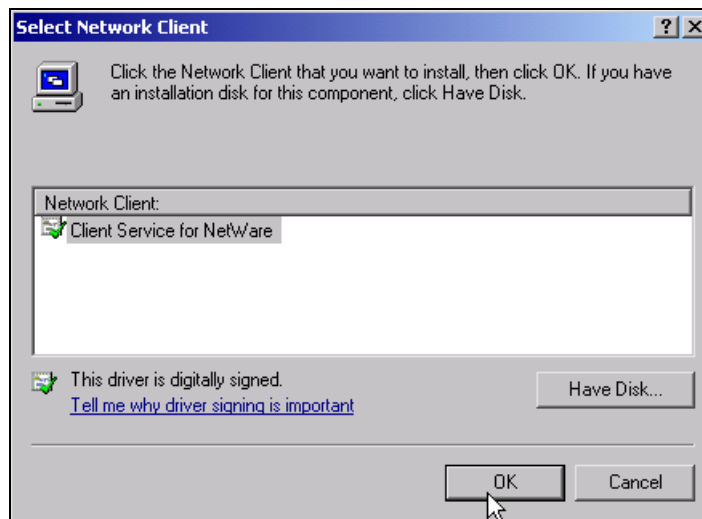
➢ Select *Client Service for NetWare*.

➢ Click the *OK* button.

The network driver for Novell Netware is installed.

Notes

• Your network administrator knows which clients, services and protocols have to be installed for your network.

• If network components not contained in D:\I386 are to be installed, a corresponding memory stick including the drivers has to be prepared (or a CD that can be read via a USB CD-ROM drive).

• In this case, click the *Have Disk...* button and indicate the path with the corresponding drivers.

Microsoft TCP/IP

The IP address 10.0.0.10 you have entered for this network adapter is already assigned to another adapter 'Intel(R) PRO/100 Network Connection'. 'Intel(R) PRO/100 Network Connection' is hidden from the Network Connections folder because it is not physically in the computer. If the same address is assigned to both adapters and they both become active, only one of them will use this address. This may result in incorrect system configuration.

Do you want to enter a different IP address for this adapter in the list of IP addresses in the Advanced dialog box?

Yes   No

After completion of the installation, the user is requested to restart the unit.

➢ Click *Yes*.

Windows will restart the system.

Examples of Configurations

Network	Protocols	Services	Notes
NOVELL Netware	NWLink IPX/SPX Compatible Transport	Client Service for NetWare	In folder "Protocols - Properties", the frame type used in the network is to be set.
IP Networks (FTP, TELNET, WWW, GOPHER, etc.)	TCP/IP Protocol	Simple TCP/IP Services	In folder "Protocols - Properties", an IP address that is unique in the network is to be set.
MICROSOFT Network	NetBEUI Protocol or TCP/IP Protocol	Workstation Server	In folder "Identification - Computer Name", a name that is unique in the network is to be entered.

Subsequent Changing of the Network Configuration (Computer Name, Domain, Workgroup, etc.)
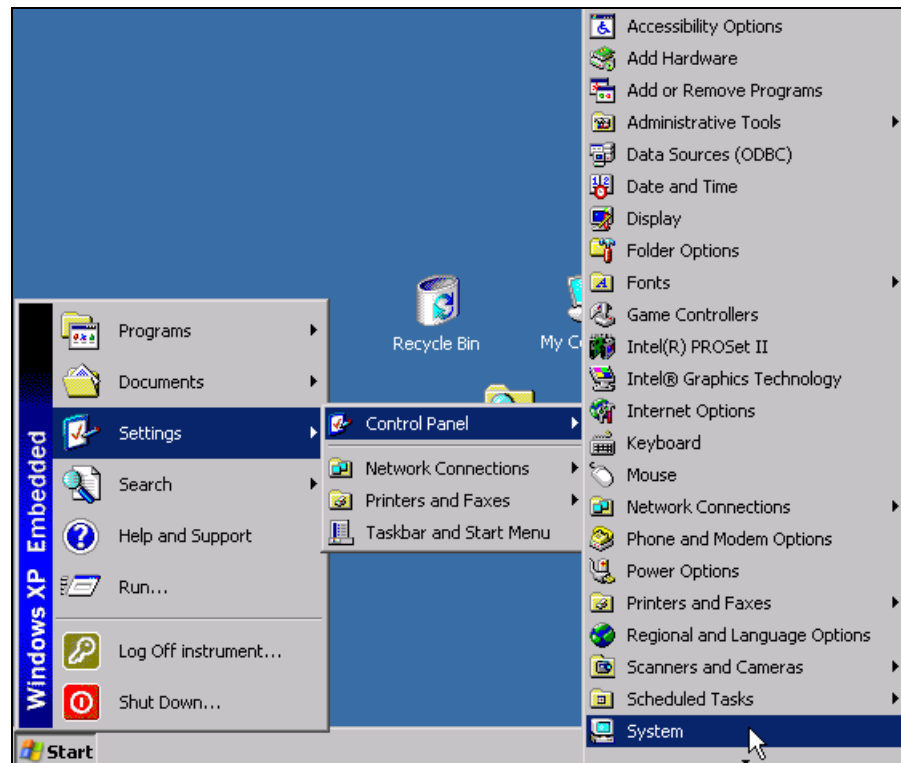
After completion of the installation, the computer name can be adapted as follows:

➢ Press the Windows key or *CTRL+ESC*.

The Windows Start menu will be opened.

➢ Select *Settings - Control Panel - System*.
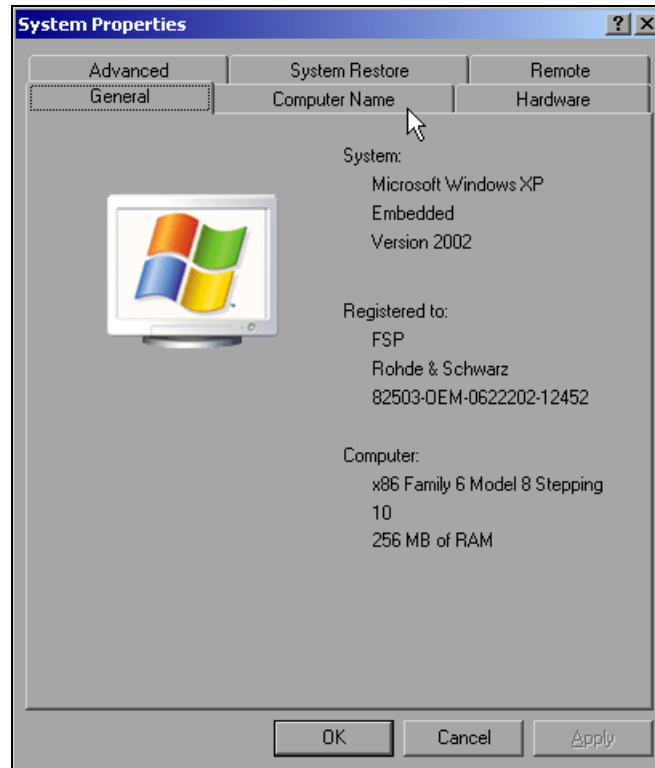
➢ Select the *Computer Name* tab.

Note

The other settings can be changed after selection of the other tabs. It is strongly recommended to consult the network administrator beforehand.
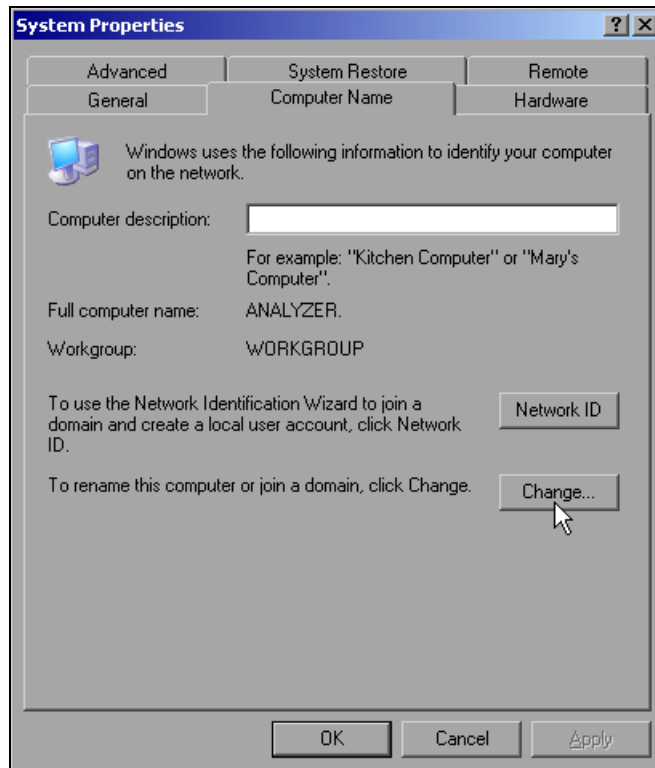
➢ Click the *Change* button.

The dialog to change the computer name, the domain and workgroup will be opened.
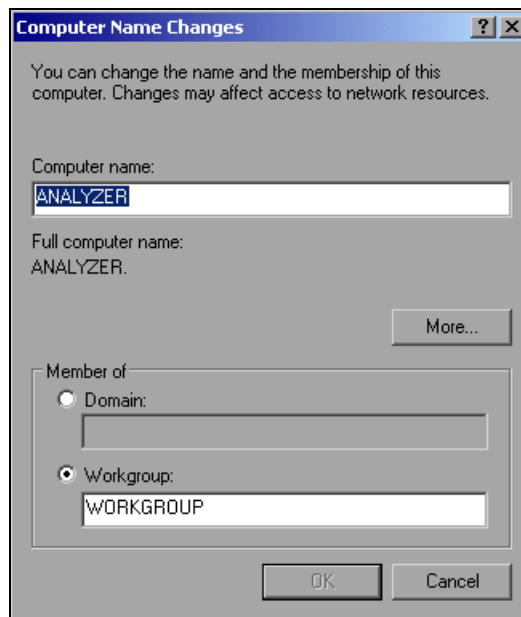
➢ Enter a new computer name.

➢ If required, enter the desired domain or workgroup.

➢ Confirm the changes with *OK*.
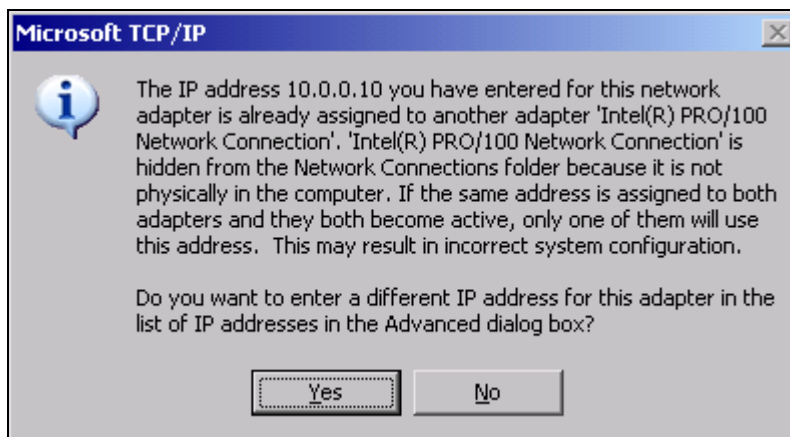
If the request to restart the unit is displayed:

➢ Click *Yes*.

Windows will restart the system.

Operating the Instrument without a Network

If the instrument is to be operated without any network connection for a limited or unlimited period of time, or permanently, no special precautions have to be taken in contrast to Windows NT. Windows XP automatically recognizes the interruption of the network connection and will not carry out any setup when the instrument is switched on.

If the user name and the password are not to be queried, proceed as described in section "Re-enabling the Auto Login Mechanism" on page 4.412.

Operating the Instrument in the Network

After the network support has been installed, it is possible to exchange data between the instrument and other computers and to use printers in the network.

A prerequisite to network operation is having the appropriate access rights for the required network resources. Resources may be file directories of other computers or also central printers.

Access rights can be obtained from the network or server administrator. In that respect it is necessary to obtain the network name of the resource as well as the corresponding access rights.

To prevent misuse, the resources are protected by passwords. Normally, every entitled user of the resources is assigned a user name that is also protected by a password. Resources can then be assigned to this user. It is possible to determine the type of data access, i.e. whether data can only be read or also written, as well as shared data access. Depending on the network operating system, different types of usage are possible.

NOVELL Networks

The operating system NETWARE from NOVELL is a server-based system. Data cannot be exchanged between individual workstations; data transfer takes place between the PC and a server. This server provides memory space and the connection to network printers. On a server, data is organized in directories as under DOS and mapped to the workstation as virtual drives. A virtual drive behaves like an additional hard disk on the workstation, and the data can be edited accordingly. Network printers can also be addressed like normal printers.

There are two versions of the NOVELL network operating system: bindery-based (NETWARE 3) and NDS-based (more recent versions of NETWARE). With the older version (NETWARE 3), each server manages its resources on its own and is independent. A user must be managed on each server separately. In the case of NDS-based versions, all resources in the network are managed together in the NDS (NOVELL DIRECTORY SERVICE). The user must log into the network only once and is given access to the resources according to his/her access rights. The individual resources and users are managed as objects in a hierarchical tree (NDS TREE). The position of the object in the tree is referred to as "CONTEXT" with NETWARE and must be known for access to the resources.

MICROSOFT Network

In case of a MICROSOFT network, data can be exchanged both between workstations (peer to peer) and between workstations and servers. The latter can supply access to files and connection to the printers. On a server, data is organized in directories as under DOS and mapped to the workstation as virtual drives. A virtual drive behaves like an additional hard disk on the workstation, and the data can be edited accordingly. Network printers can also be addressed like normal printers. A connection is possible to DOS, WINDOWS FOR WORKGROUPS, WINDOWS95/98/ME, WINDOWS NT/XP.

Defining Users

After the network driver software has been installed, the instrument will output an error message on the next power-on, as there is no user called "Instrument" (= user name for XP auto login) in the network. It is therefore necessary to define a common user for Windows XP, to adapt the password to the network password and the network and to disable the auto login mechanism subsequently.

The definition of new users in the network is done by the network administrator. For definition of a new user on the instrument, the User Account Assistant is required:
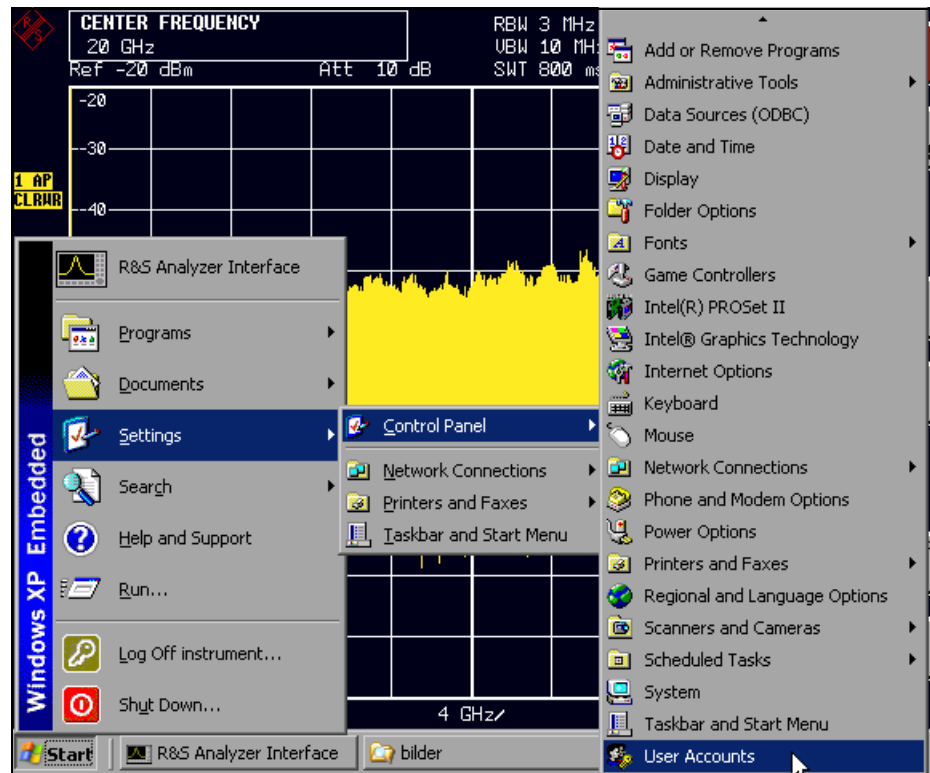
➢ Call up the Windows XP start menu using the Windows key or the key combination *CTRL+ESC*.

➢ Then click *Settings*, *Control Panel* and *User Accounts* one after the other.

The User Accounts wizard with the *Pick a task...* dialog will be opened.
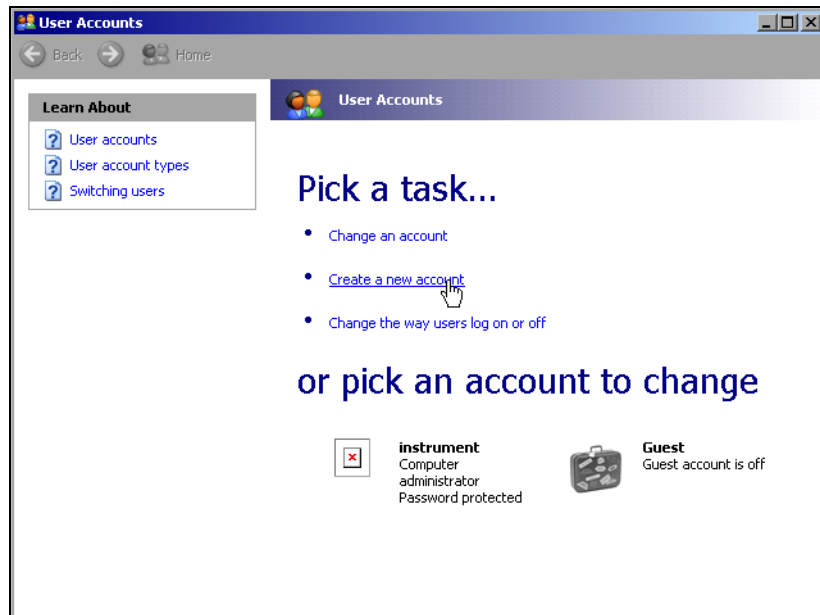
➢ Select *Create a new account*.

The dialog to enter a new user name will be opened.
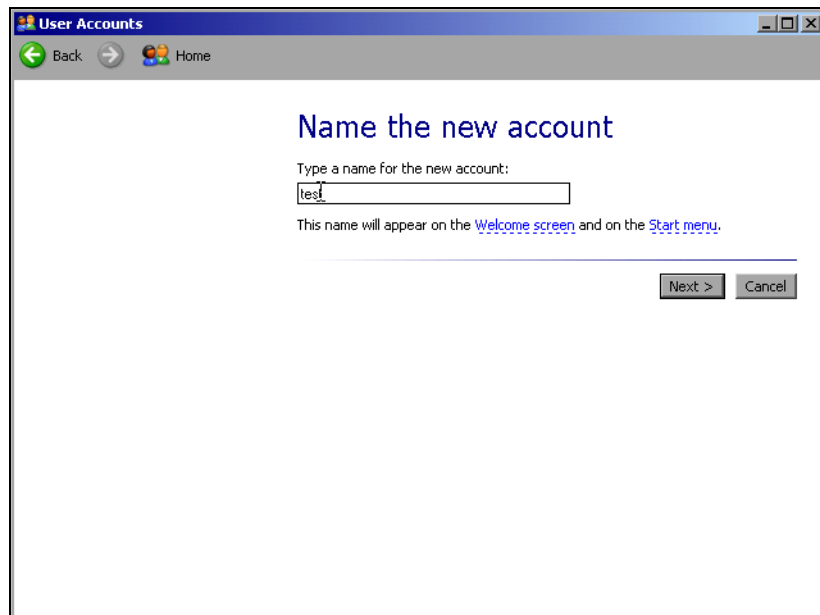
➢ Enter the name of the new user into the text field and terminate the entry with *Next ->*.

The *Pick an account type* dialog to select the user rights will be opened.
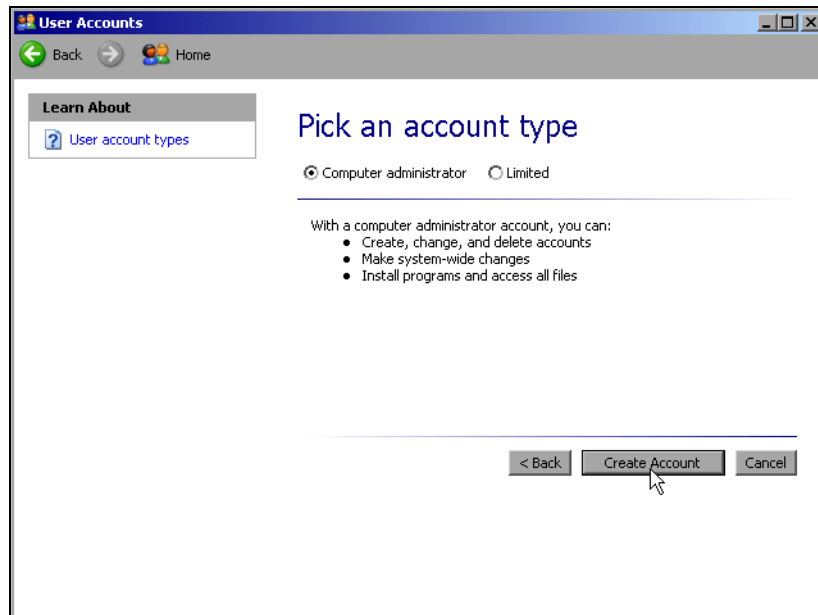
➢ Select *Computer administrator*.

Note

Administrator rights are required to ensure trouble-free operation of the firmware.

➢ Confirm the newly created user with the *Create Account* button.

The new user is created.

Changing the User Password

After the new user has been created, the password has to be adapted to the network password. This is also done via the User Accounts wizard:
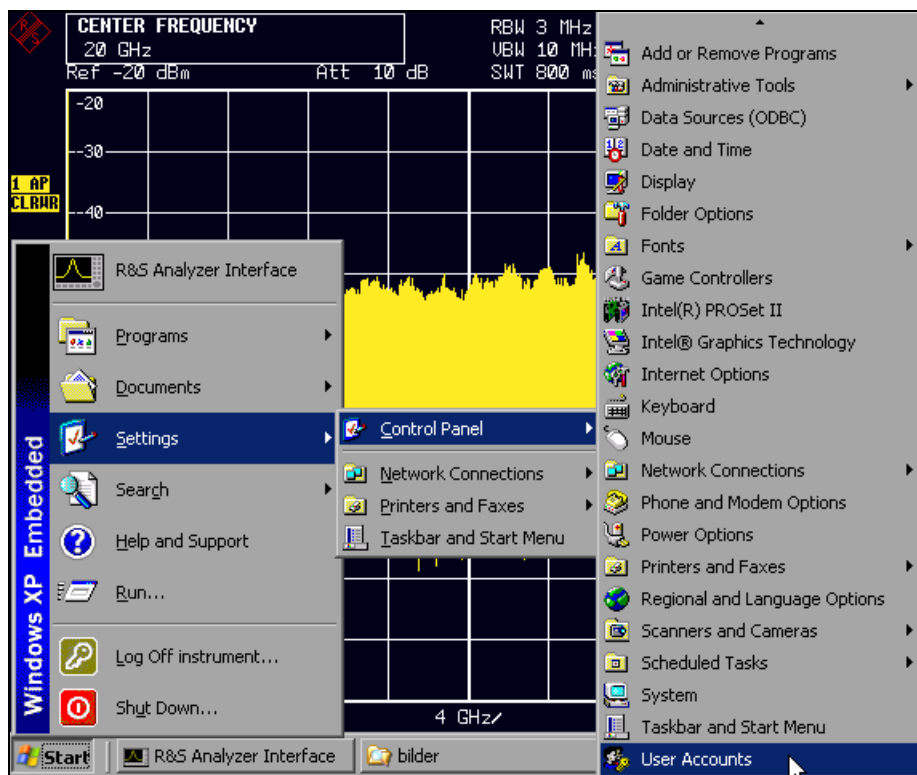
➢ Call up the Windows XP start menu using the Windows key or the key combination *CTRL+ESC*.

➢ Then click *Settings*, *Control Panel* and *User Accounts* one after the other.

The User Accounts wizard with the *Pick a task...* dialog will be opened.
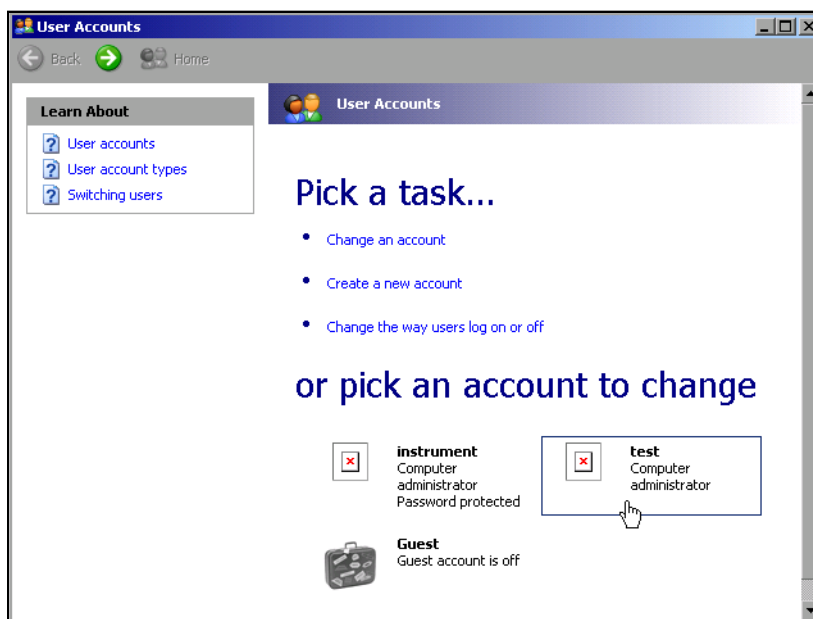
➢ Click the required user account (in the example: "test").

The dialog to select the desired action will be opened.
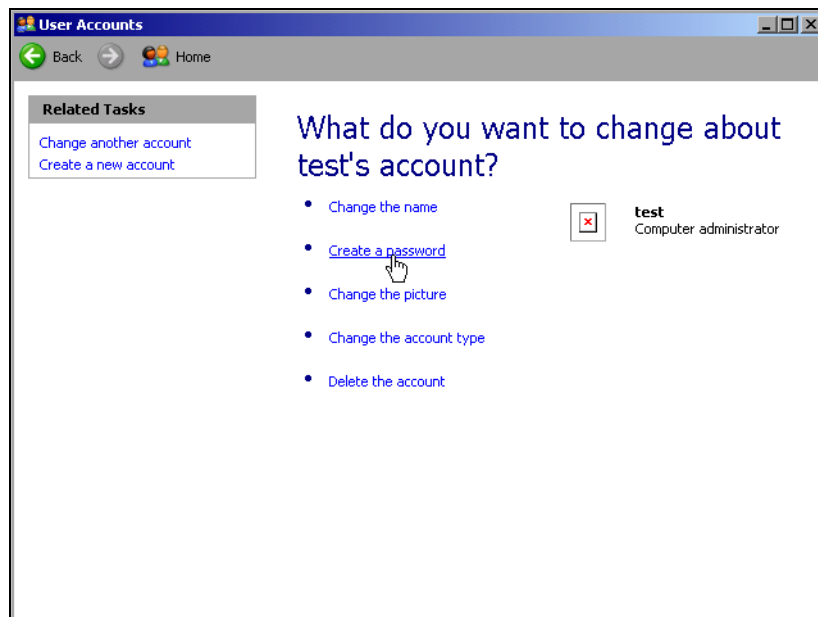
➢ Click *Create a password*.

The dialog to enter a new password will be opened.
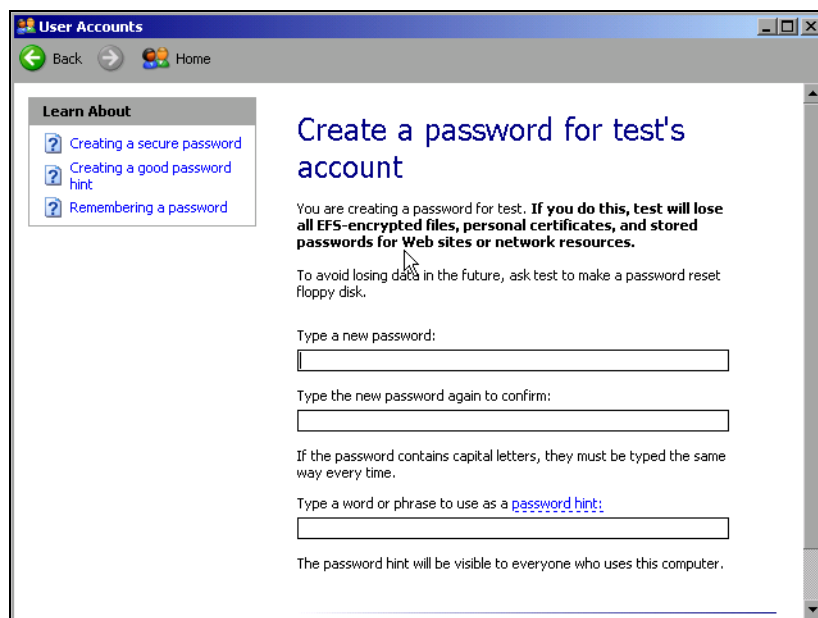
➢ Enter the new password in the upper text line and repeat the entry in the line below.
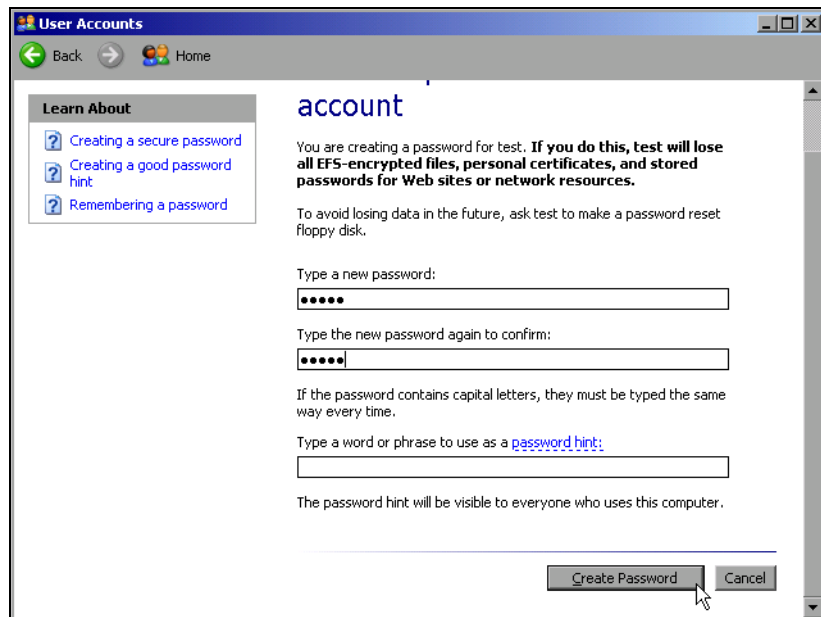
➢ Scroll the picture contents downwards and terminate the entry with the *Create Password* button.

The new password is activated.

NOVELL network only: Configure NOVELL client
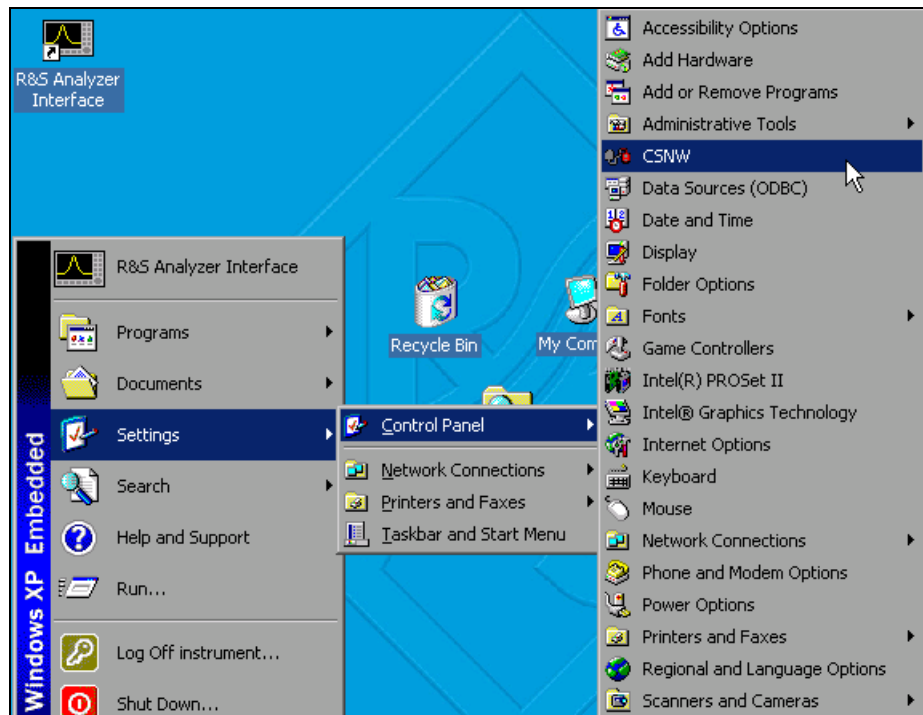
➢ Call up the Windows XP start menu using the Windows key or the key combination *CTRL+ESC*.

➢ Then click *Settings*, *Control Panel* and *CSNW* one after the other.
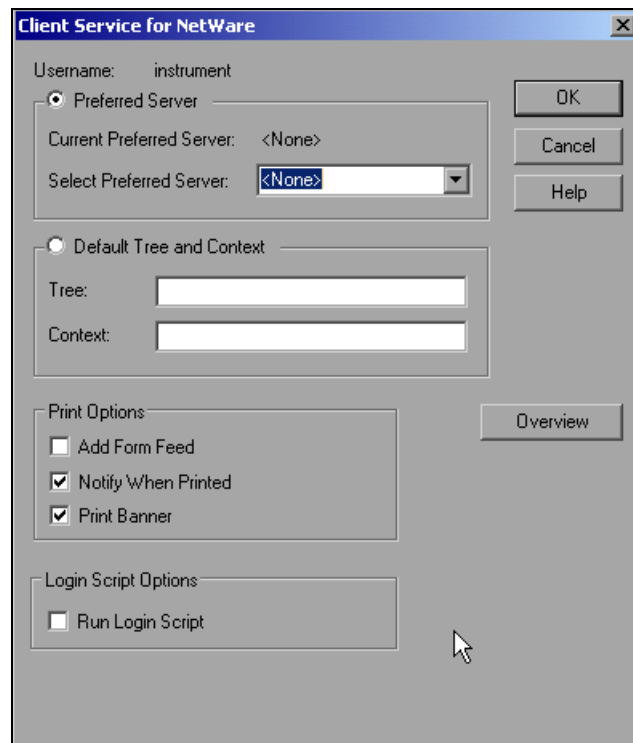
Bindary login (NOVELL 3.x)

➢ Click *Preferred Server*.

➢ Select the NOVELL server where the user is configured using *Select Preferred Server*.

NDS login (more recent NOVELL versions)

➢ Click *Default Tree and Context*.

➢ Enter the NDS Tree under *Tree* and the hierarchical path where the user is defined under *Context*.

➢ If required, click the *Run Login Script* entry.

Note

This data can be obtained from the network administrator.

➢ Terminate the Login configuration with *OK*.

Login in the Network

The user automatically logs into the network with the registration in the operating system. As a prerequisite, the user name and the password must be identical under Windows XP and on the network.

Disabling the Auto Login Mechanism

Upon delivery, the instrument is configured for automatic login into Windows XP. This mechanism must be disabled if the instrument is operated in a network, since the default user name ("instrument") and the password normally are not identical to those of the network account.

To disable the auto login mechanism, proceed as follows:

➢ Open the XP start menu by means of *CTRL+ESC*.

➢ Select the menu item *RUN*.

A dialog box opens.

➢ Enter the command "D:\USER\NO_AUTOLOGIN.REG" in the dialog box and confirm with *ENTER*.

The auto login mechanism is disabled. When the instrument is rebooted, a prompt for user name and password will appear before the instrument firmware is started.

Re-enabling the Auto Login Mechanism

To enable the auto login mechanism again, proceed as follows:

➢ Open the XP start menu by means of *CTRL+ESC*.

➢ Select the menu item *RUN*.

A dialog box opens.

➢ Enter the command "D:\USER\AUTOLOGIN.REG" in the dialog box and confirm with *ENTER*.

The auto login mechanism is re-enabled and is active when the instrument is rebooted the next time.

Using Network Drives

Mapping a network drive
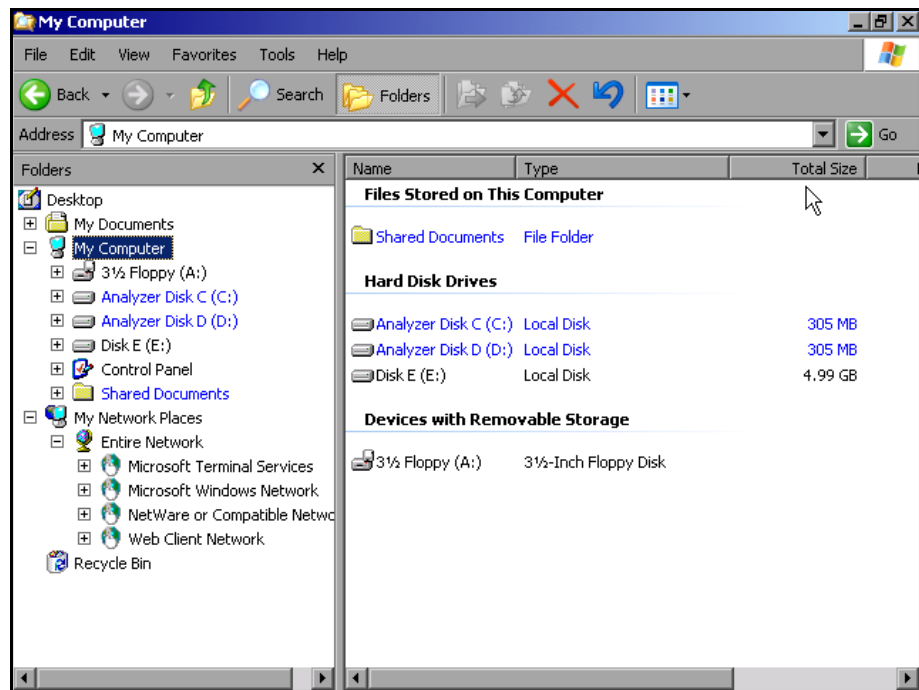
➢ Use the Windows key or the key combination *CTRL+ESC* to call the Windows XP start menu.

➢ Click *Programs - Accessories -Windows Explorer*.

➢ Click the line *My Network Places* in the overview *Desktop*.

   An overview of the available network drives is displayed.
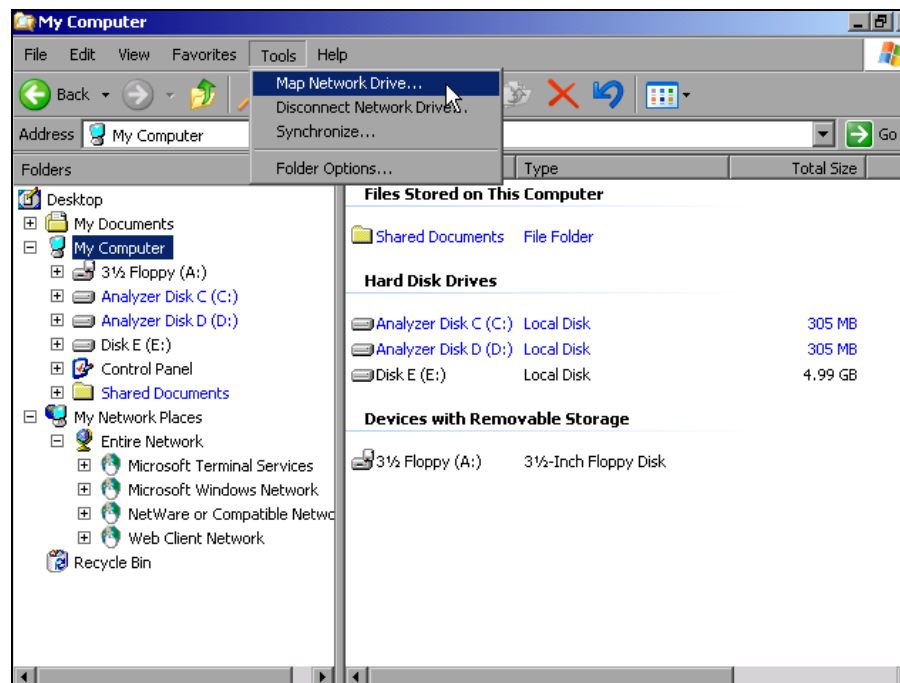
➢ Click *Tools* and then *Map Network Drive*.
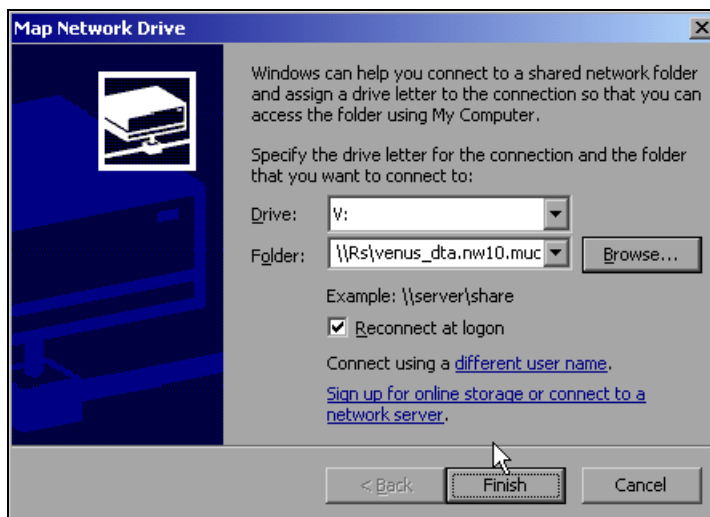
➢ Select the appropriate drive under *Drive:*.

➢ With *Browse*, open the list of available network paths in the network.

➢ Activate *Reconnect at Logon:* if the connection is to be set up automatically each time the instrument is started.

➢ Use *Finish* to connect the network path with the selected drive.
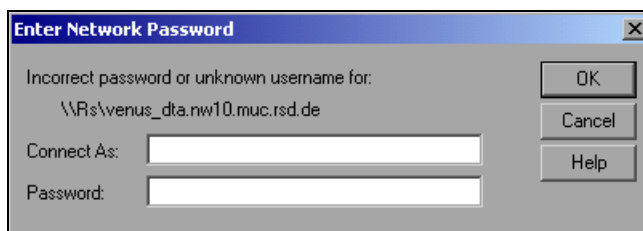
➢ Enter the user name and the password. Then the drive will appear in the *All Directories* overview of the explorer.

Note

Only those drives in the network for which the user has the appropriate access right can be connected.

Disconnecting a network drive

➢ Click *Tools* in the Explorer and then *Disconnect Network Drive*.

➢ Select the drive to be disconnected under *Network Drive:*.

➢ Disconnect the drive using *OK*. The security prompt must be answered with *Yes*.

Printing on a Network Printer

Note

The following dialogs may be operated both via the front panel and via a mouse and PC keyboard (for further information refer to the Quick Start Guide). The mouse and the PC keyboard are indispensable for the configuration of network printers.

A new printer is installed via the *INSTALL PRINTER* softkey in the *HCOPY* menu.
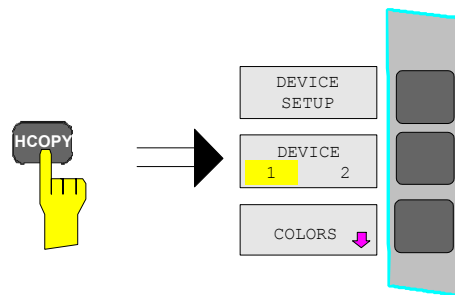
➢ Press the *HCOPY* key.

   The *HCOPY* menu will be opened.

➢ Call up the lateral menu via the *NEXT* key.

➢ Open the *Printers and Faxes* dialog with *INSTALL PRINTER*.
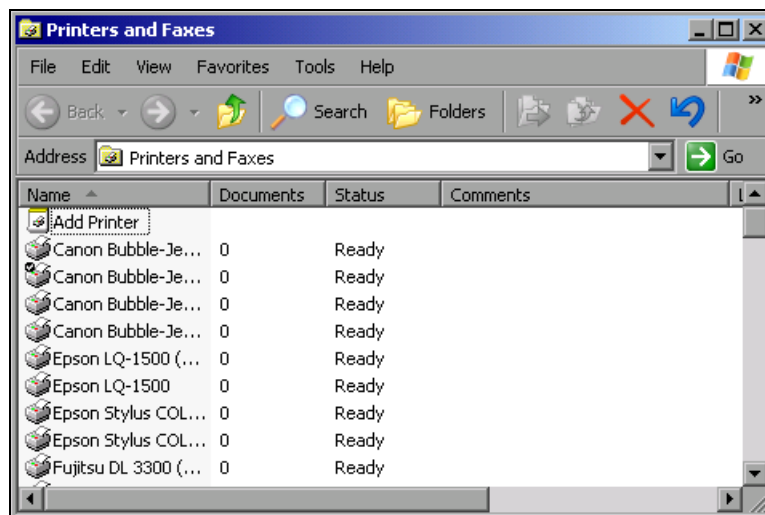
➢ Select the entry *Add Printer* in the selection list using the rotary knob.

➢ Highlight the entry with *CURSOR RIGHT* and confirm the selection by pressing *ENTER* or the rotary knob.

The *Add Printer Wizard* will be displayed.
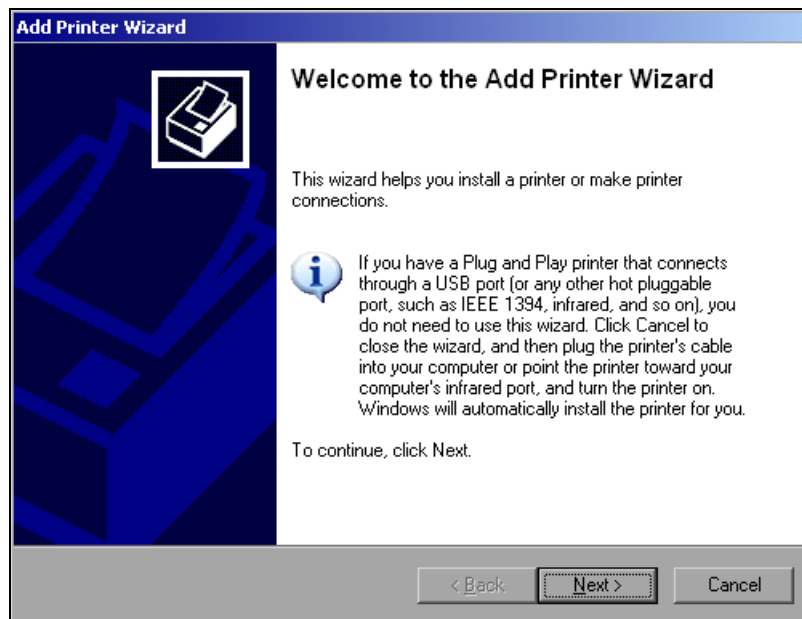
➢ Select *NEXT* with the rotary knob and confirm by pressing the rotary knob.

The selection *Local or Network Printer* will be displayed.

In the following example, an HP Laserjet 5 printer will be installed as the network printer. The Add Printer Wizard has already been opened according to the information described in the section "Installation of Non-Plug&Play Printers" on page 4.335.
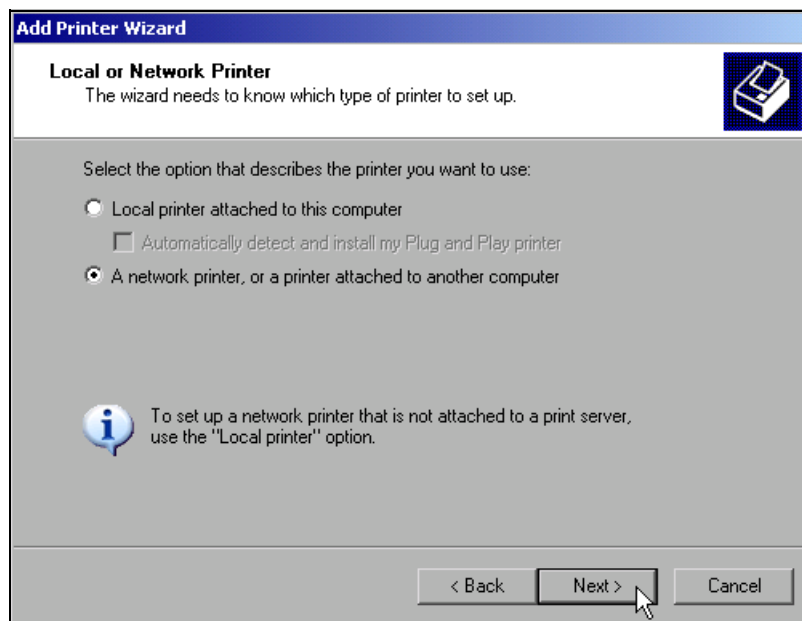
➢ To select a network printer, click the line *A network printer or a printer attached to another computer*.
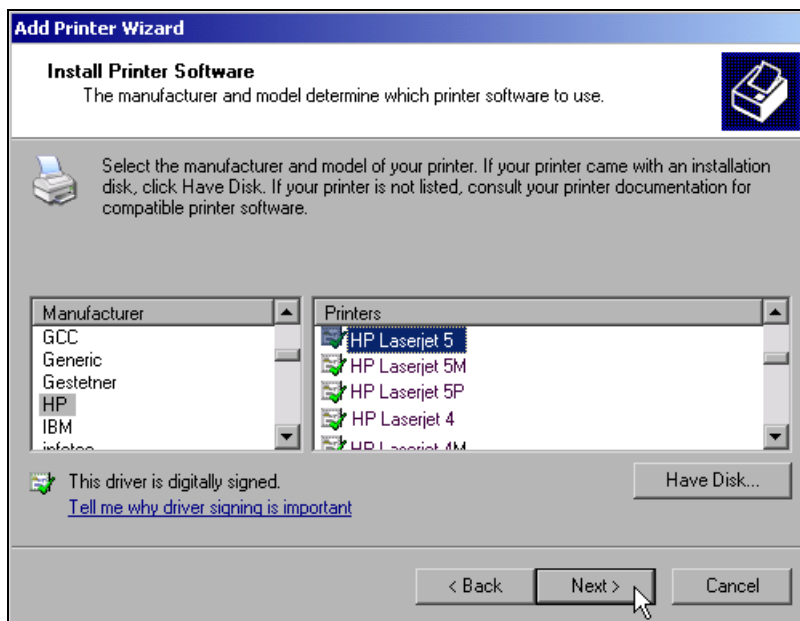
➢ Then continue with *Next*.
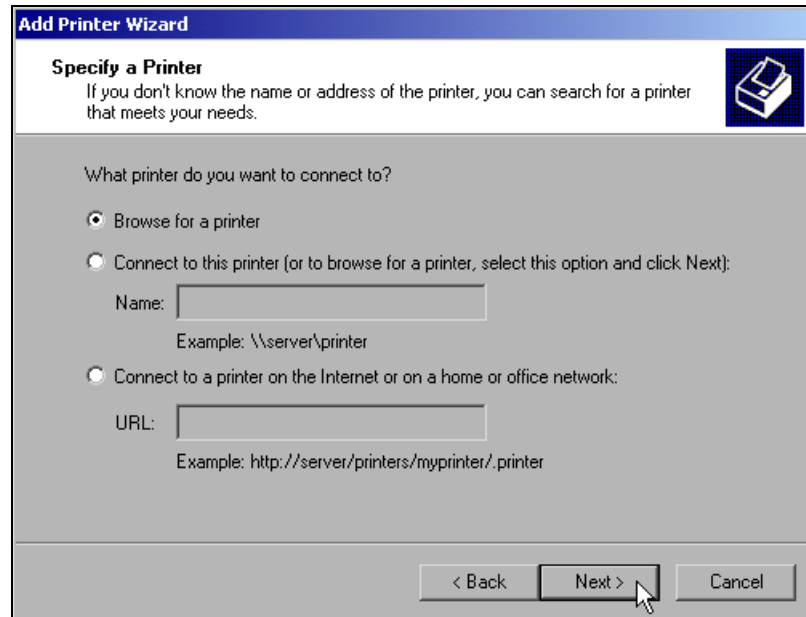
➢ First click *Browse for a printer* and then *Next*.

The selection of shared printers will appear.
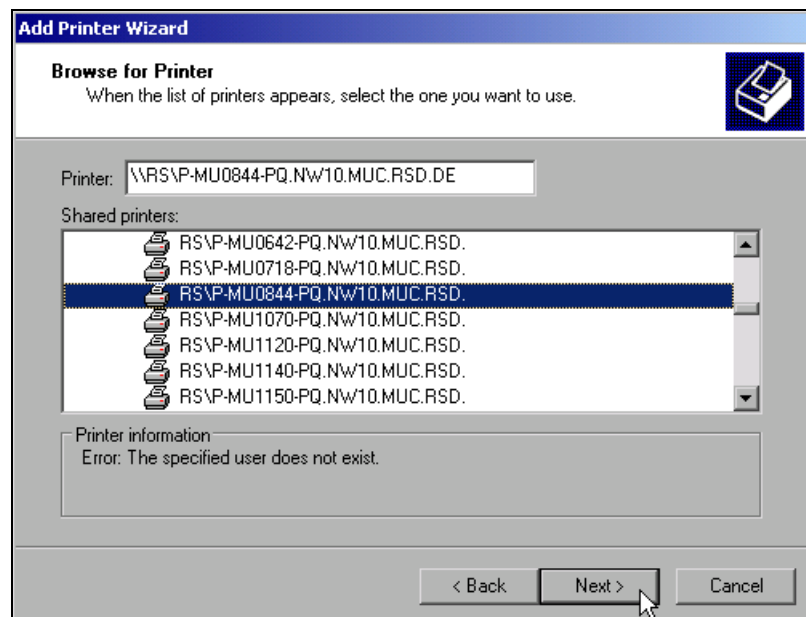
➢ Highlight printer and select with *OK*.

➢ Confirm the following request to install a suitable printer driver using *OK*.

The selection of printer drivers will be displayed.

The manufacturers are displayed in the left-hand table and the available printer drivers in the right-hand table.

➢ First highlight the manufacturer in the selection list *Manufacturers* and then the printer driver in the selection list *Printers*.
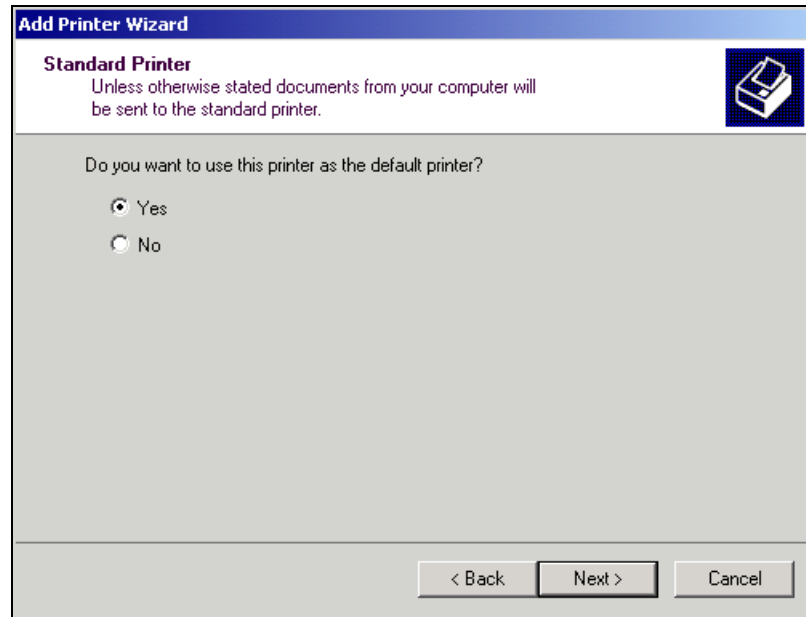

Note

If the desired printer type does not appear in this list, the driver has not yet been installed in the instrument. In this case, click the *Have Disk* button. A request to connect a memory stick with the corresponding printer driver will appear. Then click *OK* and select the desired printer driver.

➢ Click *Next*.

If one or several printers have already been installed, the query of whether the printer installed so far is to be selected as the default printer for the Windows XP applications will be displayed. *No* is preset.
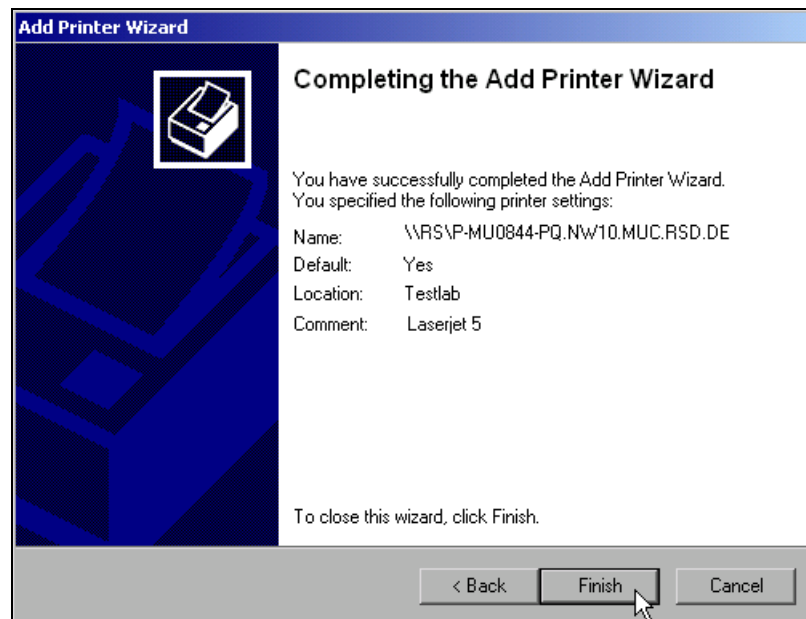
➢ Start the installation of the printer driver with *Finish*.

Finally, the instrument still has to be configured for printout via this printer with the softkeys *DEVICE SETUP* and *DEVICE 1/2* in the main hardcopy menu (see section "Selecting Printer, Clipboard and File Formats" on page 4.323).

## Sharing Directories (only for Microsoft Networks)

Data on the instrument can be made available for other computers if directories are shared. Sharing directories is only possible in the MICROSOFT network.

Sharing is a property of a file or directory. To allow sharing, proceed as follows:
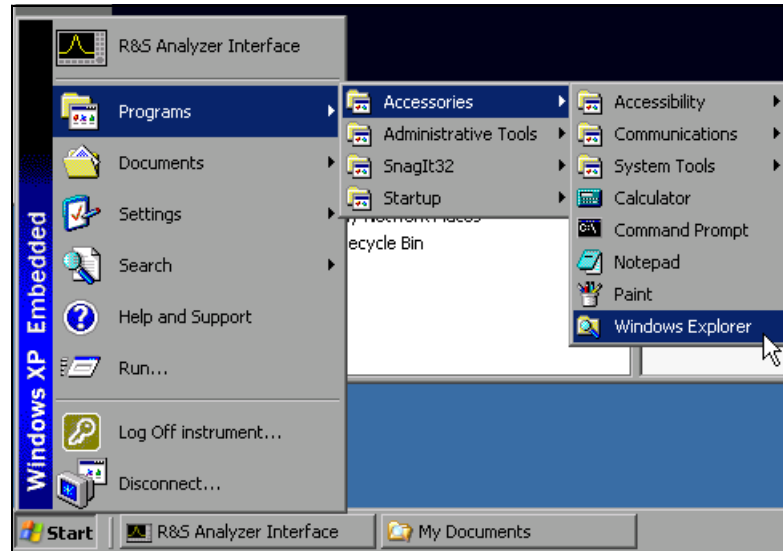
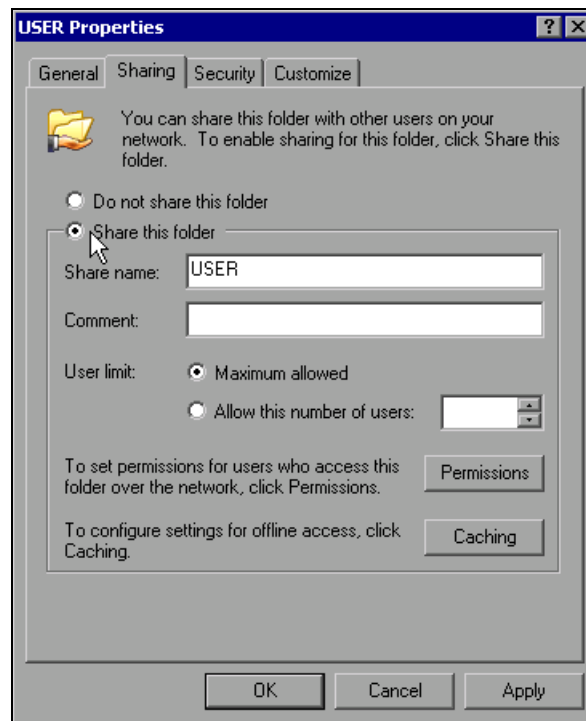➢ Open the Windows start menu using the Windows key or *CTRL+ESC*.

➢ Open the Windows Explorer by clicking *Programs - Accessories - Windows Explorer*.
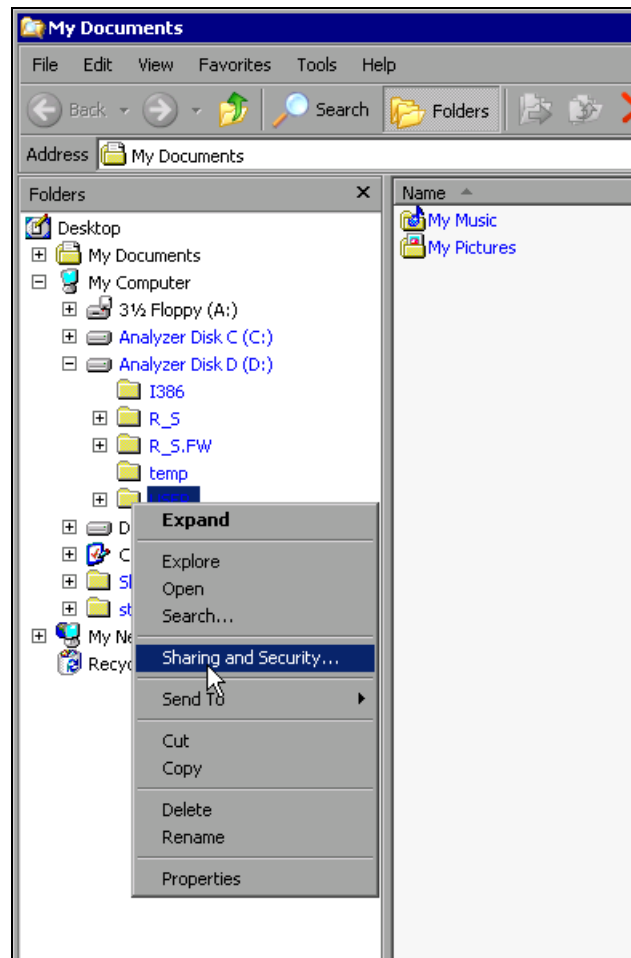
➢ Click the desired folder with the right mouse key.

➢ Click *Sharing and Security*.

The dialog to share the directories will be opened.

➢ Click *Share this folder*.

The following settings can optionally be changed:

Share name:
the name under which the directory appears in the Explorer

Comment:
a comment regarding the shared directory

User Limit:
the number of users that may access the directory at the same time

Permissions:
the rights of the users (read only, read and write, all)

Caching:
local buffering of directory contents for fast access

➢ Confirm settings with *OK*.

The drive is shared and this is shown in the Explorer by a hand under the directory symbol:

Remote Monitoring of R&S ESU via XP Remote Desktop

Introduction

In production test and measurements, the question of how to centrally monitor measuring instruments that are used for remote servicing/diagnostics is often arises. With the remote desktop of Windows XP, the analyzer family R&S ESU offers ideal preconditions for use in production:

- Access to operating functions via virtual front panel (*soft front panel*)

- Printout of measurement results directly from the controller

- Storing measurement data to the hard disk of the controller

The analyzer is connected via LAN. XP also supports the connection via data transmission (via modem). This section describes the configuration of R&S ESU and the remote desktop client of the control PC. For details on setting up the data transmission link, see relevant XP literature.

## Configuration of R&S ESU for Using Remote Desktop

The following steps are required to allow an external PC access to the desktop of the R&S ESU.

1. Determine the IP configuration of the network link:
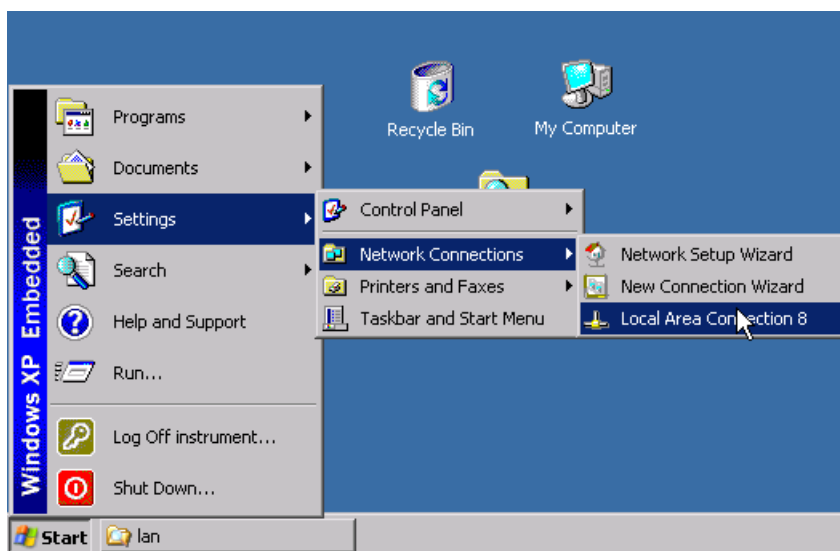
➢ Open the Windows XP start menu using the Windows key or *CTRL+ESC*.

➢ Click *Settings - Network Connections - Local Area Connection*.

➢ The *Local Area Connection Status* dialog will be opened.
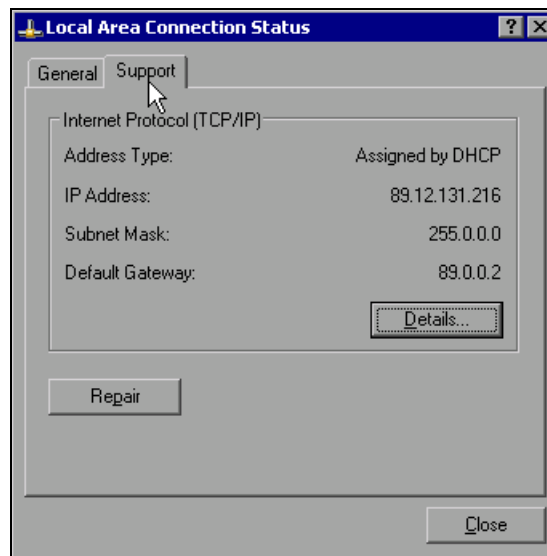
➢ Click the *Support* tab.

The current TCP/IP configuration will be displayed.

If the entry "Assigned by DHCP" is displayed in the *Address Type* field, continue with step 2 (Installing a fixed   IP address...)

It would otherwise be sufficient to note the IP address and to continue with step 3 (Enabling the R&S ESU...)

2. Install a fixed IP address for the TCP/IP protocol as described in the section "Configuration of Available Network Protocols (TCP/IP Protocol)" on page 4.391.

Note

Operation with a fixed IP address is strongly recommended.

When a DHCP server is used, a new IP address (which has to be determined first) will be assigned any time the instrument is restarted. For this reason, a DHCP server would not be suitable for use for detached operation of the R&S ESU.

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3. Enable the R&S ESU for operation with the remote desktop.
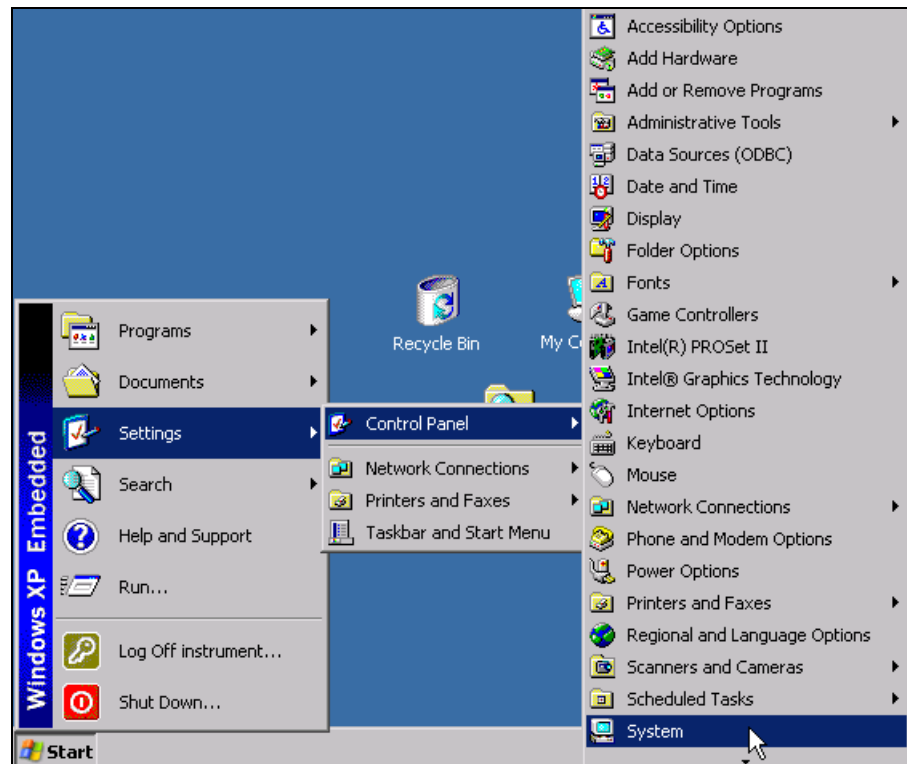
➢ Press the Windows key or *CTRL+ESC*.

   The Windows start menu will be opened.

➢ Select Settings - Control Panel - System.
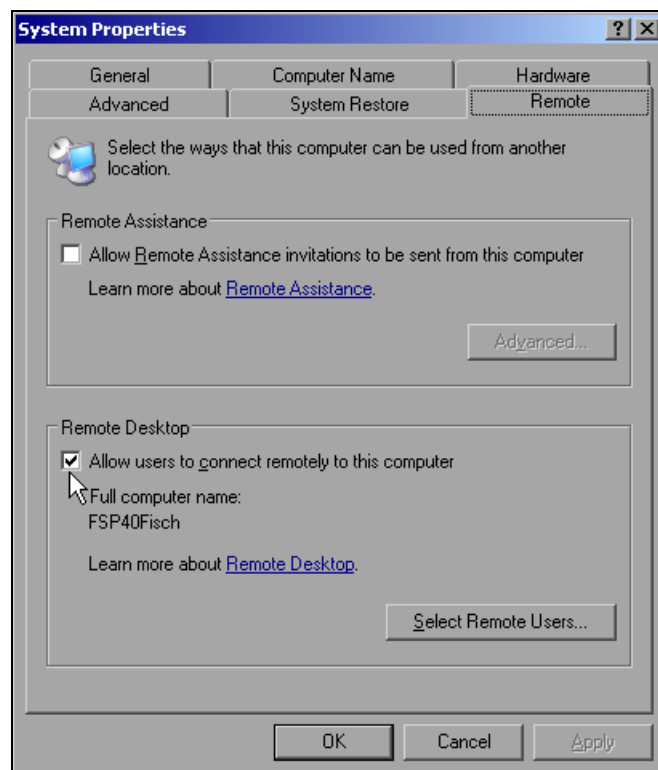
➢ Select the *Remote* tab.

➢ In the *Remote Desktop* field, tick the box in front of *Allow users to connect remotely to this computer*.

➢ If required, select the users installed on the R&S ESU who are to also have access to the R&S ESU via remote desktop in the *Select Remote Users...* dialog.

Note

The user account under which the configuration is to be performed is automatically enabled for remote desktop.

➢ Confirm setting with *OK*.

The R&S ESU is therefore ready for setting up the connection with the remote desktop of the controller.

Configuration of Controller

A precondition for the operation of the remote desktop is the availability of the TCP/IP protocol on the controller and the installation of the remote desktop client.
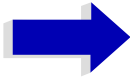
Note

For Windows XP, the remote desktop client is part of the operating system and available under *Start - Programs - Accessories - Communications - Remote Desktop Connection*.

For other Windows versions, Microsoft offers the remote client as a separate program package for subsequent installation.

The settings on the remote desktop client of the controller must be made prior to setting up the connection with the R&S ESU. The following steps are required:
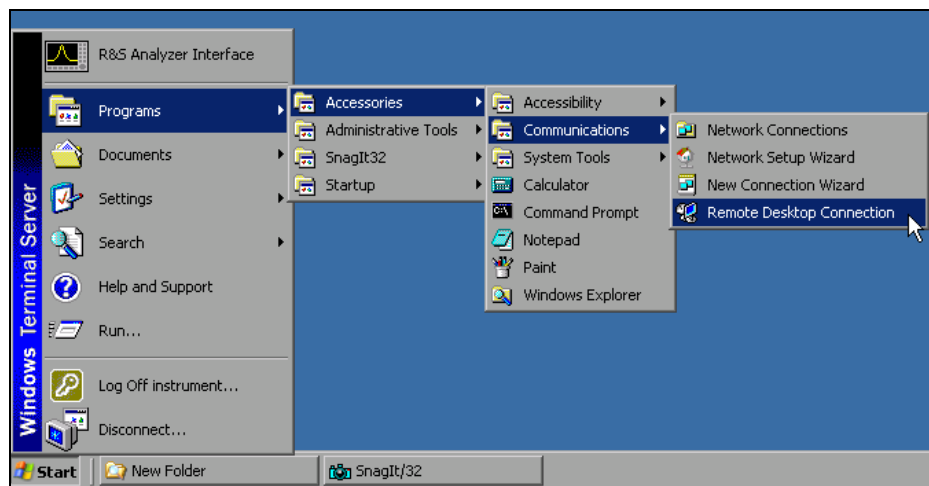
➢ Press the Windows key or *CTRL+ESC*.

➢ Select *Programs - Accessories - Communications - Remote Desktop Connection*.

The Remote Desktop Connection screen will be opened.
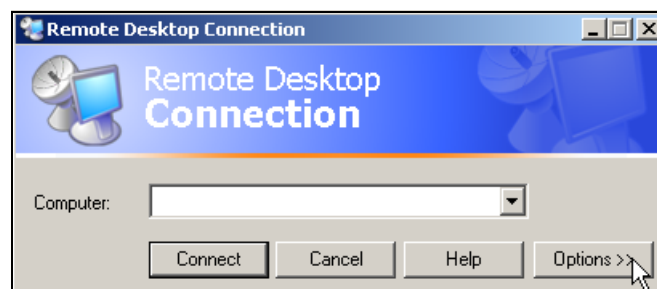
➢ Click the *Options* >> button.

The tabs with the configuration data will be opened.
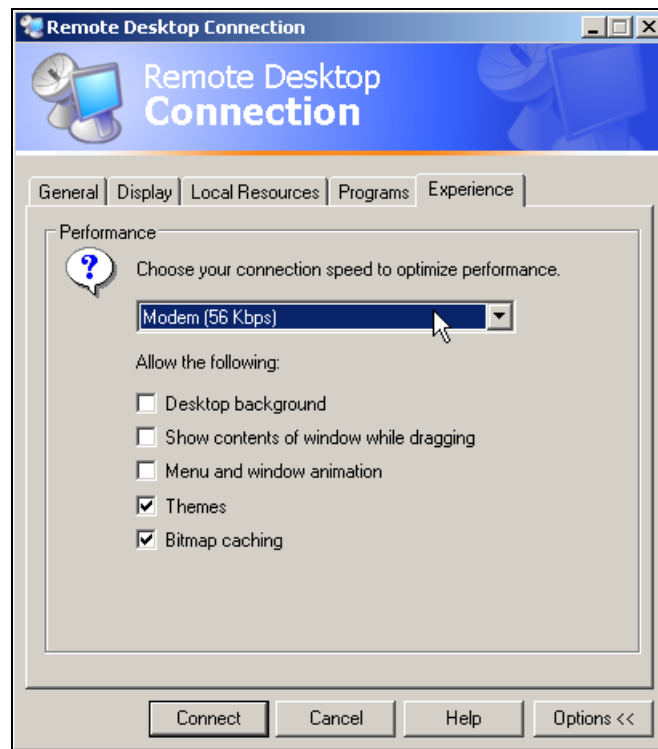
➢ Select the *Experience* tab.

The speed of setting up the connection will be selected and optimized.

➢ Click the selection list under *Choose your connection speed to optimize performance*.

The list of available configurations will be opened.
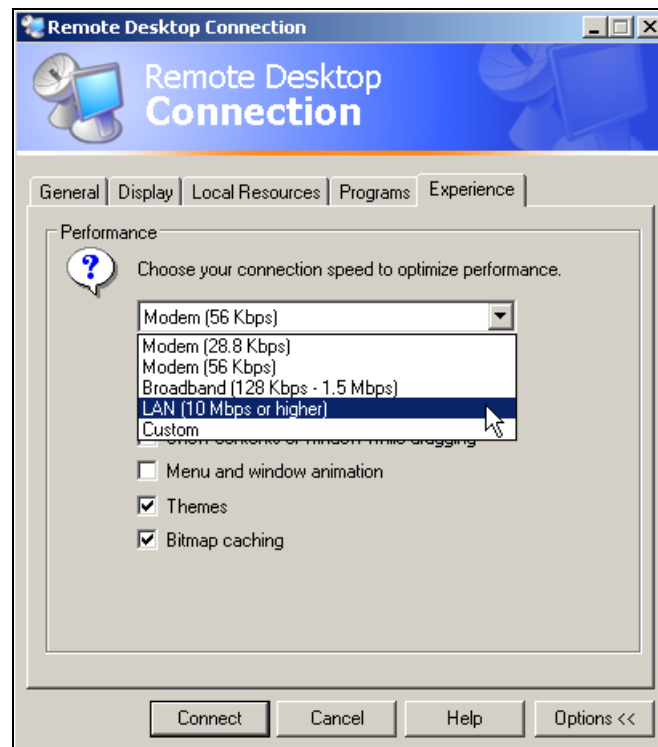
➢ Select the suitable connection (in the example LAN (10 Mbps or higher)).

Different boxes in the list below are activated depending on the selection and depending on the performance of the connection.

➢ To improve the performance, the entries *Desktop background*, *Show Contents of Window* while dragging and *Menu and Window animation* can be switched off.

➢ Click the *Local Resources* tab.

The tab to share printers, local drives and serial interfaces will be opened.
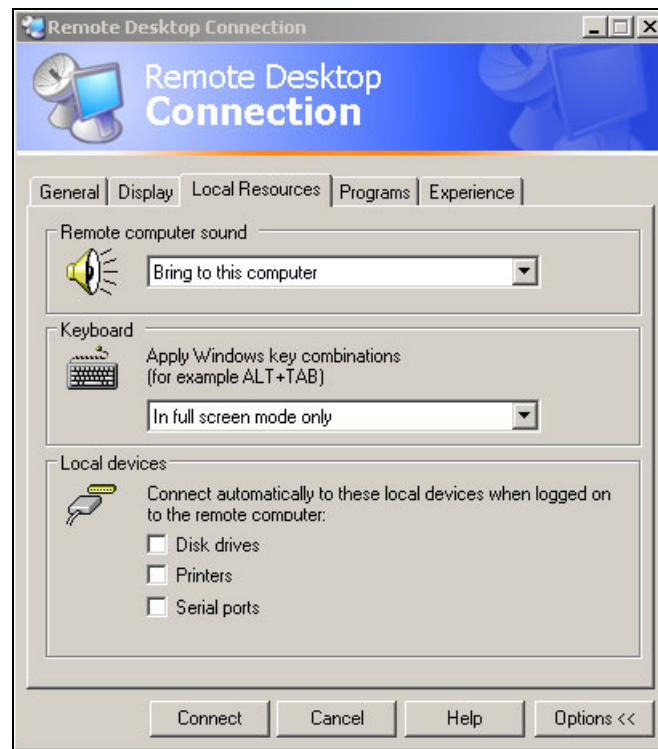
➢ Click the box in front of *Disk drives* if drives of the controller are to be accessed from the R&S ESU (e.g. to save settings or to copy files from the controller to the R&S ESU).

Windows XP will then map the drives of the controller like network drives on the R&S ESU.

➢ Click the box in front of *Printers* if printers connected to the controller are to be used from the R&S ESU.

➢ Do not change the other settings.

➢ Click the *Display* tab.

The configuration of the representation of the R&S ESU screen on the controller will be opened.
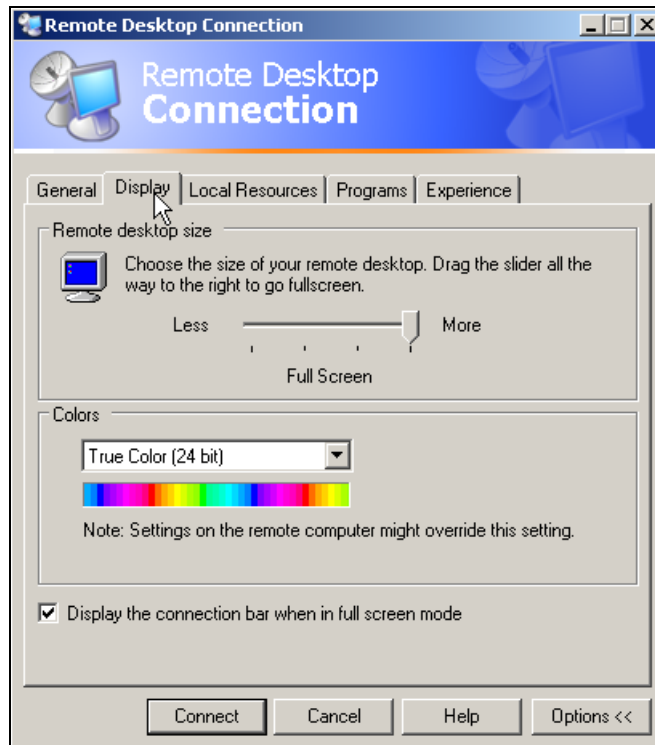
➢ The size of the R&S ESU window on the desktop of the controller can be changed by means of the slider. The default setup is full screen.

➢ Do not change the color depth.

➢ *Display the connection bar when in full screen mode*:

If this box is checked, a bar will appear at the top screen margin. This bar displays the network address of the R&S ESU and can be used to reduce, minimize or to close the window.

If the box is not checked, a return from the R&S ESU screen to the controller desktop in the full-screen mode is possible only if *Disconnect* is selected in the start menu:
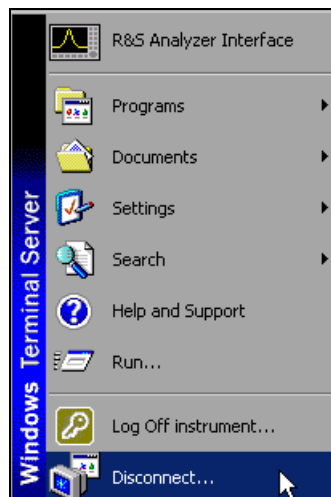
Setting Up the Connection with the R&S ESU

After configuration of the remote desktop client, the connection with the R&S ESU has to be set up.
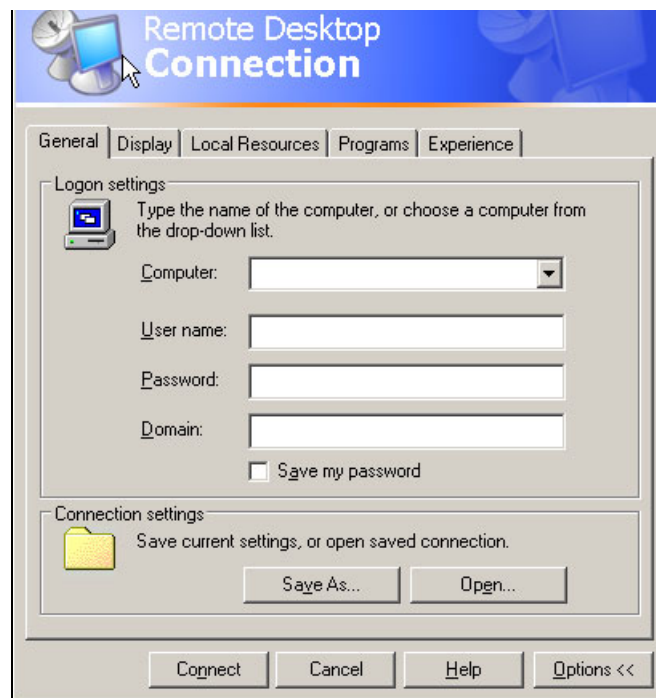
➢ Click the *General* tab. The connection information will be entered.

➢ Enter the IP address of the R&S ESU in the *Computer* field.

➢ The information can be stored via the *Save As...* button for the next time. With the *Open...* button, it is possible to load an existing configuration again.

➢ Press the *Connect* button.

The connection will be set up.

Note

If the entry *Disk Drives* is active in the *Local Resources* tab, a warning is issued that the drives will be shared for access from the R&S ESU:

Confirm the warning with *OK*. The setup will be continued.

The R&S ESU screen will appear on the controller screen with the request to log in. To allow remote control of the R&S ESU, the following steps have to be carried out:

➢ Enter user name "instrument" and password "instrument".

The R&S ESU screen will be opened in a few moments.

If the screen is dark or if a dark rectangle appears in the upper left corner, the R&S ESU firmware must be restarted in order to recognize the modified screen resolution. In this case:

➢ Press ALT+F4.

The R&S ESU firmware will be shut down. This may last for several seconds.
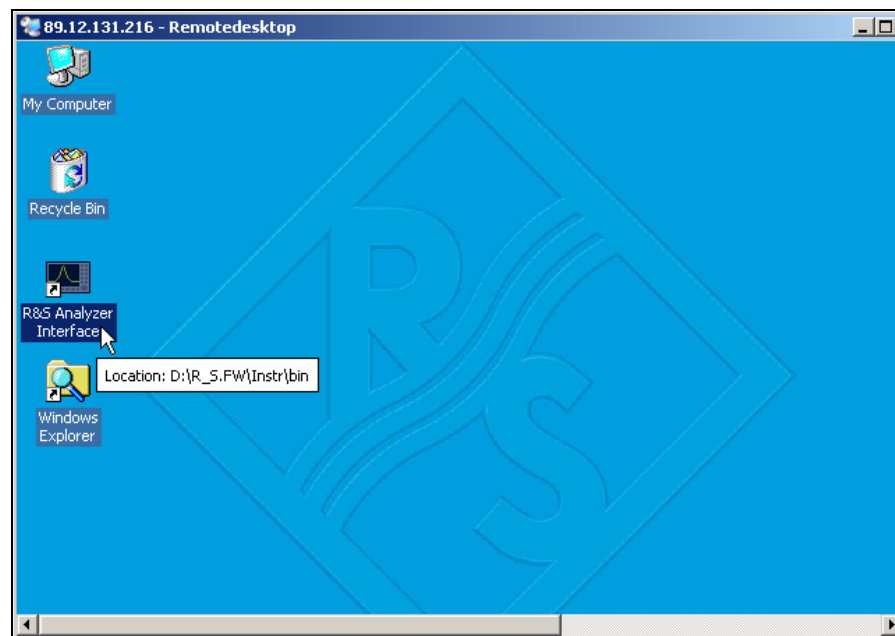
➢ Double-click the entry *R&S Analyzer Interface*.

The firmware will restart and will automatically open the *Soft Frontpanel*, i.e. the user interface in which all front panel buttons and the rotary knob are shown.

➢ If the R&S ESU application is directly displayed after setup, shutdown and restart can be omitted.
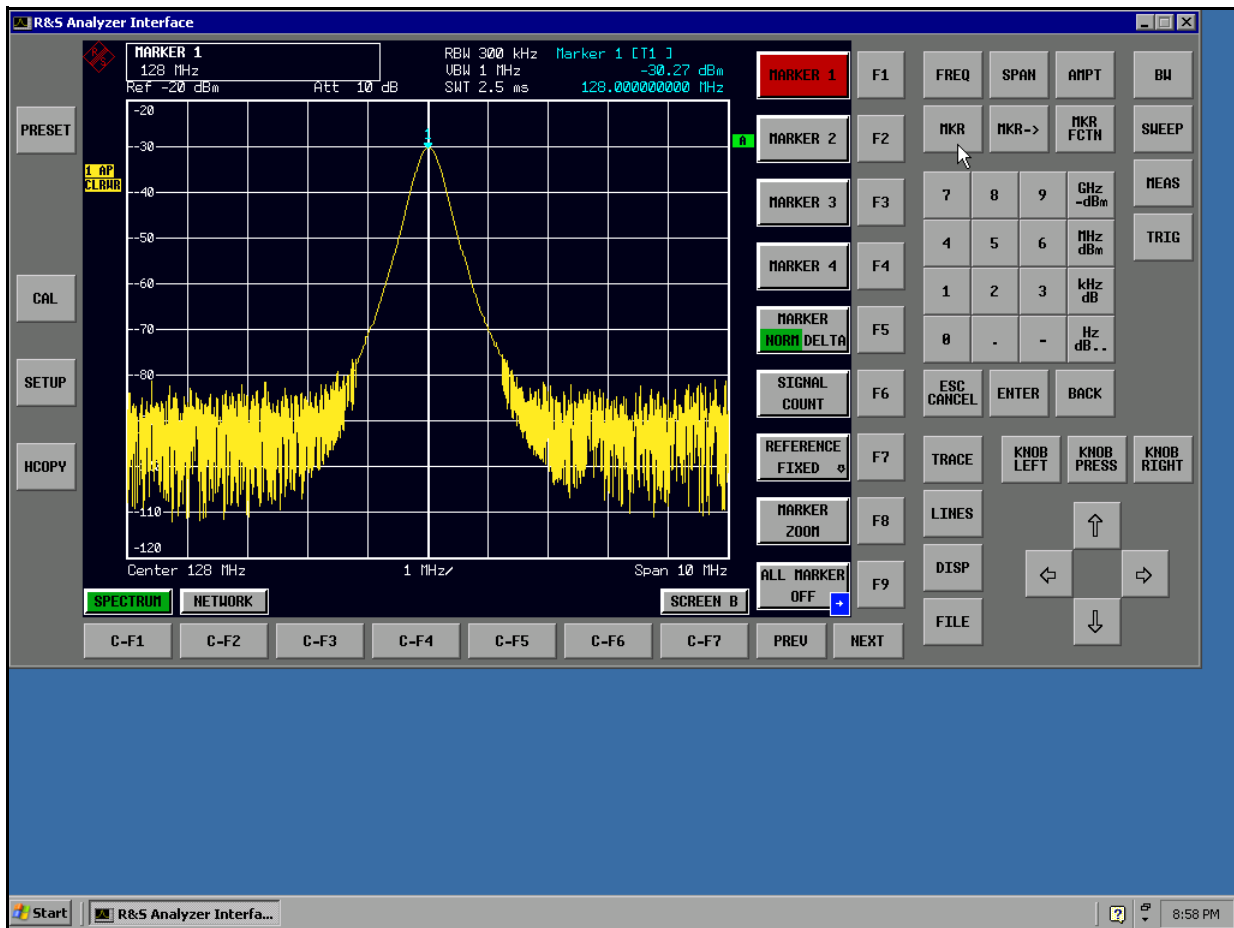
➢ All hardkeys, softkeys and hotkeys can be operated with the mouse.

➢ The rotary knob is implemented by *KNOB LEFT, KNOB RIGHT* and *KNOB PRESS*.

➢ The XP start menu is available if the remote desktop window is enlarged to full size.

Interruption and Re-Setup of Remote Desktop Connection with the R&S ESU

The connection to the R&S ESU can be interrupted any time if the remote desktop window is connected to the controller.

To reestablish the connection, the setup with the R&S ESU only has to be performed again as described in the section "Setting Up the Connection with the R&S ESU" on page 4.432. The R&S ESU will then maintain its state in case of an interruption with a subsequent re-setup.

When the connection is set up with the controller, the login entry will be displayed on the R&S ESU screen. If the login procedure is carried out successfully, the message that a different user has assumed control of the instrument and that the connection was therefore cleared will be displayed on the screen of the controller.

Switching Off the R&S ESU from the Controller

The R&S ESU can be switched off per remote control. For this purpose, proceed as follows:

1. Click the R&S ESU soft front panel and close the application with *ALT+F4*.

2. Click the desktop and press *ALT+F4*.

   A confirmation query with the warning that the instrument cannot be switched on again via remote control is displayed with the query to continue the shutdown process.

3. Answer the confirmation query with *YES*.

   The connection to the controller will then be cleared and the R&S ESU will be switched off.

Remote Data Transfer with TCP/IP Services

The protocol TCP/IP allows the transfer of files between different computer systems. This requires a program running on the two computers that controls this data transfer. It is not necessary that the same operating or file system is used by both computers. For example, a file transfer between DOS/WINDOWS and UNIX is possible. One of the two partners must be configured as Host and the other one as Client. However, they may change their roles. Usually, the system which is able to perform several processes at the same time will play the host role. The file transfer program usually used under TCP/IP is FTP (File Transfer Protocol). An FTP host is installed as standard on the majority of UNIX systems.

If the TCP/IP services are installed, a terminal connection is possible using *Start - Programs - Accessories - Telnet* or a data transfer via FTP by means of *Start - Run ftp - OK*. Thus all computer systems supporting these universal protocols can be addressed (UNIX, Vetc).

For further information, refer to the corresponding XP literature.

File Transfer via FTP

The total scope of functions and commands is described in the FTP literature. The following table therefore only contains the major functions:

Setting up the connection

➢ Click *Start* and then *Run* in the task bar.

➢ The DOS command `FTP` starts the program.

➢ The command `OPEN <xx.xx.xx.xx>` sets up the connection. (xx.xx.xx.xx = IP address e.g. 89.0.0.13)

Data transfer

- The command `PUT <file name>` transfers the data to the target system.

- The command `GET <file name>` transfers the data from the target system.

- The command `TYPE B` transfers the data in BINARY format; no conversion takes place.

- The command `TYPE A` transfers the data in ASCII format, converting control characters so that text files can also be read on the target system.

Examples

`PUT C:\AUTOEXEC.BAT`

    sends the file `AUTOEXEC.BAT` to the target system.

`LCD DATA`

    changes the current directory on the local machine to subdirectory `DATA`

`CD SETTING`

    changes to the subdirectory `SETTING` on the target system

file name = file name e.g. DATA.TXT

Changing the directories

- The command `LCD <path>` changes the directory on the local machine as with DOS.

- The command `LDIR` shows the directory contents on the local machine.

These commands refer to the file system of the ESU. If the "L" is omitted ahead of the commands, they apply to the target system.

RSIB Protocol

The instrument is equipped with an RSIB protocol as standard, which allows the instrument to be controlled by means of Visual C++ and Visual Basic programs, but also by means of the Windows applications WinWord and Excel as well as National Instruments LabView, LabWindows/CVI and Agilent VEE. The control applications run on an external computer in the network.

A UNIX operating system can be installed on an external computer in addition to a Windows operating system. In this case, the control applications are created either in C or C++. The supported UNIX operating systems include:

•   Sun Solaris 2.6 Sparc Station

•   Sun Solaris 2.6 Intel Platform

•   Red Hat Linux 6.2 x86 Processors

Remote Control via RSIB Protocol

Windows Environment

To access the measuring instruments via the RSIB protocol, the file `RSIB32.DLL` must be copied to the Windows `system32` directory or to the directory of the control applications. For 16-bit applications, the file `RSIB.DLL` must be additionally copied to the directories mentioned. The files RSIB.DLL and RSIB32.DLL are included on the instrument in directory D:\R_S\Instr\RSIB.

For the different programming languages, there are files available that contain the declarations of the DLL functions and the definition of the error codes.

Visual Basic (16 bit):	`'RSIB.BAS'`	`(D:\R_S\Instr\RSIB)`
Visual Basic (32 bit):	`'RSIB32.BAS'`	`(D:\R_S\Instr\RSIB)`
C:/C++:	`'RSIB.H'`	`(D:\R_S\Instr\RSIB)`

For C/C++: programs, import libraries are additionally available.

Import library for RSIB.DLL:	`RSIB.LIB'`	`(D:\R_S\Instr\RSIB)`
Import library for RSIB32.DLL:	`RSIB32.LIB'`	`(D:\R_S\Instr\RSIB)`

The control is performed using the Visual C++ or Visual Basic programs WinWord, Excel, LabView, LabWindows/CVI or Agilent VEE. Every application that can load a DLL is able to use the RSIB protocol. The programs use the IP address of the instrument or its *host name* to set up the connection.

Via VisualBasic:

    ud = RSDLLibfind ("82.1.1.200", ibsta, iberr, ibcntl)

Return to manual operation is possible via the front panel (*LOCAL* key) or via the RSIB protocol:

Via RSIB:

    ud = RSDLLibloc (ud, ibsta, iberr, ibcntl)*;*

    or

    ud = RSDLLibonl (ud, 0, ibsta, iberr, ibcntl)*;*

UNIX Environment

To access the measuring equipment via the RSIB interface, copy the `librsib.so.X.Y` file to a directory for which the control application has read rights. `X.Y` in the file name indicates the version number of the library, for example `1.0`.

The `librsib.so.X.Y` library is created as a *shared library*. The applications using the library need not consider its version. They simply link the library with the `lrsib` option. The following instructions have to be observed so that linking can be successfully performed and the library can be found during program execution:

File link:

- Use the operating system command *ln* to create a file with the link name `librsib.so` and pointing to `librsib.so.X.Y` in a directory for which the control application has read rights. Example:

    `$ ln –s /usr/lib/librsib.so.1.0 /usr/lib/librsib.so`

Linker options for creating applications:

- `-lrsib` : import library

- `-Lxxx` : path information where the import library can be found. This is where the above file link has been created. Example: `-L/usr/lib`.

Additional linker options for creating applications (only under Solaris):

- `-Rxxx`: path information where the library is searched for during the program run: `-R/usr/lib`.

Run-time environment:

- Set environment variable `LD_RUN_PATH` to the directory in which the file link has been created. This is necessary only if `librsib.so` cannot be found in the default search path of the operating system and the `-R` linker option (only Solaris) was not specified.

For C/C++ programming, the declarations of the library functions and the definition of error codes are contained in:

C/C++:   'RSIB.H'   (D:\R_S\Instr\RSIB)

RSIB Interface Functions

This section lists all functions of the DLL `"RSIB.DLL" or "RSIB32.DLL"` or `"librsib.so"`, which allow control applications to be produced.

Overview of Interface Functions

The library functions are adapted to the interface functions of National Instruments for GPIB programming. The functions supported by the libraries are listed in the following table.

Function	Description
RSDLLibfind()	Provides a handle for access to a device.
RSDLLibwrt()	Sends a zero-terminated string to a device.
RSDLLilwrt()	Sends a certain number of bytes to a device.
RSDLLibwrtf()	Sends the contents of a file to a device.
RSDLLibrd()	Reads data from a device into a string.
RSDLLilrd()	Reads a certain number of bytes from a device.
RSDLLibrdf()	Reads data from a device into a file.
RSDLLibtmo()	Sets time-out for RSIB functions.
RSDLLibsre()	Switches a device to the local or remote state.
RSDLLibloc()	Temporarily switches a device to the local state.
RSDLLibeot()	Enables/disables the END message for write operations.
RSDLLibrsp()	Performs a serial poll and provides the status byte.
RSDLLibonl()	Sets the device online/offline.
RSDLLTestSRQ()	Checks whether a device has generated an SRQ.
RSDLLWaitSrq()	Waits until a device generates an SRQ.
RSDLLSwapBytes	Swaps the byte sequence for binary numeric display (only required for non-Intel platforms).

Variables ibsta, iberr, ibcntl

As with the National Instrument interface, the successful execution of a command can be checked by means of the variables `ibsta`, `iberr` and `ibcntl`. For this purpose, all RSIB functions are assigned references to these three variables.

Status word - ibsta

The status word ibsta provides information on the status of the RSIB interface. The following bits are defined:

Bit designation	Bit	Hex code	Description
ERR	15	8000	Is set when an error has occurred on calling a function. If this bit is set, `iberr` contains an error code that specifies the error in greater detail.
TIMO	14	4000	Is set when a time-out has occurred on calling a function.
CMPL	8	0100	Is set if the response of the GPIB parser has been read out completely. If a parser response is read out with the function `RSDLLilrd()` and the length of the buffer is insufficient for the answer, the bit will be cleared.

Error variable - iberr

If the ERR bit (8000h) is set in the status word, `iberr` contains an error code which allows the error to be specified in greater detail. Extra error codes are defined for the RSIB protocol, independent of the National Instruments interface.

Error	Error code	Description
IBERR_CONNECT	2	Setup of the connection to the measuring instrument has failed.
IBERR_NO_DEVICE	3	A function of the interface has been called with an illegal device handle.
IBERR_MEM	4	No empty memory available.
IBERR_TIMEOUT	5	Time-out has occurred.
IBERR_BUSY	6	The RSIB protocol is blocked by a function that is still running.
IBERR_FILE	7	Error when reading or writing to a file.
IBERR_SEMA	8	Error upon creating or assigning a semaphore (only under UNIX).

Count variable - ibcntl

The variable `ibcntl` is updated with the number of transferred bytes each time a read or write function is called.

Description of Interface Functions

RSDLLibfind()

The function provides a handle for access to the device with the name `udName`.

VB format: `Function RSDLLibfind (ByVal udName$, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short WINAPI RSDLLibfind( char far *udName, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

C format (UNIX): `short RSDLLibfind( char *udName, short *ibsta, short *iberr, unsigned long *ibcntl)`

Parameters: `udName`   IP address of device

Example: `ud = RSDLLibfind ("89.10.38.97", ibsta, iberr, ibcntl)`

The function must be called prior to all other functions of the interface.

As return value, the function provides a handle that must be indicated in all functions for access to the device. If the device with the name `udName` is not found, the handle has a negative value.

RSDLLibwrt

This function sends data to the device with the handle `ud`.

VB format: `Function RSDLLibwrt (ByVal ud%, ByVal Wrt$, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short WINAPI RSDLLibwrt( short ud, char far *Wrt, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`

C format (UNIX): `short RSDLLibwrt( short ud, char *Wrt, short *ibsta, short *iberr, unsigned long *ibcntl )`

Parameters: `ud`   Device handle

`Wrt`   String sent to the device.

Example: `RSDLLibwrt(ud, "SENS:FREQ:STAR?", ibsta, iberr, ibcntl)`

This function allows setting and query commands to be sent to the measuring instruments. Whether the data is interpreted as a complete command can be set using the function `RSDLLibeot()`.

RSDLLilwrt

This function sends `Cnt` bytes to a device with the handle `ud`.

VB format:	`Function RSDLLilwrt (ByVal ud%, ByVal Wrt$, ByVal Cnt&, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`short WINAPI RSDLLilwrt( short ud, char far *Wrt, unsigned long Cnt, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format (UNIX):	`short RSDLLilwrt( short ud, char *Wrt, unsigned long Cnt, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameters:	`ud` Device handle
	`Wrt` String sent to the GPIB parser.
	`Cnt` Number of bytes sent to the device.
Example:	`RSDLLilwrt (ud, '......', 100, ibsta, iberr, ibcntl)`

Like `RSDLLibwrt()` this function sends data to a device. The only difference is that binary data can be sent as well. The length of the data is not determined by a zero-terminated string, but by the indication of `Cnt` bytes. If the data is to be terminated with EOS (0Ah), the EOS byte must be appended to the string.

RSDLLibwrtf

This function sends the contents of a file `file$` to the device with the handle `ud`.

VB format:	`Function RSDLLibwrtf (ByVal ud%, ByVal file$, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`short WINAPI RSDLLibwrt( short ud, char far *Wrt, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`
C format (UNIX):	`short RSDLLibwrt( short ud, char *Wrt, short *ibsta, short *iberr, unsigned long *ibcntl )`
Parameters:	`ud` Device handle
	`file` File whose contents is sent to the device.
Example:	`RSDLLibwrtf(ud, "C:\db.sav", ibsta, iberr, ibcntl)`

This function allows setting and query commands to be sent to the measuring instruments. Whether the data is interpreted as a complete command can be set using the function `RSDLLibeot()`.

RSDLLibrd()

The function reads data from the device with the handle `ud` into the string `Rd`.

VB format:	`Function RSDLLibrd (ByVal ud%, ByVal Rd$,` `ibsta%, iberr%, ibcntl&) As Integer`

C format:	`short WINAPI RSDLLibrd( short ud, char far`
	`*Rd, short far *ibsta, short far *iberr,`
	`unsigned long far *ibcntl )`

C format (UNIX):	`short RSDLLibrd( short ud, char *Rd, short`
	`*ibsta, short *iberr, unsigned long *ibcntl`
	`)`

Parameters:	`ud` Device handle
	`Rd` String to which the read data is copied.
Example:	`RSDLLibrd (ud, Rd, ibsta, iberr, ibcntl)`

This function fetches the responses of the GPIB parser to a query.

In the case of Visual Basic programming, a string of sufficient length must be generated beforehand. This can be done during the definition of the string or using the command `Space$()`.

Generation of a string of the length 100:

— `Dim Rd as String * 100`

— `Dim Rd as String`
  `Rd = Space$(100)`

RSDLLilrd

This function reads `Cnt` bytes from the device with the handle `ud`.

VB format:	`Function RSDLLilrd (ByVal ud%, ByVal Rd$,`
	`ByVal Cnt&, ibsta%, iberr%, ibcntl&) As`
	`Integer`

C format:	`short WINAPI RSDLLilrd( short ud, char far`
	`*Rd, unsigned long Cnt, short far *ibsta,`
	`short far *iberr, unsigned long far *ibcntl`
	`)`

C format (UNIX):	`short RSDLLilrd( short ud, char *Rd,`
	`unsigned long Cnt, short *ibsta, short`
	`*iberr, unsigned long *ibcntl )`

Parameters:	`ud` Device handle
	`cnt` Maximum number of bytes copied from the DLL into the target string `Rd`.
Example:	`RSDLLilrd (ud, RD, 100, ibsta, iberr,` `ibcntl)`

Like the function `RSDLLibrd()`, this function reads data from a device. The only difference is that in this case the maximum number of bytes to be copied to the target string `Rd` can be indicated by means of `Cnt`. This function prevents writing beyond the end of the string.

RSDLLibrdf()

Reads data from the device with the handle `ud` into the file `file`.

VB format:	`Function RSDLLibrdf (ByVal ud%, ByVal file$, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`short WINAPI RSDLLibrd( short ud, char far *file, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`
C format (UNIX):	`short RSDLLibrd( short ud, char *file, short *ibsta, short *iberr, unsigned long *ibcntl )`
Parameters:	`ud` Device handle
	`file` File to which the read data is written.
Example:	`RSDLLibrdf (ud, "c:\db.sav", ibsta, iberr, ibcntl)`

The file name may as well include a drive or path specification.

RSDLLibtmo

This function defines the time-out for a device. The default value for the time-out is set to 5 seconds.

VB format:	`Function RSDLLibtmo (ByVal ud%, ByVal tmo%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLibtmo( short ud, short tmo, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`
C format (UNIX):	`short RSDLLibtmo( short ud, short tmo, short *ibsta, short *iberr, unsigned long *ibcntl )`
Parameters:	`ud` Device handle
	`tmo` Time-out in seconds
Example:	`RSDLLibtmo (ud, 10, ibsta, iberr, ibcntl)`

RSDLLibsre

This function sets the device to the 'LOCAL' or 'REMOTE' state.

VB format:	`Function RSDLLibsre (ByVal ud%, ByVal v%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLibsre( short ud, short v, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format (UNIX):	`short RSDLLibsre( short ud, short v, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameters:	`ud` Device handle
	`v` State of device 0 - local 1 - remote
Example:	`RSDLLibsre (ud, 0, ibsta, iberr, ibcntl)`

RSDLLibloc

This function temporarily switches the device to the 'LOCAL' state.

VB format:	`Function RSDLLibloc (ByVal ud%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLibloc( short ud, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format (UNIX):	`short RSDLLibloc( short ud, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameter:	`ud` Device handle
Example:	`RSDLLibloc (ud, ibsta, iberr, ibcntl)`

After switch over to LOCAL state, the instrument can be manually operated via the front panel. On the next access to the instrument by means of one of the functions of the library, the instrument is switched again to the REMOTE state.

RSDLLibeot

This function enables or disables the END message after write operations.

VB format:	`Function RSDLLibeot (ByVal ud%, ByVal v%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLibsre( short ud, short v, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format (UNIX):	`short RSDLLibsre( short ud, short v, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameters:	ud Device handle
	v 0 - no END message 1 – send END message
Example:	`RSDLLibeot (ud, 1, ibsta, iberr, ibcntl)`

If the END message is disabled, the data of a command can be sent with several successive calls of write functions. The END message must be enabled again before sending the last data block.

RSDLLibrsp

This function performs a serial poll and provides the status byte of the device.

VB format:	`Function RSDLLibrsp(ByVal ud%, spr%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLibrsp( short ud, char far* spr, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format (UNIX):	`short RSDLLibrsp( short ud, char *spr, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameters:	ud Device handle
	spr Pointer to status byte
Example:	`RSDLLibrsp(ud, spr, ibsta, iberr, ibcntl)`

RSDLLibonl

This function switches the device to 'online' or 'offline' mode. When it is switched to 'offline' mode, the interface is released and the device handle becomes invalid. By calling RSDLLibfind again, the communication is set up again.

VB format:	`Function RSDLLibonl (ByVal ud%, ByVal v%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLibonl( short ud, short v, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format:	`short RSDLLibonl( short ud, short v, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameters:	`ud` Device handle
	`v` Device state 0 - local 1 - remote
Example:	`RSDLLibonl(ud, 0, ibsta, iberr, ibcntl)`

RSDLLTestSRQ

This function checks the status of the SRQ bit.

VB format:	`Function RSDLLTestSrq (ByVal ud%, Result%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLTestSrq( short ud, short far *result, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format (UNIX):	`short RSDLLTestSrq( short ud, short *result, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameters:	`ud` Device handle
	`result` Reference to an integer value in which the library returns the status of the SRQ bit 0 - no SRQ 1 - SRQ active, device requests service
Example:	`RSDLLTestSrq (ud, result%, ibsta, iberr, ibcntl)`

This function corresponds to the function `RSDLLWaitSrq`. The only difference is that `RSDLLTestSRQ` immediately returns the current status of the SRQ bit, whereas `RSDLLWaitSrq` waits for an SRQ to occur.

RSDLLWaitSrq

This function waits until the device triggers an SRQ with the handle `ud`.

VB format:	`Function RSDLLWaitSrq (ByVal ud%, Result%, ibsta%, iberr%, ibcntl&) As Integer`
C format:	`void WINAPI RSDLLWaitSrq( short ud, short far *result, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`
C format (UNIX):	`short RSDLLWaitSrq( short ud, short *result, short *ibsta, short *iberr, unsigned long *ibcntl)`
Parameters:	`ud` Device handle
	`result` Reference to an integer value in which the library returns the status of the SRQ bit 0 - No SRQ occurred during the time-out 1 - SRQ occurred during the time-out
Example:	`RSDLLWaitSrq( ud, result, ibsta, iberr, ibcntl );`

The function waits until one of the following two events occurs.

- The measuring instrument triggers an SRQ.

- No SRQ occurs during the time-out defined with `RSDLLibtmo()`.

RSDLLSwapBytes

This function changes the display of binary numbers on non-Intel platforms.

VB format:	`Not provided at present since it is required only on non-Intel platforms.`
C format:	`void WINAPI RSDLLSwapBytes( void far *pArray, const long size, const long count)`
C format (UNIX):	`void RSDLLSwapBytes( void *pArray, const long size, const long count)`
Parameters:	`pArray` Array in which modifications are made
	`size` Size of a single element in `pArray`
	`count` Number of elements in `pArray`
Example:	`RSDLLSwapBytes( Buffer, sizeof(float), ibcntl/sizeof(float))`

This function swaps the display of various elements from *Big Endian* to *Little Endian* and vice versa. It is expected that a coherent storage area of elements of the same file type (`size` byte) is transferred to `pArray`. This function has no effect on Intel platforms.

Different types of processor architecture store data in different byte sequences. For example, Intel processors store data in the reverse order of Motorola processors. Comparison of byte sequences:

Byte sequence	Use in	Display in memory	Description
Big Endian	Motorola processors, network standard	Most significant byte at least significant address	The *most significant* byte is at the left end of the word.
Little Endian	Intel processors	Least significant byte at least significant address	The *most significant* byte is at the right end of the word.

Programming via the RSIB Protocol

Visual Basic

Programming tips

Access to the functions of the RSIB.DLL

To create Visual Basic control applications, the file RSIB.BAS must be added to a project for 16-bit Basic programs and the file RSIB32.BAS for 32-bit Basic programs (D:\R_S\INSTR\RSIB) so that the functions of the RSIB.DLL or RSIB32.DLL can be accessed.

Generating a response buffer

Prior to calling the functions `RSDLLibrd()` and `RSDLLilrd()`, a string of sufficient length must be generated. This is possible either by defining the string or using the command `Space$()`.

Generating a string of the length 100:

— `Dim Response as String * 100`

— `Dim Response as String`
  `Response = Space$(100)`

If a response is to be output as a string from the measuring instrument, the appended blanks can be removed using the Visual Basic Function RTrim().

Example:

```
Response = Space$(100)
Call RSDLLibrd(ud, Response, ibsta, iberr, ibcntl)
Response = RTrim(Response)
' Output of Response
```

Reading out trace data in real format

Using the function declarations in the file RSIB.BAS or RSIB32.BAS the responses of the device can be assigned to one string only. If the data are to be read into an array with float values, the header and the useful data must be read out with separate function calls.

Example of a header

$$\# \quad 4 \quad 2004$$

Prefix for binary data

Number of digits of the following length indication

Length of data, e.g. 501 pixels 4 bytes/pixel
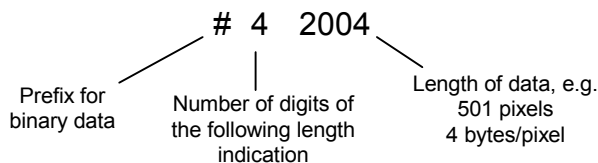
In order to enable the trace data to be directly read into a float array, a special function declaration must be created.

```
Declare Function RSDLLilrdTraceReal Lib "rsib32.dll" Alias
"RSDLLilrd" (ByVal ud%, Rd As Single, ByVal Cnt&, ibsta%,
iberr%, ibcntl&) As Integer
```

Example

```
Dim ibsta As Integer            ' Status variable
Dim iberr As Integer            ' Error variable
Dim ibcntl As Long              ' Count variable
Dim ud As Integer               ' Handle for measuring instrument
Dim Result As String            ' Buffer for simple results
Dim Digits As Byte              ' Number of digits of length indication
Dim TraceBytes As Long          ' Length of trace data in bytes
Dim TraceData(501) As Single    ' Buffer for floating point Binary data


' Set up connection to instrument
ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)


' Query trace data in real format
Call RSDLLibwrt(ud, "FORM:DATA REAL,32", ibsta, iberr, ibcntl)
Call RSDLLibwrt(ud, "TRACE? TRACE1", ibsta, iberr, ibcntl)


' Read number of digits of length indication
Result = Space$(20)
Call RSDLLilrd(ud, Result, 2, ibsta, iberr, ibcntl)
Digits = Val(Mid$(Result, 2, 1))


' Read length indication
Result = Space$(20)
Call RSDLLilrd(ud, Result, Digits, ibsta, iberr, ibcntl)
TraceBytes = Val(Left$(Result, Digits))     'and store


' Read out trace data
Call RSDLLilrdTraceReal(ud, TraceData(0), TraceBytes, ibsta, iberr,ibcntl)
```

Programming examples

In this example, the start frequency of the instrument is queried.

```
Dim ibsta As Integer    ' Status variable
Dim iberr As Integer    ' Error variable
Dim ibcntl As Long      ' Count variable
Dim ud As Integer       ' Handle for measuring instrument
Dim Response As String  ' Response string

' Set up connection to measuring instrument
ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)
If (ud < 0) Then
   ' Error treatment
End If

' Send query command
Call RSDLLibwrt(ud, "FREQ:START?", ibsta, iberr, ibcntl)

' Provide space for response
Response = Space$(100)

' Read response from measuring instrument
Call RSDLLibrd(ud, Response, ibsta, iberr, ibcntl)
```

In this example, a Save/Recall of the instrument setups is performed.

```
Dim ibsta As Integer    ' Status variable
Dim iberr As Integer    ' Error variable
Dim ibcntl As Long      ' Count variable
Dim ud As Integer       ' Handle for measuring instrument
Dim Cmd As String       ' Command string

' Set up connection to measuring instrument
ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)
If (ud < 0) Then
   ' Error treatment
End If

' Request instrument settings
Cmd = "SYST:SET?"
Call RSDLLibwrt(ud, Cmd, ibsta, iberr, ibcntl)

' Store instrument response in file
Call RSDLLibrdf(ud, "C:\db.sav", ibsta, iberr, ibcntl)

' Reset instrument
Call RSDLLibwrt(ud, "*RST", ibsta, iberr, ibcntl)
```

```
                        ' and restore the previous settings
                        ' to this end disable the END message
                        Call RSDLLibeot(ud, 0, ibsta, iberr, ibcntl)
                        ' first send off command
                        Call RSDLLibwrt(ud, "SYST:SET ", ibsta, iberr, ibcntl)
                        ' enable the END message again
                        Call RSDLLibeot(ud, 1, ibsta, iberr, ibcntl)
                        ' and send the data
                        Call RSDLLibwrtf(ud, "C:\db.sav", ibsta, iberr, ibcntl)
```

Visual Basic for Applications (Winword and Excel)

Programming tips

The programming language Visual Basic for Applications (VBA) is supported as a macro language by various manufacturers. The programs Winword and Excel use this language for the versions Winword 97 or Excel 5.0 and higher.

For macros created with Visual Basic for Applications, the same tips are valid as for Visual Basic Applications.

Programming example

Using the macro `QueryMaxPeak`, a single sweep with subsequent query of the maximum peak is performed. The result is entered in a Winword or Excel document.

```
Sub QueryMaxPeak()

    Dim ibsta As Integer    ' Status variable
    Dim iberr As Integer    ' Error variable
    Dim ibcntl As Long      ' transferred characters
    Dim ud As Integer       ' Unit Descriptor (handle)for instrument
    Dim Response As String  ' Response string

    ' Set up connection to measuring instrument
    ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)
    If (ud < 0) Then
        Call MsgBox("Device with address 89.10.38.97 could" & _
                "not be found", vbExclamation)
        End
    End If

    ' Determine maximum peak in the range 1-2MHZ
    Call RSDLLibwrt(ud, "*RST", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "INST:SEL SAN", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "INIT:CONT OFF", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "FREQ:START 1MHZ", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "FREQ:STOP 2MHZ", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "INIT:IMM;*WAI", ibsta, iberr, ibcntl)
```

```
    Call RSDLLibwrt(ud, "CALC:MARK:MAX;Y?", ibsta, iberr, ibcntl)
    Response = Space$(100)
    Call RSDLLibrd(ud, Response, ibsta, iberr, ibcntl)
    Response = RTrim(Response) ' Cut off space

    ' Insert value in current document (Winword)
    Selection.InsertBefore (Response)
    Selection.Collapse (wdCollapseEnd)

    ' Terminate connection to measuring instrument
    Call RSDLLibonl(ud, 0, ibsta, iberr, ibcntl)

End Sub
```

The entry of the peak value in the Winword document can be replaced as follows for Excel:

```
' Insert value in current document (Excel)
ActiveCell.FormulaR1C1 = Response
```

C / C++

Programming tips

Access to the functions of the RSIB32.DLL (Windows platforms)

The functions of the `RSIB32.DLL` are declared in the header file `RSIB.H`. The DLL functions can be linked to a C/C++ program in different ways.

- Enter one of the supplied import libraries (`RSIB.LIB` or `RSIB32.LIB`) into the linker options.

- Load the library using the function `LoadLibrary()` during runtime and determine the function pointers of the DLL functions using `GetProcAddress()`. Before the end of the program, the `RSIB.DLL` must be unloaded again using the function `FreeLibrary()`.

When import libraries are used, the DLL is automatically loaded immediately before the application is started. At the end of the program, the DLL is unloaded again unless it is still used by other applications.

Access to librsib.so functions (UNIX platforms)

The functions of `librsib.so` are declared in the header file `RSIB.H`. Uppercase/lowercase characters for file names are typically observed under UNIX. The library functions are linked to a C/C++ program by entering the `-lrsib` linker option.

The *shared library* `librsib.so` is automatically loaded on starting the application. The accessibility (for example via standard path) of the library must be ensured. Refer to section "UNIX Environment" on page 4.438.

Query of strings

If instrument responses are to be further processed as strings, a zero termination must be appended.

Example

```
char buffer[100];
...
RSDLLibrd( ud, buffer, &ibsta, &iberr, &ibcntl );
buffer[ibcntl] = 0;
```

Programming example

In the following C program example, a single sweep is started on the device with the IP address 89.10.38.97 and subsequently a marker is set to maximum level. Prior to the search for maximum, a synchronization to the end of the sweep is performed. For this purpose the command `"*OPC"` (Operation complete) is used to create a service request at the end of the sweep, for which the control program waits with the function `RSDLLWaitSrq()`. Then the maximum is determined (`"CALC:MARK:MAX"`) and the level read out (`"Y?"`).

```
#define MAX_RESP_LEN 100

short           ibsta, iberr;
unsigned long   ibcntl;
short           ud;
short           srq;
char            MaxPegel[MAX_RESP_LEN];
char            spr;

// Determine handle for instrument
ud = RSDLLibfind( "89.10.38.97", &ibsta, &iberr, &ibcntl );

// if instrument exists
if ( ud >= 0 )
{
  // Set timeout for RSDLLWaitSrq() to 10 seconds
  RSDLLibtmo( ud, 10, &ibsta, &iberr, &ibcntl );

  // Activate SRQ generation via event status register (ESR)
  // and enable ESB bit in SRE register
  RSDLLibwrt( ud, "*ESE 1;*SRE 32", &ibsta, &iberr, &ibcntl );

  // Set single sweep, trigger sweep and use "*OPC" to cause
  // the generation of a service request at the end of the sweep
  RSDLLibwrt( ud, "INIT:CONT off;INIT;*OPC", &ibsta, &iberr, &ibcntl );

  // Wait for SRQ (end of sweep)
  RSDLLWaitSrq( ud, &srq, &ibsta, &iberr, &ibcntl );
```

```
  // Clear RQS/MSS bit
  RSDLLibrsp( ud, &spr, &ibsta, &iberr, &ibcntl );

  // if sweep is terminated
  if (srq)
  {
    // then set marker to first maximum and query the level
    RSDLLibwrt( ud, "CALC:MARK:MAX;Y?", &ibsta, &iberr, &ibcntl );
    RSDLLilrd( ud, MaxPegel, MAX_RESP_LEN, &ibsta, &iberr, &ibcntl );
    MaxPegel[ibcntl] = 0;
  }
  // End connection to instrument
  RSDLLibonl (ud, 0, &ibsta, &iberr, &ibcntl ) ;
}
else
{
  ; // Error Instrument not found
}
```

User Port

The user port is located at the rear panel of the ESU. For information on the mechanical design and the electrical characteristics refer to the Quick Start Guide, chapter "Front and Rear Panel":

An essential performance criterion to be met by automatic test systems is to minimize the time overhead of the entire test relative to the net measurement time. A typical test comprises the following steps:

1. Setting of analyzer (frequency, level, bandwidth, measurement time, trigger source)

2. Setting of device under test (DUT) and activation of its output signal

3. Start of measurement on analyzer; analyzer waits for trigger signal

4. Generation of trigger signal; test system waits for ready signal from analyzer

5. Reading of measured data

After the start of a measurement, hardware settling times are allowed for the R&S ESU before data acquisition is started. Trigger signals received by the R&S ESU during the settling time will, therefore, be ignored.

This behavior is not critical in most cases, as long as the trigger signal is periodic and the test signal is stationary.
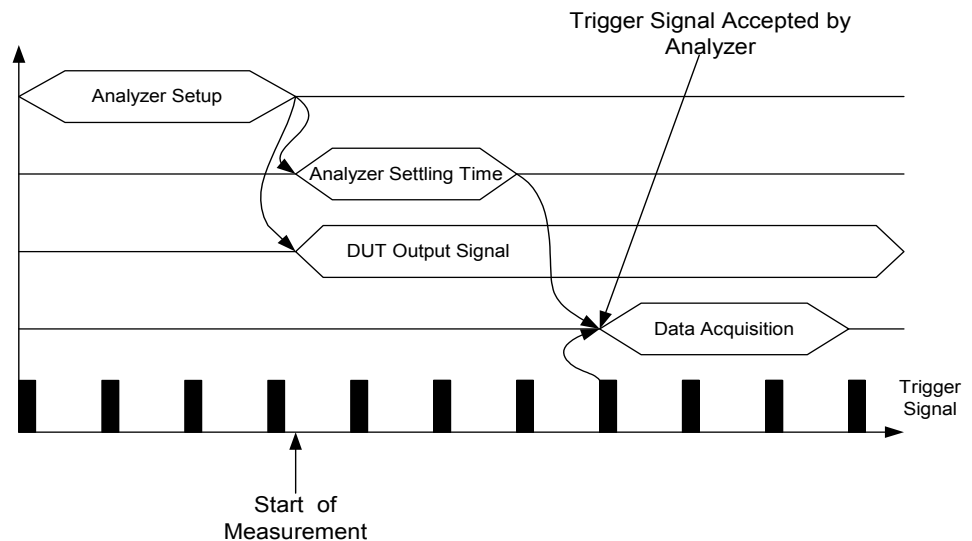
Fig. 4-36   Test with stationary test signal and periodic trigger signal

In the above case, the analyzer will respond to the first trigger signal received after the settling time.

The situation is quite different, however, if data acquisition is to be started by a single trigger event. In such a case it is mandatory that settling times on the analyzer have elapsed before the trigger signal is sent. Otherwise, the trigger signal will not be identified as a request for data acquisition, and the subsequent query of measured data will result in a time-out on the controller:
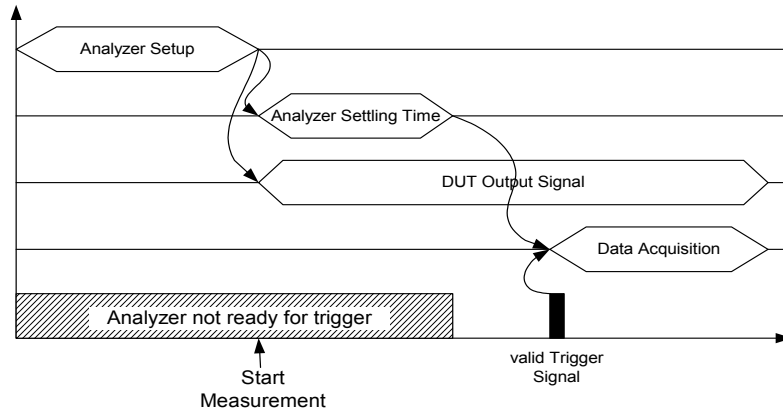
Fig. 4-37   Test with single trigger pulse

A particularly difficult aspect of this problem is the variable settling times of the analyzer, which are unavoidable in practice. If there is no signal to indicate that the analyzer is ready to collect measured data, the maximum settling time will have to be allowed for until the trigger signal is sent, thus ensuring reliable measurements. This results in considerable – and in many cases unacceptable – time overhead, depending on the instrument settings.

To minimize this overhead, the port supplies a signal that indicates the analyzer's readiness to collect measured data. The signal is reset on detection of the next trigger signal. In this way, a handshake is established between the analyzer and the DUT and between the analyzer and the controller, which ensures reliable measurements and reduces the time overhead to the settling time actually needed by the analyzer:

Fig. 4-38   Test with ready-for-trigger signal

5   Remote Control – Basics

Overview

In this chapter you'll find:

- instructions on how to put the R&S ESU into operation via remote control,

- a general introduction to remote control of programmable instruments. This includes the description of the command structure and syntax according to the SCPI standard, the description of command execution and of the status registers,

- diagrams and tables describing the status registers used in the R&S ESU.

In chapter "Remote Control – Description of Commands", all remote control functions are described in detail. The subsystems are listed by alphabetical order according to SCPI. All commands and their parameters are listed by alphabetical order in the command list at the end of the chapter.

Program examples for the R&S ESU can be found in chapter "Remote Control – Programming Examples".

The remote control interfaces and their interface functions are described in chapter "Maintenance and Instrument Interfaces".

Introduction

The instrument is equipped with an IEC-bus interface according to standard IEC 625.1/IEEE 488.2 and a RS-232 interface. The connectors are lo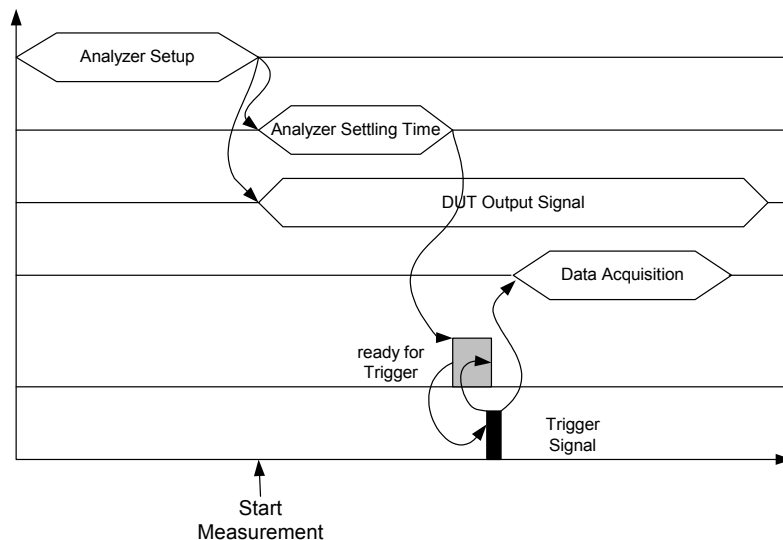cated at the rear of the instrument and permit to connect a controller for remote control. In addition, the instrument can be remotely controlled in a local area network (LAN interface).

The instrument supports the SCPI version 1997.0 (Standard Commands for Programmable Instruments). The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers (see section "SCPI Introduction" on page 5.11).

The tutorial "Automatic Measurement Control – A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI. For remote control in a network, refer to section "Remote Control in a Network (RSIB Interface)" on page 5.9.

This section assumes basic knowledge of IEC/IEEE bus programming and operation of the controller. A description of the interface commands can be obtained from the relevant manuals.

The requirements of the SCPI standard placed on command syntax, error handling and configuration of the status registers are explained in detail in the following sections. Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

The program examples for IEC-bus programming are all written in VISUAL BASIC.

Getting Started

The short and simple operating sequence provided below enables you to quickly put the instrument into operation and set its basic functions. As a prerequisite, the IEC/IEEE bus address, which is factory-set to 20, must remain unchanged.

1. Connect instrument and controller using IEC/IEEE bus cable.

2. Write and start the following program on the controller:

   ```
   CALL IBFIND("DEV1", analyzer%)
   ```
   'Open port to the instrument

   ```
   CALL IBPAD(analyzer%, 20)
   ```
   'Inform controller about instrument address

   ```
   CALL IBWRT(analyzer%, '*RST;*CLS')
   ```
   'Reset instrument

   ```
   CALL IBWRT(analyzer%, 'FREQ:CENT 20MHz')
   ```
   'Set center frequency to 20 MHz

   ```
   CALL IBWRT(analyzer%, 'BAND 9 kHz')
   ```
   'Set resolution bandwidth to 9 kHz

   ```
   CALL IBWRT(analyzer%, 'DET:REC POS')
   ```
   'Switch on peak detector

   The instrument now measures at 20 MHz with 9 kHz RBW the peak level.

3. To return to manual control, press the *LOCAL* key on the front panel.

Starting Remote Control Operation

On power-on, the instrument is always in the manual operating state ("LOCAL" state) and can be operated via the front panel.

It is switched to remote control ("REMOTE" state)

IEC/IEEE-bus   as soon as it receives an addressed command from a controller.

                      if it is controlled in a network (RSIB interface), as soon as it receives a command from a controller.

RS-232   as soon as it receives the command "@REM" from a controller.

During remote control, operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via the front panel or via remote control interfaces. Switching from manual operation to remote control and vice versa does not affect the remaining instrument settings.

Display Contents during Remote Control

During remote control, only the LOCAL softkey appears, with which it is possible to return to manual operation.

In addition, the display of diagrams and results can be blanked out with the command "SYSTem: DISPlay:UPDate OFF" (default in remote control) to obtain optimum performance during remote control operation.

During program execution it is recommended to activate the display of results by means of "SYSTem: DISPlay:UPDate ON" so that it is possible to follow the changes in the device settings and the recorded measurement curves on the screen.

Note

If the instrument is exclusively operated in remote control, it is recommended to switch on the power-save mode (*POWER SAVE*). In this mode, the required display is completely switched off after a preset time.

Remote Control via IEC/IEEE Bus

Setting the Device Address

In order to operate the instrument via the IEC-bus, it must be addressed using the set IEC/IEEE bus address. The IEC/IEEE bus address of the instrument is factory-set to 20. It can be changed manually in the *SETUP - GENERAL SETUP* menu or via IEC bus. Addresses 0 to 30 are permissible.

Manually:

➢ Call *SETUP - GENERAL SETUP* menu

➢ Enter desired address in table *GPIB-ADDRESS*

➢ Terminate input using the *ENTER* key

Via IEC/IEEE bus:

```
CALL IBFIND("DEV1", analyzer%)
```
'Open port to the instrument

```
CALL IBPAD(analyzer%, 20)
```
'Inform controller about old address

```
CALL IBWRT(analyzer%, "SYST:COMM:GPIB:ADDR 18")
```
'Set instrument to new address

```
CALL IBPAD(analyzer%, 18)
```
'Inform controller about new address

Return to Manual Operation

Return to manual operation is possible via the front panel or the IEC/IEEE bus.

Manually:

➢ Press the *LOCAL* softkey or the *PRESET* key

Notes

- Before the transition, command processing must be completed as otherwise transition to remote control is performed immediately.

- The keys can be disabled by the universal command LLO (see chapter "Maintenance and Instrument Interfaces", section "Interface Messages" on page 8.5) in order to prevent unintentional transition. In this case, transition to manual mode is only possible via the IEC/IEEE bus.

- The keys can be enabled again by deactivating the REN line of the IEC/IEEE bus (see chapter "Maintenance and Instrument Interfaces", section "Bus Lines" on page 8.4).

Via IEC bus:

…

```
CALL IBLOC(analyzer%)
'Set instrument to manual operation
```

…

Remote Control via RS-232-Interface

Setting the Transmission Parameters

To enable an error-free and correct data transmission, the parameters of the unit and the controller should have the same setting.

Parameters can be manually changed in menu *SETUP-GENERAL SETUP* in table *COM PORT* or via remote control using the command `SYSTem:COMMunicate:SERial:...`.

The transmission parameters of the COM interface are factory-set to the following values:

   baudrate = 9600, data bits = 8, stop bits = 1, parity = NONE and owner = INSTRUMENT.

For remote control operation, the interface should be allocated to the operating system (owner = OS) so that the control characters including @ can be recognized by the interface.

Manually:

Setting the COM interface

➢ Call *SETUP-GENERAL SETUP* menu

➢ Select desired baudrate, bits, stopbit, parity in table *COM PORT.*

➢ Set owner to OS in table *COM PORT.*

➢ Terminate input using the *ENTER* key.

Return to Manual Operation

Return to manual operation is possible via the front panel or via RS-232 interface.

Manually:

➢ Press the *LOCAL* softkey or the *PRESET* key.

Notes

- Before the transition, command processing must be completed as otherwise transition to remote control is performed immediately
- The keys can be enabled again by sending the control string "@LOC" via RS-232 (see chapter "Maintenance and Instrument Interfaces", section "RS-232-C Interface (COM)" on page 8.8).

Via RS-232:

…

```
v24puts(port,"@LOC");
```
Set instrument to manual operation.

…

Restrictions

The following restrictions apply if the unit is remote-controlled via the RS-232-C interface:

No interface messages, only control strings (see interface description in chapter "Maintenance and Instrument Interfaces", section "RS-232-C Interface (COM)" on page 8.8).

Only the Common Commands *OPC? can be used for command synchronization, *WAI and *OPC are not available.

Block data cannot be transmitted.

Remote Control in a Network (RSIB Interface)

Setting the Device Address

For control of the instrument in a network, it must be accessed using the preselected IP address. The IP address of the instrument (device address) is defined in the network configuration.

Setting the IP address:

➢ Call *SETUP - GENERAL SETUP – CONFIGURE NETWORK* menu.

➢ Select *Protocols* tab.

➢ Under *Properties*, set IP address for TCP/IP protocol (for details refer to the Quick Start Guide, appendix LAN Interface).

Return to Manual Operation

Return to manual operation can be made manually via the front panel or remotely via the RSIB interface.

Manually:

➢ Press *LOCAL* softkey or *PRESET* key.

Note

Make sure that the execution of commands is completed prior to switch over since otherwise the instrument will switch back to remote control immediately.

Via RSIB interface:

…

```
CALL RSDLLibloc(analyzer%, ibsta%, iberr%, ibcntl&)
'Set device to manual control
```

…

Messages

The messages transferred via the data lines of the IEC bus (see chapter "Maintenance and Instrument Interfaces", section "IEC/IEEE Bus Interface" on page 8.3) can be divided into two groups:

– "IEC/IEEE-Bus Interface Messages"

– "Device Messages (Commands and Device Responses)"

IEC/IEEE-Bus Interface Messages

Interface messages are transferred on the data lines of the IEC bus, the "ATN" control line being active. They are used for communication between controller and instrument and can only be sent by a controller which has the IEC/IEEE bus control. Interface commands can be subdivided into

– **universal commands** and

– **addressed commands**.

Universal commands act on all devices connected to the IEC/IEEE bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in chapter "Maintenance and Instrument Interfaces", section "Interface Functions" on page 8.5.

Device Messages (Commands and Device Responses)

Device messages are transferred on the data lines of the IEC bus, the "ATN" control line not being active. ASCII code is used.

A distinction is made according to the direction in which they are sent on the IEC/IEEE bus:

– **Commands** are messages the controller sends to the instrument. They operate the device functions and request informations.

  The commands are subdivided according to two criteria:

  • According to the effect they have on the instrument:

    Setting commands cause instrument settings such as reset of the instrument or setting the center frequency.

    Queries cause data to be provided for output on the IEC/IEEE bus, e.g. for identification of the device or polling the marker.

  • According to their definition in standard IEEE 488.2:

    Common Commands are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standardized status registers, reset and selftest.

    Device-specific commands refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee (cf. section "SCPI Introduction" on page 5.11).

– **Device responses** are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. section "Responses to Queries" on page 5.15).

Structure and syntax of the device messages are described in the following section.

Structure and Syntax of the Device Messages

SCPI Introduction

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure.

Fig. 5-1 illustrates this tree structure using a section of command system SENSe, which controls the device-specific settings, that do not refer to the signal characteristics of the measurement signal.

SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see section "Responses to Queries" on page 5.15).

Structure of a Command

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Note

The commands used in the following examples are not in every case implemented in the instrument.

Common commands

Common commands consist of a header preceded by an asterisk "*" and one or several parameters, if any.

Examples:

`*RST`
RESET, resets the device

`*ESE 253`
EVENT STATUS ENABLE, sets the bits of the event status enable register

`*ESR?`
EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy:

Device-specific commands are of hierarchical structure (see Fig. 5-1). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example:

`SENSe`
This key word denotes the command system `SENSe`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example:

`SENSe:FREQuency:SPAN 10MHZ`
This command lies in the third level of the SENSe system. It sets the frequency span.
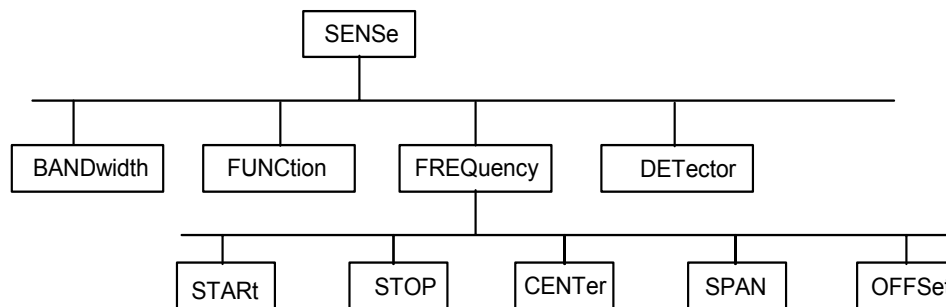
Fig. 5-1   Tree structure the SCPI command systems using the SENSe system by way of example

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, that is to say, at which position in the header of a command they are inserted.

Examples:

`SOURce:FM:POLarity NORMal`
This command contains key word POLarity in the third command level. It defines the polarity between modulator and modulation signal.

`SOURce:FM:EXTernal:POLarity NORMal`
This command contains key word POLarity in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

Optional key words

Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example:

`[SENSe]:BANDwidth[:RESolution]:AUTO`
This command couples the resolution bandwidth of the instrument to other parameters. The following command has the same effect:

`BANDwidth:AUTO`

Note

An optional key word must not be omitted if its effect is specified in detail by a numeric suffix.

Long and short form

The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permissible.

Example:

`STATus:QUEStionable:ENABle 1= STAT:QUES:ENAB 1`

Note

The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serve the above purpose, the instrument itself does not make any difference between upper-case and lower-case letters.

Parameter

The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to section "Parameters" on page 5.15.

Example:

`SENSe:FREQuency:STOP? MAXimum`
This query requests the maximal value for the stop frequency. Response: 3.5E9

Numeric suffix

If a device features several functions or features of the same kind, e.g. inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1.

Example:

`SYSTem:COMMunicate:SERial2:BAUD 9600`
This command sets the baudrate of a second serial interface.

Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. The IEC/IEEE driver of the controller usually produces automatically an EOI together with the last data byte.

Several commands in a command line are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

```
CALL IBWRT(analyzer%,"SENSe:FREQuency:CENTer 100MHz;:INPut:ATTenuation 10")
```
> This command line contains two commands. The first one is part of the SENSe command system and is used to determine the center frequency of the instrument. The second one is part of the INPut command system and sets the input signal attenuation.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. For that purpose, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 5-1). The colon following the semicolon must be omitted in this case.

Example:

```
CALL IBWRT(analyzer%, "SENSe:FREQuency:STARt 1E6;:SENSe:FREQuency:STOP 1E9")
```
> This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SENSe command system, subsystem FREQuency, i.e. they have two common levels.

> When abbreviating the command line, the second command begins with the level below `SENSe:FREQuency`. The colon after the semicolon is omitted.

> The abbreviated form of the command line reads as follows:

```
CALL IBWRT(analyzer%, "SENSe:FREQuency:STARt 1E6;STOP 1E9")
```
However, a new command line always begins with the complete path.

Example:

```
CALL IBWRT(analyzer,  "SENSe:FREQuency:STARt 1E6")
CALL IBWRT(analyzer%,  "SENSe:FREQuency:STOP 1E9")
```

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1. The requested parameter is transmitted without header.

   Example: `INPut:COUPling?`
   Response: `DC`

2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.

   Example: `SENSe:FREQuency:STOP? MAX`
   Response: `3.5E9`

3. Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.

   Example: `SENSe:FREQuency:CENTer?`
   Response: `1E6` for 1 MHz

4. Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).

   Example: `SENSe:BANDwidth:AUTO?`
   Response: `1` for ON

5. Text (character data) is returned in a short form.

   Example: `SYSTem:COMMunicate:SERial:CONTrol:RTS?`
   Response (for standard): `STAN`

Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). It the unit is missing, the basic unit is used.

Example:

```
SENSe:FREQuency:STOP 1.5GHz = SENSe:FREQuency:STOP 1.5E9
```

Special numerical

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as values special numerical values.

In the case of a query, the numerical value is provided.

Example:

Setting command: `SENSe:FREQuency:STOP MAXimum`

Query: `SENSe:FREQuency:STOP?`
Response: `3.5E9`

MIN/MAX

> MINimum and MAXimum denote the minimum and maximum value.

DEF

> DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command

UP/DOWN

> UP, DOWN increases or reduces the numerical value by one step. The step width can be specified via an allocated step command (see annex C, List of Commands) for each parameter which can be set via UP, DOWN.

INF/NINF

> INFinity, Negative INFinity (NINF) Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device responses.

NAN

> Not A Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. 0 or 1 is provided in a query.

Example:

Setting command: `DISPlay:WINDow:STATe ON`

Query: `DISPlay:WINDow:STATe?`
Response: `1`

Text

Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:

Setting command: `INPut:COUPling    GROund`

Query: `INPut:COUPling?`
Response: `GRO`

Strings

Strings must always be entered in quotation marks (' or ").

Example:

```
SYSTem:LANGuage "SCPI"   or
SYSTem:LANGuage 'SCPI'
```

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

```
HEADer:HEADer #45168xxxxxxxx
```

ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted.

Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

| : | The colon separates the key words of a command. In a command line the colon after the separating semicolon marks the uppermost command level. |

| ; | The semicolon separates two commands of a command line. It does not alter the path. |

| , | The comma separates several parameters of a command. |

| ? | The question mark forms a query. |

| * | The asterix marks a common command. |

| " | Quotation marks introduce a string and terminate it. |

| # | The double dagger (#) introduces block data |

| | A "white space (ASCII-Code 0 to 9, 11 to 32 decimal, e.g.blank) separates header and parameter. |

Instrument Model and Command Processing

The instrument model shown in Fig. 5-2 has been made viewed from the standpoint of the servicing of IEC-bus commands. The individual components work independently of each other and simultaneously. They communicate by means of so-called "messages".

IEC Bus →

[Input unit with input puffer]
↓
[Command recognition] →
↓
[Data set] →
[Instrument hardware] →
[Status reporting-system]
↓
IEC Bus ←
[Output unit with output buffer]
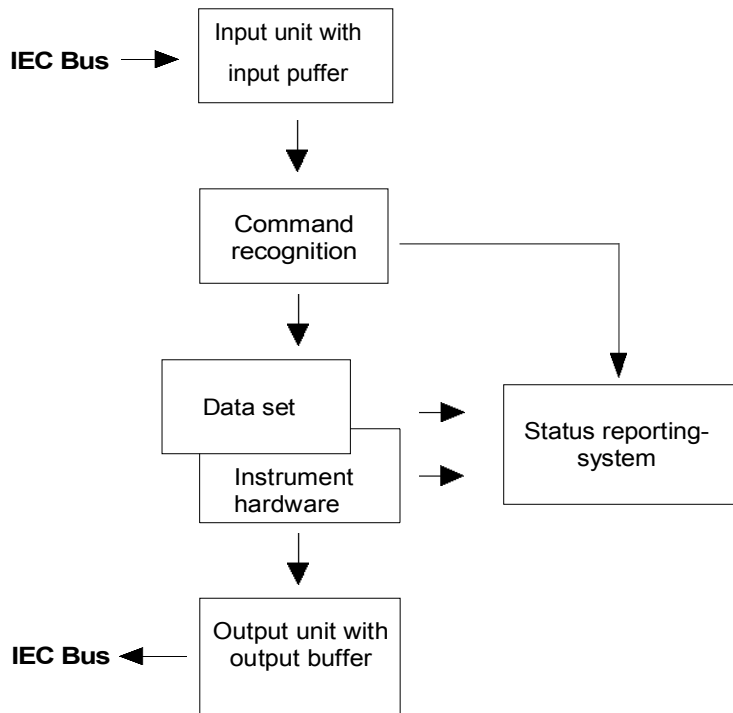
Fig. 5-2   Instrument model in the case of remote control by means of the IEC bus

Input Unit

The input unit receives commands character by character from the IEC bus and collects them in the input buffer. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.

If the input buffer is full, the IEC-bus traffic is stopped and the data received up to then are processed. Subsequently the IEC-bus traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, a GET (Group Execute Trigger), e.g., is only executed after the commands received before as well. Each recognized command is immediately transferred to the instrument data base but without being executed there at once.

Syntactical errors in the command are recognized in the command recognition and supplied to the status reporting system. The rest of a command line after a syntax error is analyzed further if possible and serviced.

If the command recognition recognizes a delimiter (<PROGRAM MESSAGE SEPARATOR> or <PROGRAM MESSAGE TERMINATOR>) or a DCL, it requests the instrument data base to set the commands in the instrument hardware as well now. Subsequently it is immediately prepared to process commands again. This means for the command servicing that further commands can already be serviced while the hardware is still being set ("overlapping execution").

Instrument Data Base and Instrument Hardware

Here the expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included.

The instrument data base is a detailed reproduction of the instrument hardware in the software.

IEC-bus setting commands lead to an alteration in the data set. The data base management enters the new values (e.g. frequency) into the data base, however, only passes them on to the hardware when requested by the command recognition.

The data are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that an execution is not possible, an "execution error" is signalled to the status reporting system. The alteration of the data base are cancelled, the instrument hardware is not reset.

IEC-bus queries induce the data base management to send the desired data to the output unit.

Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in section .

Output Unit

The output unit collects the information requested by the controller, which it receives from the data base management. It processes it according to the SCPI rules and makes it available in the output buffer. If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data base management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC bus, the controller waits until it has reached its time limit. This behavior is specified by SCPI.

Command Sequence and Command Synchronization

What has been said above makes clear that all commands can potentially be carried out overlapping.

In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By a suitable programming, the controller can be forced to wait for the respective action to occur (cf. Table 5-1).

Table 5-1   Synchronization using *OPC, *OPC? and *WAI

Command	Action after the hardware has settled	Programming the controller
*OPC	Setting the operation-complete bit in the ESR	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for service request (SRQ)
*OPC?	Writing a "1" into the output buffer	Addressing the instrument as a talker
*WAI	Continuing the IEC-bus handshake	Sending the next command

An example as to command synchronization can be found in chapter "Remote Control – Programming Examples".

For a couple of commands the synchronization to the end of command execution is mandatory in order to obtain the desired result. The affected commands require either more than one measurement in order to accomplish the desired instrument setting (e.g. auto range functions), or they require a longer period of time for execution. If a new command is received during execution of the corresponding function this may either lead to either to an aborted measurement or to invalid measurement data.

The following list includes the commands, for which a synchronization via *OPC, *OPC? or *WAI is mandatory:

Table 5-2   Commands with mandatory synchronization (Overlapping Commands)

Command	Purpose
INIT	start measurement
INIT:CONM	continue measurement
CALC:MARK:FUNC:ZOOM	zoom frequency range around marker 1
CALC:STAT:SCAL:AUTO ONCE	optimize level settings for signal statistic measurement functions
[SENS:]POW:ACH:PRES:RLEV	optimize level settings for adjacent channel power measurements

Status Reporting System

The status reporting system (cf. Fig. 5-4) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out a calibration and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills the same function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in Fig. 5-4.

Structure of an SCPI Status Register

Each SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. Fig. 5-3). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. For example, bit 3 of the STATus:OPERation register is assigned to the hardware status "wait for trigger" in all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.
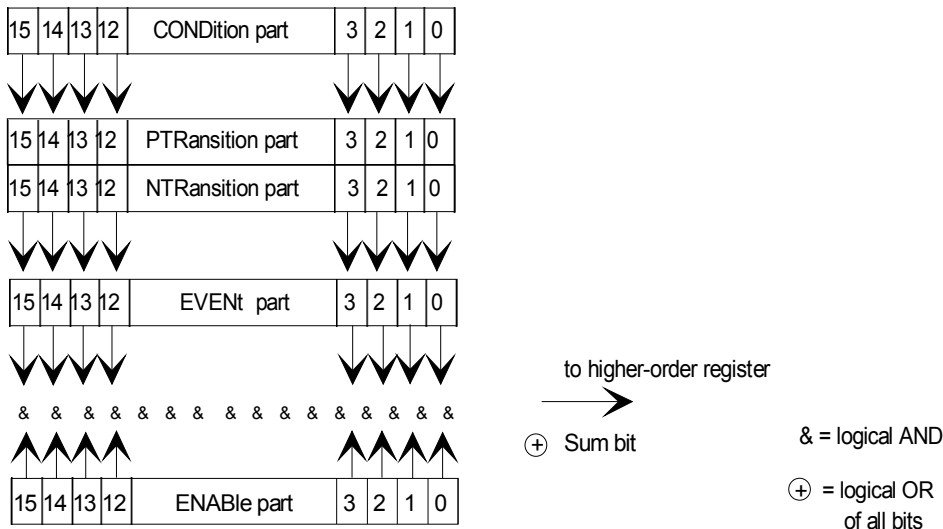
Fig. 5-3   The status-register model

CONDition part

The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part

The Positive-TRansition part acts as an edge detector. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.

PTR bit =1: the EVENt bit is set.

PTR bit =0: the EVENt bit is not set.

This part can be written into and read at will. Its contents is not affected by reading.

NTRansition part

The Negative-TRansition part also acts as an edge detector. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.

NTR-Bit = 1: the EVENt bit is set.

NTR-Bit = 0: the EVENt bit is not set.

This part can be written into and read at will. Its contents is not affected by reading.

With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part

The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the edge filters. It is permanently updated by the instrument. This part can only be read by the user. During reading, its contents is set to zero. In linguistic usage this part is often equated with the entire register.

ENABle part

The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+').

ENABle-Bit = 0: the associated EVENt bit does not contribute to the sum bit

ENABle-Bit = 1: if the associated EVENT bit is "1", the sum bit is set to "1" as well.

This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit

As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note

The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.

Overview of the Status Registers

15	not used
14	Subrange limit attained
13	
12	
11	
10	
9	Subrange 10
8	Subrange 9
7	Subrange 8
6	Subrange 7
5	Subrange 6
4	Subrange 5
3	Subrange 4
2	Subrange 3
1	Subrange 2
0	Subrange 1

STATus:QUEStionable:TRANsducer

& = logic AND
⊕ = logic OR
of all bits

15	not used
14	
13	
12	
11	
10	
9	SCAN results available
8	HCOPy in progress
7	
6	
5	
4	
3	
2	
1	
0	CALibrating

STATus:OPERation

15	not used
14	
13	ALT2 LOWer FAIL (screen B)
12	ALT2 UPPer FAIL (screen B)
11	ALT1 LOWer FAIL (screen B)
10	ALT1 UPPer FAIL (screen B)
9	ADJ LOWer FAIL (screen B)
8	ADJ UPPer FAIL (screen B)
7	
6	
5	ALT2 LOWer FAIL (screen A)
4	ALT2 UPPer FAIL (screen A)
3	ALT1 LOWer FAIL (screen A)
2	ALT1 UPPer FAIL (screen A)
1	ADJ LOWer FAIL (screen A)
0	ADJ UPPer FAIL (screen A)

STATus:QUEStionable:ACPLimit

SRQ

7	
6	RQS/MSS
5	ESB
4	MAV
3	
2	
1	
0	

SRE   STB

Screen A	Screen B		Screen A	Screen B
15 not used	15		15 not used	15
14	14		14	14
13	13		13	13
12	12		12	12
11	11		11	11
10	10		10	10
9	9		9	9
8	8		8	8
7 LMARgin 8 FAIL	7		7 LIMit 8 FAIL	7
6 LMARgin 7 FAIL	6		6 LIMit 7 FAIL	6
5 LMARgin 6 FAIL	5		5 LIMit 6 FAIL	5
4 LMARgin 5 FAIL	4		4 LIMit 5 FAIL	4
3 LMARgin 4 FAIL	3		3 LIMit 4 FAIL	3
2 LMARgin 3 FAIL	2		2 LIMit 3 FAIL	2
1 LMARgin 2 FAIL	1		1 LIMit 2 FAIL	1
0 LMARgin 1 FAIL	0		0 LIMit 1 FAIL	0

STATus:QUEStionable:LMARgin<1|2>   **STATus:QUEStionable:LIMit<1|2>**

15	not used
14	
13	TRANsducer break
12	ACPLimit
11	
10	LMARgin
9	LIMit
8	CALibration (= UNCAL)
7	
6	
5	FREQuency
4	
3	POWer
2	
1	
0	

STATus:QUEStionable

PPE

IST flag

7	Power on
6	User Request
5	Command Error
4	Execution Error
3	Device Dependent Error
2	Query Error
1	Request Control
0	Operation Complete

Error/event queue   Outpu-buffer   ESE   ESR

15	not used
14	
13	
12	
11	
10	
9	LO UNLocked (screen B)
8	
7	
6	
5	
4	
3	
2	
1	LO UNLocked (screen A)
0	OVEN COLD

STATus:QUEStionable:FREQuency

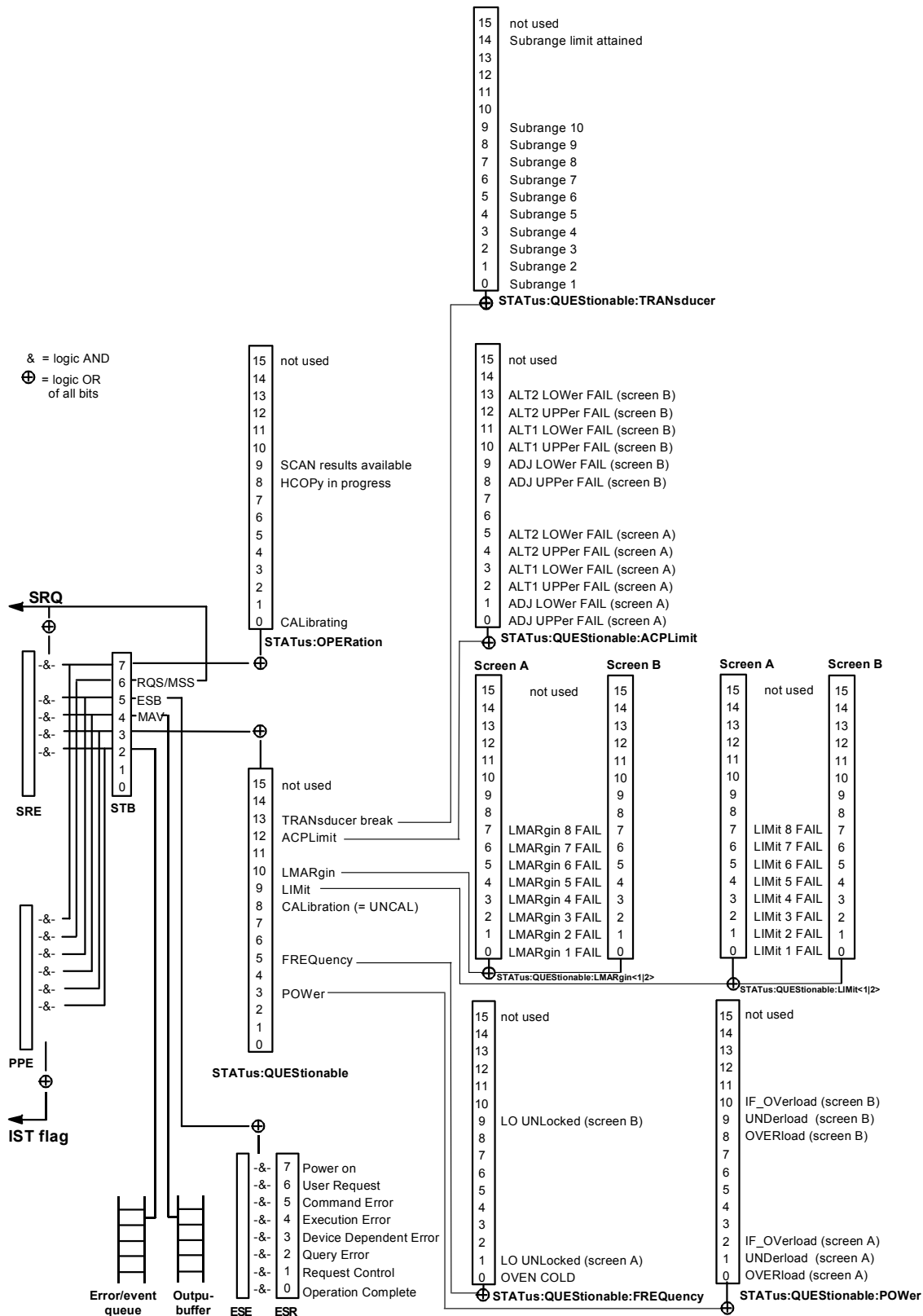|	
15	not used
14	
13	
12	
11	
10	IF_OVerload (screen B)
9	UNDerload (screen B)
8	OVERload (screen B)
7	
6	
5	
4	
3	
2	IF_OVerload (screen A)
1	UNDerload (screen A)
0	OVERload (screen A)

STATus:QUEStionable:POWer

Fig. 5-4   Overview of the status registers

Description of the Status Registers

Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STATUS BYTE is read out using the command "*STB?" or a serial poll.

The STB implies the SRE. It corresponds to the ENABle part of the SCPI registers as to its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the IEC bus, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.

The SRE can be set using command "*SRE" and read using "*SRE?".

Table 5-1   Meaning of the bits in the status byte

Bit No.	Meaning
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with IEC-bus control.
3	**QUEStionable status sum bit** The bit is set if an EVENt bit is set in the QUEStionable: status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUEStionable status register.
4	**MAV bit** (message available) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller (cf. chapter "Remote Control – Programming Examples").
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit implies an error or an event which can be specified in greater detail by polling the event status register.
6	**MSS bit** (master status summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** The bit is set if an EVENt bit is set in the OPERation-Status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by polling the OPERation-status register.

IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll (cf. section "Parallel Poll" on page 5.33) or using command "*IST?".

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The Ist flag results from the ORing of all results. The PPE can be set using commands "*PRE" and read using command "*PRE?".

Event-Status Register (ESR) and Event-Status-Enable Register (ESE)

The ESR is already defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command "*ESR?".

The ESE is the associated ENABle part. It can be set using command "*ESE" and read using command "*ESE?".

Table 5-2   Meaning of the bits in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	This bit is not used
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having send a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. chapter "Error Messages").
4	**Execution Error** This bit is set if a received command is syntactically correct, however, cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. chapter "Error Messages").
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue (cf. chapter "Error Messages").
6	**User Request** This bit is set on pressing the *LOCAL* key.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using commands `"STATus:OPERation:CONDition?"` or `"STATus:OPERation[:EVENt]?"`.

Table 5-3   Meaning of the bits in the STATus.OPERation register

Bit No.	Meaning
0	**CALibrating** This bit is set as long as the instrument is performing a calibration.
1 to 7	These bits are not used
8	**HardCOPy in progress** This bit is set while the instrument is printing a hardcopy.
9	SCAN results available This bit is set when a block of scan results is available. Must be enabled by TRAC:FEED:CONT ALWays
10	**Sweep Break** This bit is set when end of sweep range is reached (spurious measurement, mode analyzer). Command "INIT:CONM" has to be used to proceed.
11 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable Register

This register comprises information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be queried by commands `STATus:QUEStionable:CONDition?` and `STATus:QUEStionable[:EVENt]?`.

Table 5-4   Meaning of bits in STATus:QUEStionable register

Bit No.	Meaning
0 to 2	These bits are not used
3	**POWer** This bit is set if a questionable power occurs (cf. also section "STATus:QUEStionable:POWer Register" on page 5.32)
4	**TEMPerature** This bit is set if a questionable temperature occurs.
5	**FREQuency** The bit is set if a frequency is questionable (cf. section "STATus:QUEStionable:FREQuency Register" on page 5.29)
6 to 7	These bits are not used
8	**CALibration** The bit is set if a measurement is performed uncalibrated (equivalent to label "UNCAL")
9	**LIMit** (device-specific) This bit is set if a limit value is violated (see also section "STATus:QUEStionable:LIMit<1|2> Register" on page 5.30)
10	**LMARgin** (device-specific) This bit is set if a margin is violated (see also section "STATus:QUEStionable:LMARgin<1|2> Register" on page 5.31)
11	**This bit is not used**
12	**ACPLimit** (device-specific) This bit is set if a limit for the adjacent channel power measurement is violated (see also section "STATus: QUEStionable:ACPLimit Register" on page 5.28)
13 to 14	These bits are not used
15	This bit is always 0.

STATus:QUEStionable:ACPLimit Register

This register comprises information about the observance of limits during adjacent power measurements. It can be queried with commands STATus:QUEStionable:ACPLimit:CONDition? and STATus:QUEStionable:ACPLimit[:EVENt]?.

Table 5-5   Meaning of bits in STATus:QUEStionable:ACPLimit register

Bit No.	Meaning
0	**ADJ UPPer FAIL(Screen A)** This bit is set if in screen A. the limit is exceeded in the upper adjacent channel
1	**ADJ LOWer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the lower adjacent channel.
2	**ALT1 UPPer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the upper 1st alternate channel.
3	**ALT1 LOWer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the lower 1st alternate channel.
4	**ALT2 UPPer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the upper 2nd alternate channel.
5	**ALT2 LOWer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the lower 2nd alternate channel.
6 to 7	not used
8	**ADJ UPPer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the upper adjacent channel.
9	**ADJ LOWer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the lower adjacent channel.
10	**ALT1 UPPer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the upper 1st alternate channel.
11	**ALT1 LOWer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the lower 1st alternate channel.
12	**ALT2 UPPer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the upper 2nd alternate channel.
13	**ALT2 LOWer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the lower 2nd alternate channel.
14	not used
15	This bit is always set to 0.

STATus:QUEStionable:FREQuency Register

This register comprises information about the reference and local oscillator.

It can be queried with commands `STATus:QUEStionable:FREQuency:CONDition?` and `STATus:QUEStionable:FREQuency[:EVENt]?`.

Table 5-6   Meaning of bits in STATus:QUEStionable:FREQuency register

Bit No.	Meaning
0	**OVEN COLD** This bit is set if the reference oscillator has not yet attained its operating temperature. 'OCXO' will then be displayed.
1	**LO UNLocked** (Screen A) This bit is set if the local oscillator no longer locks. 'LOUNL will then be displayed.
2 to 8	not used
9	**LO UNLocked** (Screen B) This bit is set if the local oscillator no longer locks.' LOUNL' will then be displayed.
10 to 14	not used
15	This bit is always 0.

STATus:QUEStionable:LIMit<1|2> Register

This register comprises information about the observance of limit lines in the corresponding measurement window (LIMit 1 corresponds to Screen A, LIMit 2 to Screen B). It can be queried with commands `STATus:QUEStionable:LIMit<1|2>:CONDition?` and `STATus:QUEStionable:LIMit<1|2>[:EVENt]?`.

Table 5-7   Meaning of bits in STATus:QUEStionable:LIMit<1|2> register

Bit No.	Meaning
0	**LIMit 1 FAIL** This bit is set if limit line 1 is violated.
1	**LIMit 2 FAIL** This bit is set if limit line 2 is violated.
2	**LIMit 3 FAIL** This bit is set if limit line 3 is violated.
3	**LIMit 4 FAIL** This bit is set if limit line 4 is violated.
4	**LIMit 5 FAIL** This bit is set if limit line 5 is violated.
5	**LIMit 6 FAIL** This bit is set if limit line 6 is violated.
6	**LIMit 7 FAIL** This bit is set if limit line 7 is violated.
7	**LIMit 8 FAIL** This bit is set if limit line 8 is violated.
8 to 14	not used
15	This bit is always 0.

STATus:QUEStionable:LMARgin<1|2> Register

This register comprises information about the observance of limit margins in the corresponding measurement window (LMARgin1 corresponds to Screen A, LMARgin2 corresponds to Screen B). It can be queried with commands `STATus:QUEStionable:LMARgin<1|2>:CONDition?` and "`STATus:QUEStionable:LMARgin<1|2>[:EVENt]?`.

Table 5-8   Meaning of bits in STATus:QUEStionable:LMARgin<1|2> register

Bit No.	Meaning
0	**LMARgin 1 FAIL** This bit is set if limit margin 1 is violated.
1	**LMARgin 2 FAIL** This bit is set if limit margin 2 is violated.
2	**LMARgin 3 FAIL** This bit is set if limit margin 3 is violated.
3	**LMARgin 4 FAIL** This bit is set if limit margin 4 is violated.
4	**LMARgin 5 FAIL** This bit is set if limit margin 5 is violated.
5	**LMARgin 6 FAIL** This bit is set if limit margin 1 is violated.
6	**LMARgin 7 FAIL** This bit is set if limit margin 7 is violated.
7	**LMARgin 8 FAIL** This bit is set if limit margin 8 is violated.
8 to 14	not used
15	This bit is always 0.

STATus:QUEStionable:POWer Register

This register comprises all information about possible overloads of the unit.

It can be queried with commands `STATus:QUEStionable:POWer:CONDition?` and `STATus:QUEStionable:POWer[:EVENt]?`.

Table 5-9   Meaning of bits in STATus:QUEStionable:POWer register

Bit No.	Meaning
0	**OVERload** (Screen A) This bit is set if the RF input is overloaded. 'OVLD' will then be displayed.
1	**UNDerload** (Screen A) This bit is set if the RF input is underloaded. 'UNLD' will then be displayed.
2	**IF_OVerload** (Screen A) This bit is set if the IF path is overloaded. 'IFOVL' will then be displayed.
3 to 7	not used
8	**OVERload** (Screen B) This bit is set if the RF input is overloaded. 'OVLD' will then be displayed.
9	**UNDerload** (Screen B) This bit is set if the RF input is underloaded. 'UNLD' will then be displayed.
10	**IF_OVerload** (Screen B) This bit is set if the IF path is overloaded. 'IFOVL' will then be displayed.
11 to 14	not used
15	This bit is always 0.

Application of the Status Reporting Systems

In order to be able to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are represented in the following. Detailed program examples are to be found in chapter "Remote Control – Programming Examples".

Service Request, Making Use of the Hierarchy Structure

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react with corresponding actions. As evident from Fig. 5-4, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The corresponding setting of the ENABle parts of the status registers can achieve that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request, all bits should be set to "1" in enable registers SRE and ESE.

Examples (cf. Fig. 5-4 and chapter "Remote Control – Programming Examples"):

Use of command "*OPC" to generate an SRQ at the end of a sweep.

➢ `CALL IBWRT(analyzer%, "*ESE 1")` Set bit 0 in the ESE (Operation Complete)

➢ `CALL IBWRT(analyzer%, "*SRE 32")` Set bit 5 in the SRE (ESB)?

    After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument in a way that a service request is initiated in the case of malfunction. The program should react appropriately to the service request. A detailed example for a service request routine is to be found in chapter "Remote Control – Programming Examples".

Serial Poll

In a serial poll, just as with command "*STB", the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works with instruments which do not adhere to SCPI or IEEE 488.2.

The VISUAL BASIC command for executing a serial poll is "IBRSP()". Serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the IEC bus.

Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller by means of a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to logically "0" or "1". By analogy to the SRE register which determines under which conditions an SRQ is generated, there is a parallel poll enable register (PPE) which is ANDed with the STB bit by bit as well considering bit 6. The results are ORed, the result is then sent (possibly inverted) as a response in the parallel poll of the controller. The result can also be queried without parallel poll by means of command "*IST".

The instrument first has to be set for the parallel poll using quick-BASIC command "IBPPC()". This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using "IBRPP()".

The parallel-poll method is mainly used in order to quickly find out after an SRQ which instrument has sent the service request if there are many instruments connected to the IEC bus. To this effect, SRE and PPE must be set to the same value. A detailed example as to the parallel poll is to be found in chapter "Remote Control – Programming Examples".

Query by Means of Commands

Each part of every status register can be read by means of queries. The individual commands are indicated in the detailed description of the registers. What is returned is always a number which represents the bit pattern of the register queried. Evaluating this number is effected by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages which can be looked at in the ERROR menu via manual control or queried via the IEC bus using command "SYSTem:ERRor?". Each call of "SYSTem:ERRor?" provides an entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

Resetting Values of the Status Reporting System

Table 5-10 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for *RST and SYSTem:PRESet influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 5-10   Resetting instrument functions

Event	Switching on supply voltage		DCL,SDC (Device Clear, Selected Device Clear)	*RST or SYSTem: PRESet	STATus: PRESet	*CLS
	Power-On-Status-Clear					
Effect	0	1				
Clear STB,ESR	—	yes	—	—	—	yes
Clear SRE,ESE	—	yes	—		—	—
Clear PPE	—	yes	—		—	—
Clear EVENTt parts of the registers	—	yes	—	—		yes
Clear Enable parts of all OPERation and QUEStionable registers, Fill Enable parts of all other registers with "1".	—	yes	—	—	yes	—
Fill PTRansition parts with "1" , Clear NTRansition parts	—	yes	—	—	yes	—
Clear error queue	yes	yes	—	—	—	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	—	—	—

1) Every command being the first in a command line, i.e., immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

6   Remote Control – Description of Commands

Introduction

This chapter describes all remote control commands for the EMI Test Receiver functions of the R&S ESU in detail. The remote control commands for phase noise measurements are provided in the appendix. For details on the notation of the remote control commands refer to "Notation" on page 6.4.

The remote control commands are sorted according to the subsystem they belong to. The following subsystems are included in this chapter:

Additionally, a subset of IEC/IEEE-bus commands of HP models is supported. These commands are listed in section "IEC/IEEE-Bus Commands of HP Models 856xE, 8566A/B, 8568A/B and 8594E" on page 6.243. For information on differences between the FSP and FSE families refer to section "Differences in GPIB Behavior between the FSP and the FSE Families of Instruments" on page 6.267.

Notation

In the following sections, all commands implemented in the instrument are first listed in tables and then described in detail, arranged according to the command subsystems. The notation is adapted to the SCPI standard. The SCPI conformity information is included in the individual description of the commands.

Table of Commands

Command:	In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).
Parameter:	The parameter column indicates the requested parameters together with their specified range.
Unit:	The unit column indicates the basic unit of the physical parameters.
Comment:	In the comment column an indication is made on:

- whether the command does not have a query form,

- whether the command has only one query form

- whether the command is implemented only with a certain option of the instrument

Indentations The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level, the further the indentation to the right. Please note that the complete notation of the command always includes the higher levels as well.

Example:

`SENSe:FREQuency:CENTer` is represented in the table as follows:

`SENSe` first level
     `:FREQuency` second level
          `:CENTer` third level

Individual description The individual description contains the complete notation of the command. An example for each command, the *RST value and the SCPI information are included as well.

The operating modes for which a command can be used are indicated by the following abbreviations:

- R – receiver

- A – spectrum analysis

- A-F – spectrum analysis - frequency domain only

- A-T – spectrum analysis - time domain only (zero span)

- FM – analog demodulation

Note

The receiver and spectrum analysis modes are implemented in the basic unit. For the other modes, the corresponding options are required.

Upper/lower case notation   Upper/lower case letters are used to mark the long or short form of the key words of a command in the description (see chapter "Remote Control – Basics"). The instrument itself does not distinguish between upper and lower case letters.

Special characters   **|**

A selection of key words with an identical effect exists for several commands. These key words are indicated in the same line; they are separated by a vertical stroke. Only one of these key words needs to be included in the header of the command. The effect of the command is independent of which of the key words is used.

Example:

```
SENSe:FREQuency:CW|:FIXed
```

The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1 kHz:

```
SENSe:FREQuency:CW 1E3 = SENSe:FREQuency:FIXed 1E3
```

A vertical stroke in parameter indications marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is used.

Example: Selection of the parameters for the command

```
DISPlay:FORMat FULL | SPLit
```

If parameter FULL is selected, full screen is displayed, in the case of SPLit, split screen is displayed.

[ ]

Key words in square brackets can be omitted when composing the header (cf. chapter "Remote Control – Basics", section "Optional key words" on page 5.12). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.

Parameters in square brackets can be incorporated optionally in the command or omitted as well.

{ }

Parameters in braces can be incorporated optionally in the command, either not at all, once or several times.

Description of parameters   Due to the standardization, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also chapter "Remote Control – Basics", section "Parameters" on page 5.15).

<Boolean>   This key word refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the key word **OFF** or by the numeric value 0, the "on" state is indicated by **ON** or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric_value> <num>	These key words mark parameters which may be entered as numeric values or be set using specific key words (character data).
	The following key words given below are permitted:

– `MINimum` – This key word sets the parameter to the smallest possible value.

– `MAXimum` – This key word sets the parameter to the largest possible value.

– `DEFault` – This key word is used to reset the parameter to its default value.

– `UP` – This key word increments the parameter value.

– `DOWN` – This key word decrements the parameter value.

The numeric values associated to MAXimum/MINimum/DEFault can be queried by adding the corresponding key words to the command. They must be entered following the quotation mark.

Example:

`SENSe:FREQuency:CENTer? MAXimum`

returns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>	This key word is provided for commands the parameters of which consist of a binary data block.

Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. A particular command has the same effect on different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in chapter "Remote Control – Basics".

Command	Parameter	Function	Comment
*CAL?		Calibration Query	query only
*CLS		Clear Status	no query
*ESE	0 to 255	Event Status Enable	
*ESR?		Standard Event Status Query	query only
*IDN?		Identification Query	query only
*IST?		Individual Status Query	query only
*OPC		Operation Complete	
*OPT?		Option Identification Query	query only
*PCB	0 to 30	Pass Control Back	no query
*PRE	0 to 255	Parallel Poll Register Enable	
*PSC	0 | 1	Power On Status Clear	
*RST		Reset	no query
*SRE	0 to 255	Service Request Enable	
*STB?		Status Byte Query	query only
*TRG		Trigger	no query
*TST?		Self Test Query	query only
*WAI		Wait to continue	no query

*CAL?

> **CALIBRATION QUERY** initiates a calibration of the instrument and subsequently queries the calibration status. Any responses > 0 indicate errors.

*CLS

> **CLEAR STATUS** sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

*ESE 0 to 255

> **EVENT STATUS ENABLE** sets the event status enable register to the value indicated. The query form *ESE? returns the contents of the event status enable register in decimal form.

*ESR?

> **STANDARD EVENT STATUS QUERY** returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

*IDN?

IDENTIFICATION QUERY queries the instrument identification.

Example: " Rohde&Schwarz, ESU-26, 123456/789, 3.97"

ESU-26 = Device name

123456/789 = Serial number of the instrument

3.97 = Firmware version number

*IST?

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 | 1). The IST flag is the status bit which is sent during a parallel poll (cf. chapter "Remote Control – Basics").

*OPC

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (cf. chapter "Remote Control – Basics").

*OPC?

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. chapter "Remote Control – Basics").

*OPT?

OPTION IDENTIFICATION QUERY checks which options the instrument contains and returns a list of installed options. The individual options are separated by commas.

Position	Option	
1		Reserved
2	B4	OCXO
3		Preselector (always present)
4 to 6		Reserved
7	B9	Tracking Generator 3.6 GHz / I/Q can be modulated
8	B10	Ext. Generator Control
9		Reserved
10	B12	Attenuator for Tracking Generator
11 to 13		Reserved
14 to 16		LAN Interface
17		Reserved
18	ESU-K53	Time Domain Scan
19 to 31		Reserved
32	FS-K7	FM Demodulator
33 to 51		Reserved

Example:

0,B4,0,B6,0,0,B9,B10,0,0,0,0,0,B16,0,0,0,0,0,0,0,0,0,0,0,0,0,0,K5,0,0,0,0,0,0,0,0,0,0

*PCB 0 to 30

PASS CONTROL BACK indicates the controller address which the IEC-bus control is to be returned to after termination of the triggered action.

*PRE 0 to 255

PARALLEL POLL REGISTER ENABLE sets the parallel poll enable register to the indicated value. The query form *PRE? returns the contents of the parallel poll enable register in decimal form.

*PSC 0 | 1

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers are preserved or reset during power-up.

*PSC = 0   causes the contents of the status registers to be preserved. Thus a service request can be generated when switching on the instrument, if the status registers ESE and SRE are suitably configured.

*PSC <> 0   Resets the registers.

The query form *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

*RST

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing the *PRESET* key. The default setting is indicated in the description of the commands.

*SRE 0 to 255

SERVICE REQUEST ENABLE sets the service request enable register to the indicated value. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is generated. The query form *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

*STB?

READ STATUS BYTE QUERY reads out the contents of the status byte in decimal form.

*TRG

TRIGGER initiates all actions in the currently active test screen expecting a trigger event. This command corresponds to `INITiate:IMMediate` (cf. section "TRIGger Subsystem" on page 6.240).

*TST?

SELF TEST QUERY initiates the selftest of the instrument and outputs an error code in decimal form (0 = no error).

*WAI

WAIT-to-CONTINUE permits servicing of subsequent commands only after all preceding commands have been executed and all signals have settled (cf. section "*OPC" on page 6.8 and chapter "Remote Control – Basics").

ABORt Subsystem

The ABORt subsystem contains the commands for aborting triggered actions. An action can be triggered again immediately after being aborted. All commands trigger events, and therefore they have no *RST value.

ABORt

This command aborts a current measurement and resets the trigger system.

Example:	`"ABOR;INIT:IMM"`
Characteristics:	*RST value: 0 SCPI: conforming
Mode:	R, A, FM

:HOLD

This command interrupts a current scan measurement. The scan is resumed by "INITiate<1|2>[: IMMediate]" on page 6.119

Example:	`"HOLD"` 'interrupts the current scan measurement
Characteristics:	*RST value: - SCPI: conforming
Mode:	R

CALCulate Subsystem

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSe subsystem.

The numeric suffix is used in CALCulate to make the distinction between the two measurement windows SCREEN A and SCREEN B:

CALCulate1 = Screen A
CALCulate2 = Screen B.

For commands without suffix, screen A is selected automatically.

Full Screen	The settings are valid for the measurement window selected with the numeric suffix. They become effective as soon as the corresponding measurement window has been selected as active measurement window using the command `DISPLay[:WINDow<1|2>]:SELect`. Triggering measurements and querying measured values is possible only in the active measurement window.
Split Screen	The settings are valid for the measurement window selected by means of the numeric suffix and become effective immediately.

Note

In the receiver mode, the marker can be activated only for the scan display. The numeric suffixes are irrelevant. In receiver mode the markers can only be activated after a scan is carried out.

CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem controls the delta-marker functions in the instrument. The measurement windows are selected via CALCulate1 (screen A) or 2 (screen B).

In the receiver mode, the markers can only be activated after a scan is performed.

CALCulate<1|2>:DELTamarker<1 to 4>[:STATe] ON | OFF

This command switches on and off the delta marker when delta marker 1 is selected. The corresponding marker becomes the delta marker when delta marker 2 to 4 is selected. If the corresponding marker is not activated, it will be activated and positioned on the maximum of the measurement curve.
If no numeric suffix is indicated, delta marker 1 is selected automatically.

Example:	"CALC:DELT3 ON"
	'Switches marker 3 in screen A to delta marker mode.
Characteristics:	*RST value: OFF
	SCPI: device-specific
Mode:	R, A, FM

CALCulate<1|2>:DELTamarker<1 to 4>:MODE ABSolute | RELative

This command switches between relative and absolute frequency input of the delta marker (or time with span = 0). It affects all delta markers independent of the measurement window.

Example:	"CALC:DELT:MODE ABS"
	'Switches the frequency/time indication for all delta markers to absolute values.
	"CALC:DELT:MODE REL"
	'Switches the frequency/time indication for all delta markers to relative to marker 1.
Characteristics:	*RST value: REL
	SCPI: device-specific
Mode:	R, A, FM

CALCulate<1|2>:DELTamarker<1 to 4>:AOFF

This command switches off all active delta markers in the selected measurement window (screen A or screen B).

Example:	"CALC2:DELT:AOFF"
	'Switches off all delta markers in screen B.
Characteristics:	*RST value: -
	SCPI: device-specific
Mode:	R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:TRACe   1 to 3

This command assigns the selected delta marker to the indicated measurement curve in the indicated measurement window. The selected measurement curve must be active, i.e. its state must be different from "BLANK".

Example: `"CALC:DELT3:TRAC 2"`
'Assigns deltamarker 3 to trace 2 in screen A.

                      `"CALC:DELT:TRAC 3"`
'Assigns delta marker 1 to trace 3 in screen B.

Characteristics: *RST value: -
                     SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:DELTamarker<1 to 4>:X   0 to MAX (frequency | sweep time)

This command positions the selected delta marker in the indicated measurement window to the indicated frequency (span > 0), time (span = 0) or level (APD measurement = ON or CCDF measurement = ON). The input is in absolute values or relative to marker 1 depending on the command `CALCulate:DELTamarker:MODE`. If Reference Fixed measurement (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`) is active, relative values refer to the reference position are entered. The query always returns absolute values.

Example: `"CALC:DELT:MOD  REL"`
'Switches the input for all delta markers to relative to marker 1.

                      `"CALC:DELT2:X 10.7MHz"`
'Positions delta marker 2 in screen A 10.7 MHz to the right of marker 1.

                      `"CALC2:DELT:X?"`
'Outputs the absolute frequency/time of delta marker 1 in screen B

                      `"CALC2:DELT:X:REL?"`
'Outputs the relative frequency/time/level of delta marker 1 in screen B

Characteristics: *RST value: -
                     SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:DELTamarker<1 to 4>:X:RELative?

This command queries the frequency (span > 0) or time (span = 0) of the selected delta marker relative to marker 1 or to the reference position (for `CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`). The command activates the corresponding delta marker, if necessary.

Example: `"CALC:DELT3:X:REL?"`
'Outputs the frequency of delta marker 3 in screen B relative to marker 1 or relative to the reference position.

Characteristics: *RST value: -
                     SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:DELTamarker<1 to 4>:Y?

This command queries the measured value of the selected delta marker in the indicated measurement window. The corresponding delta marker will be activated, if necessary. The output is always a relative value referred to marker 1 or to the reference position (reference fixed active).

To obtain a valid query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the delta marker and the query of the y value. This is only possible in single sweep mode. In receiver mode, the markers can be only activated after a scan is carried out.

Depending on the unit defined with `CALC:UNIT` or on the activated measuring functions, the query result is output in the units below:

- DBM | DBPW | DBUV | DBMV | DBUA: Output unit DB

- WATT | VOLT | AMPere: Output unit W | V | A

- Statistics function (APD or CCDF) on: Dimensionless output

- Result display FM (FS-K7): Hz

- Result display RF POWER (FS-K7): dB

- Result display SPECTRUM (FS-K7): dB

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

                     `"CALC:DELT2 ON"`
'Switches on delta marker 2 in screen A.

                     `"INIT;*WAI"`
'Starts a sweep and waits for its end.

                     `"CALC:DELT2:Y?"`
'Outputs measurement value of delta marker 2 in screen A.

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum[:PEAK]

This command positions the delta marker to the current maximum value on the measured curve. If necessary, the corresponding delta marker will be activated first.

Example: `"CALC2:DELT3:MAX"`
'Sets delta marker 3 in screen B to the maximum value of the associated trace.

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:NEXT

This command positions the delta marker to the next smaller maximum value on the measured curve. The corresponding delta marker will be activated first, if necessary.

Example: `"CALC1:DELT2:MAX:NEXT"`
'Sets delta marker 2 in screen A to the next smaller maximum value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:RIGHt

This command positions the delta marker to the next smaller maximum value to the right of the current value (i.e. ascending X values). The corresponding delta marker is activated first, if necessary.

Example: `"CALC2:DELT:MAX:RIGH"`
'Sets delta marker 1 in screen B to the next smaller maximum value to the right of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:LEFT

This command positions the delta marker to the next smaller maximum value to the left of the current value (i.e. descending X values). The corresponding delta marker will be activated first, if necessary.

Example: `"CALC:DELT:MAX:LEFT"`
'Sets delta marker 1 in screen A to the next smaller maximum value to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum[:PEAK]

This command positions the delta marker to the current minimum value on the measured curve. The corresponding delta marker will be activated first, if necessary.

Example: `"CALC2:DELT3:MIN"`
'Sets delta marker 3 in screen B to the minimum value of the associated trace.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:NEXT

This command positions the delta marker to the next higher minimum value of the measured curve. The corresponding delta marker will be activated first, if necessary.

Example: `"CALC1:DELT2:MIN:NEXT"`
'Sets delta marker 2 in screen A to the next higher minimum value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:RIGHt

This command positions the delta marker to the next higher minimum value to the right of the current value (i.e. ascending X values). The corresponding delta marker will be activated first, if necessary.

Example: `"CALC2:DELT:MIN:RIGH"`
'Sets delta marker 1 in screen B to the next higher minimum value to the right of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:LEFT

This command positions the delta marker to the next higher minimum value to the left of the current value (i.e. descending X values). The corresponding delta marker will be activated first, if necessary.

Example: `"CALC:DELT:MIN:LEFT"`
'Sets delta marker 1 in screen A to the next higher minimum to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1...4>:LINK   ON | OFF

This command switches on and off the delta marker when delta marker 1 is selected. The corresponding marker becomes the delta marker when delta marker 2 to 4 is selected. If the corresponding marker is not activated, it will be activated and positioned on the maximum of the measurement curve.
If no numeric suffix is indicated, delta marker 1 is selected automatically.

Example: `"CALC:DELT3 ON"`
'Switches marker 3 in screen A to delta marker mode.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R, A

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed[:STATe] ON | OFF

This command switches the relative measurement to a fixed reference value on or off. Marker 1 will be activated previously and a peak search will be performed, if necessary. If marker 1 is activated, its position becomes the reference point for the measurement. The reference point can then be modified with commands `CALCulate:DELTamarker:FUNCtion:FIXed:RPOint:X` and `to:RPOint:Y` independently of the position of marker 1 and of a trace. It is valid for all delta markers in the selected measurement window as long as the function is active.

Example: `"CALC2:DELT:FUNC:FIX ON"`
'Switches on the measurement with fixed reference value for all delta markers in screen B.

`"CALC2:DELT:FUNC:FIX:RPO:X 128 MHZ"`
'Sets the reference frequency in screen B to 128 MHz.

`"CALC2:DELT:FUNC:FIX:RPO:Y 30 DBM"`
'Sets the reference level in screen B to +30 dBm

Characteristics: *RST value: OFF
SCPI: device-specific.

Mode: A

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]
<numeric_value>

This command sets the reference point level for all delta markers in the selected measurement window for a measurement with fixed reference point (CALC:DELT:FUNC:FIX:STAT ON) to the peak of the selected trace.

For phase-noise measurements (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`), the command defines a new reference point level for delta marker 2 in the selected measurement window.

Example: `"CALC:DELT:FUNC:FIX:RPO:MAX"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: A

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y   <numeric_value>

This command defines a new reference point level for all delta markers in the selected measurement window for a measurement with fixed reference point. (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`).

For phase-noise measurements (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`), the command defines a new reference point level for delta marker 2 in the selected measurement window.

Example: `"CALC:DELT:FUNC:FIX:RPO:Y –10dBm"`
'Sets the reference point level for delta markers in screen A to -10 dBm.

Characteristics: *RST value: - (`FUNction:FIXed[:STATe]` is set to OFF)
SCPI: device-specific

Mode: A

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y:OFFSet <numeric_value>

This command defines an additional level offset for the measurement with fixed reference value (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`). For this measurement, the offset is included in the display of all delta markers of the selected measurement window.

For phase-noise measurements (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`), the command defines an additional level offset which is included in the display of delta marker 2 in the selected measurement window.

Example: `"CALC:DELT:FUNC:FIX:RPO:Y:OFFS 10dB"`
'Sets the level offset for the measurement with fixed reference value or the phase-noise measurement in screen A to 10 dB.

Characteristics: *RST value: 0 dB
SCPI: device-specific

Mode: A

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:X <numeric_value>

This command defines a new reference frequency (span > 0) or time (span = 0) for all delta markers in the selected measurement window for a measurement with fixed reference value (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`).

For phase-noise measurements (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`), the command defines a new reference frequency or time for delta marker 2 in the selected measurement window.

Example: `"CALC2:DELT:FUNC:FIX:RPO:X 128MHz"`
'Sets the reference frequency in screen B to 128 MHz.

Characteristics: *RST value: - (`FUNction:FIXed[:STATe]` is set to `OFF`)
SCPI: device-specific

Mode: A

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise[:STATe] ON | OFF

This command switches on or off the phase-noise measurement with all active delta markers in the selected measurement window. The correction values for the bandwidth and the log amplifier are taken into account in the measurement.

Marker 1 will be activated, if necessary, and a peak search will be performed. If marker 1 is activated, its position becomes the reference point for the measurement.

The reference point can then be modified with commands `CALCulate:DELTamarker:FUNCtion:FIXed:RPOint:X` and `...:RPOint:Y` independently of the position of marker 1 and of a trace (the same commands used for the measurement with fixed reference point).

The numeric suffix <1 to 4> with `DELTamarker` is not relevant for this command.

Example: `"CALC:DELT:FUNC:PNO ON"`
'Switches on the phase-noise measurement with all delta markers in screen A.

`"CALC:DELT:FUNC:FIX:RPO:X 128 MHZ"`
'Sets the reference frequency to 128 MHz.

`"CALC:DELT:FUNC:FIX:RPO:Y 30 DBM"`
'Sets the reference level to +30 dBm

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise:RESult?

This command queries the result of the phase-noise measurement in the selected measurement window. The measurement will be switched on, if necessary.

Example: `"CALC:DELT:FUNC:PNO:RES?"`
'Outputs the result of phase-noise measurement of the selected delta marker in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A

This command is only a query and therefore has no *RST value.

CALCulate:LIMit Subsystem

The CALCulate:LIMit subsystem consists of the limit lines and the corresponding limit checks. In receiver mode, upper limit lines can be defined. In analyzer mode, limit lines can be defined as upper or lower limit lines. The individual Y values of the limit lines correspond to the values of the X axis (CONTrol). The number of X and Y values must be identical.

8 limit lines can be active at the same time (marked by LIMIT1 to LIMIT8) in screen A and/or screen B. The measurement windows is selected via CALCulate 1 (screen A) or 2 (screen B).

The limit check can be switched on separately for each measurement screen and limit line. WINDow1 corresponds to screen A, WINDow2 to screen B.

Each limit line can be assigned a name (max. 8 letters) under which the line is stored in the instrument. An explanatory comment can also be given for each line (max. 40 characters).

Example (analyzer mode):

Definition and use of a new limit line 5 for trace 2 in screen A and trace 1 in screen B with the following features:

- upper limit line
- absolute X axis in the frequency domain
- 5 ref. values: 126 MHz/-40 dB, 127 MHz/-40 dB, 128 MHz/-20 dB, 129 MHz/-40 dB, 130 MHz/-40 dB
- relative Y axis with unit dB
- absolute threshold value at -35 dBm
- no safety margin

Definition of the line:

1. Defining the name: `CALC:LIM5:NAME 'TEST1'`
2. Entering the comment: `CALC:LIM5:COMM 'Upper limit line'`
3. Associated trace in screen A: `CALC1:LIM5:TRAC 2`
4. Associated trace in screen B: `CALC2:LIM5:TRAC 1`
5. Defining the X axis range: `CALC:LIM5:CONT:DOM FREQ`
6. Defining the X axis scaling: `CALC:LIM5:CONT:MODE ABS`
7. Defining the Y axis unit: `CALC:LIM5:UNIT DB`
8. Defining the Y axis scaling: `CALC:LIM5:UPP:MODE REL`
9. Defining the X axis values: `CALC:LIM5:CONT 126MHZ, 127MHZ, 128MHZ, 129MHZ, 130MHZ`
10. Defining the y values: `CALC:LIM5:UPP -40, -40, -30, -40, -40`
11. Defining the y threshold value: `CALC:LIM5:UPP:THR -35DBM`

The definition of the safety margin and shifting in X and/or Y direction can take place as from here (see commands below).

Switching on and evaluating the line in screen A:

1. Switching on the line in screen A: `CALC1:LIM5:UPP:STAT ON`

2. Switching on the limit check in screen A: `CALC1:LIM5:STAT ON`

3. Starting a new measurement with synchronization: `INIT;*WAI`

4. Querying the limit check result: `CALC1:LIM5:FAIL?`

Switching on and evaluating the line in screen B is performed in the same way by using `CALC2` instead of `CALC1`.

CALCulate<1|2>:LIMit<1 to 8>:CATalog?

This command reads out the names of all limit lines stored on the hard disk.

Example:	`"CALC:LIM:CAT?"`
Characteristics:	*RST value: - SCPI: device-specific
Mode:	R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:TRACe   1 to 3

This command assigns a limit line to a trace in the indicated measurement window.

Example:	`"CALC:LIM2:TRAC 3"`
	'Assigns limit line 2 to trace 3 in screen A.
	
	`"CALC2:LIM2:TRAC 1"`
	'Assigns limit line 2 to trace 1 in screen B at the same time.

Characteristics:	*RST value: 1 SCPI: device-specific
Mode:	R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:STATe   ON | OFF

This command switches on or off the limit check for the selected limit line in the selected measurement window.

The result of the limit check can be queried with `CALCulate:LIMit<1 to 8>:FAIL?`.

Example:	`"CALC:LIM:STAT ON"`
	'Switches on the limit check for limit line 1 in screen A.
	
	`"CALC2:LIM:STAT OFF"`
	'Switches off the limit check for limit line 1 in screen B.

Characteristics:	*RST value: OFF SCPI: conforming
Mode:	R, A, FM

CALCulate<1|2>:LIMit<1...8>:UNIT   DBM | DBPW | WATT | DBUV | DBMV | VOLT |DBUA | AMPere | DB | DBPT | DEG | RAD | S | HZ | PCT | DBUV_M | DBUA_M | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBPW_MHZ | DBPT_MHZ | DBUV_MMHZ | DBUA_MMHZ | UNITLESS

This command defines the unit for the associated limit line.

The specification is valid regardless of the measurement window.

DBxx_MHZ indicates the units dBxx/MHz and DBxx_MMHZ indicates the units dBxx/mMHz (the measured level is referenced to a 1 MHz bandwidth).
Specification of the DB unit automatically switches the limit line over to relative mode. Units other than DB cause the limit line to switch over to absolute mode.

Example:	"CALC:LIM4:UNIT DBUV"
	'Sets the unit of limit line 4 to dBµV.

Characteristics:	*RST value: DBM
	SCPI: device-specific

Mode:	R, A

In the receiver mode, the following units are available: DBM, DBPW, DBUV, DBMV, DBUA, DB, DBPT, DBUV_M, DBUA_M, DBUV_MHZ, DBMV_MHZ, DBUA_MHZ, DBPW_MHZ, DBPT_MHZ, DBUV_MMHZ and DBUA_MMHZ.

CALCulate<1|2>:LIMit<1 to 8>:FAIL?

This command queries the result of the limit check of the limit line indicated in the selected measurement window. It should be noted that a complete sweep must have been performed for obtaining a valid result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided. The result of the limit check responds with 0 for PASS, 1 for FAIL, and 2 for MARGIN.

This command is not available in receiver mode.

Example:	"INIT;*WAI"
	'Starts a new sweep and waits for its end.
	"CALC2:LIM3:FAIL?"
	'Queries the result of the check for limit line 3 in screen B.

Characteristics:	*RST value: -
	SCPI: conforming

Mode:	A, FM

CALCulate<1|2>:LIMit<1 to 8>:CLEar[:IMMediate]

This command deletes the result of the current limit check for all limit lines in the selected measurement window.

Example:	"CALC:LIM:CLE"
	'Deletes the result of the limit check in screen A

Characteristics:	*RST value: -
	SCPI: conforming

Mode:	R, A, FM

This command is an event and therefore has no *RST value.

CALCulate<1|2>:LIMit<1 to 8>:COMMent   <string>

This command defines a comment for the limit line selected (max. 40 characters). The comment is independent from the measurement window.

Example: `"CALC:LIM5:COMM 'Upper limit for spectrum'"`
'Defines the comment for limit line 5.

Characteristics: *RST value: blank comment
SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:COPY   1 to 8 | <name>

This command copies one limit line onto another one. It is independent of the measurement window.

The name of the limit line may consist of max 8 characters.

Parameter: 1 to 8 ::= number of the new limit line or:
<name> ::= name of the new limit line given as a string

Example: `"CALC:LIM1:COPY 2"`
'Copies limit line 1 to line 2.

`"CALC:LIM1:COPY 'FM2'"`
'Copies limit line 1 to a new line named 'FM2'.

Characteristics: *RST value: --
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:LIMit<1 to 8>:NAME   <name of limit line>

This command assigns a name to a limit line numbered 1 to 8. If it does not exist already, a limit line with this name is created. The command is independent of the measurement window.

The name of the limit line may contain a maximum of 8 characters.

Example: `"CALC:LIM1:NAME 'FM1'"`
'Assigns the name 'FM1' to limit line 1.

Characteristics: *RST value: 'REM1' to 'REM8' for lines 1 to 8
SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:DELete

This command deletes the selected limit line. The command is independent of the measurement window.

Example: `"CALC:LIM1:DEL"`
'Deletes limit line 1.

Characteristics: *RST value: --
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate:LIMit:ACPower Subsystem

The CALCulate:LIMit:ACPower subsystem defines the limit check for adjacent channel power measurement.

CALCulate<1|2>:LIMit<1 to 8>:ACPower[:STATe]   ON | OFF

This command switches on and off the limit check for adjacent channel power measurements in the selected measurement window. The commands `CALCulate:LIMit:ACPower:ACHannel:STATe` or `CALCulate:LIMit:ACPower:ALTernate:STATe` must be used in addition to specify whether the limit check is to be performed for the upper/lower adjacent channel or for the alternate adjacent channels.

The numeric suffixes <1 to 8> are irrelevant for this command.

Example:	`"CALC:LIM:ACP ON"` 'Switches on the ACP limit check in screen A.
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel[:RELative]   0 to 100dB, 0 to 100dB

This command defines the relative limit of the upper/lower adjacent channel for adjacent channel power measurements in the selected measurement window. The reference value for the relative limit value is the measured channel power.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below the absolute limit value defined with `CALCulate:LIMit:ACPower:ACHannel:ABSolute`. This mechanism allows automatic checking of the absolute basic values of adjacent channel power as defined in mobile radio standards.

The numeric suffixes <1 to 8> are irrelevant for this command.

Parameter:	The first numeric value is the limit for the upper (lower) adjacent channel. The second value is ignored but must be indicated for reasons of compatibility with the FSE family.
Example:	`"CALC:LIM:ACP:ACH 30DB, 30DB"` 'Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.
Characteristics:	*RST value: 0 dB SCPI: device-specific
Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel[:RELative]:STATe   ON | OFF

This command activates the limit check for the relative limit value of the adjacent channel when adjacent channel power measurement is performed. Before the command, the limit check must be activated using `CALCulate:LIMit:ACPower:STATe ON`.

The result can be queried with `CALCulate:LIMit:ACPower:ACHannel:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are available.

The numeric suffixes <1 to 8> are irrelevant for this command.

Example:	`"CALC:LIM:ACP:ACH 30DB, 30DB"`
	'Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.
	`"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"`
	'Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dBm.
	`"CALC:LIM:ACP ON"`
	'Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
	`"CALC:LIM:ACP:ACH:REL:STAT ON"`
	'Switches on the check of the relative limit values for adjacent channels in screen A.
	`"CALC:LIM:ACP:ACH:ABS:STAT ON"`
	'Switches on the check of absolute limit values for the adjacent channels in screen A.
	`"INIT;*WAI"`
	'Starts a new measurement and waits for the sweep end.
	`"CALC:LIM:ACP:ACH:RES?"`
	'Queries the limit check result in the adjacent channels in screen A.
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:ABSolute   -200DBM to 200DBM, -200 to 200DBM

This command defines the absolute limit value for the lower/upper adjacent channel during adjacent-channel power measurement (Adjacent Channel Power) in the selected measurement window.

It should be noted that the absolute limit value has no effect on the limit check as soon as it is below the relative limit value defined with `CALCulate:LIMit:ACPower:ACHannel:RELative`. This mechanism allows automatic checking of the absolute basic values of adjacent channel power as defined in mobile radio standards.

The numeric suffixes <1 to 8> in LIMIt are irrelevant for this command.

Parameter:	The first value is the limit for the lower and the upper adjacent channel. The second limit value is ignored but must be indicated for reasons of compatibility with the FSE family.
Example:	`"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"`
	'Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dBm.
Characteristics:	*RST value: -200DBM SCPI: device-specific
Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:ABSolute:STATe ON | OFF

This command activates the limit check for the adjacent channel when adjacent-channel power measurement (Adjacent Channel Power) is performed. Before the command, the limit check for the channel/adjacent-channel measurement must be globally switched on using `CALC:LIM:ACP ON`.

The result can be queried with `CALCulate:LIMit:ACPower:ACHannel:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are available.

The numeric suffixes <1 to 8> in LIMIt are irrelevant for this command.

Example:	`"CALC:LIM:ACP:ACH 30DB, 30DB"`
	'Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.
	`"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"`
	'Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dBm.
	`"CALC:LIM:ACP ON"`
	'Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
	`"CALC:LIM:ACP:ACH:REL:STAT ON"`
	'Switches on the check of the relative limit values for adjacent channels in screen A.
	`"CALC:LIM:ACP:ACH:ABS:STAT ON"`
	'Switches on the check of absolute limit values for the adjacent channels in screen A.
	`"INIT;*WAI"`
	'Starts a new measurement and waits for the sweep end.
	`"CALC:LIM:ACP:ACH:RES?"`
	'Queries the limit check result in the adjacent channels in screen A.
Characteristics:	*RST value: OFF
	SCPI: device-specific
Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:RESult?

This command queries the result of the limit check for the upper/lower adjacent channel in the selected measurement window when adjacent channel power measurement is performed.

If the power measurement of the adjacent channel is switched off, the command produces a query error.
The numeric suffixes <1 to 8> are irrelevant for this command.

Parameter:	The result is returned in the form <result>, <result> where
	<result> = PASSED	FAILED, and where the first returned value denotes the lower, the second denotes the upper adjacent channel.

Example:	`"CALC:LIM:ACP:ACH 30DB, 30DB"`
	'Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.
	`"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"`
	'Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dB.
	`"CALC:LIM:ACP ON"`
	'Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
	`"CALC:LIM:ACP:ACH:STAT ON"`
	'Switches on the limit check for the adjacent channels in screen A.
	`"INIT;*WAI"`
	'Starts a new measurement and waits for the sweep end.
	`"CALC:LIM:ACP:ACH:RES?"`
	'Queries the limit check result in the adjacent channels in screen A.
Characteristics:	*RST value: --
	SCPI: device-specific
Mode:	A

This command is a query and therefore has no *RST value.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1...11>[:RELative]   0 to 100dB, 0 to 100dB.

This command defines the limit for the alternate adjacent channels in the selected measurement window for adjacent channel power measurements. The reference value for the relative limit value is the measured channel power.

The numeric suffix after ALTernate<1...11> denotes the alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below the absolute limit defined with `CALCulate:LIMit:ACPower:ALTernate<1...11>:ABSolute`. This mechanism allows automatic checking of the absolute basic values of adjacent channel power as defined in mobile radio standards.

Parameter:	The first value is the limit for the lower and the upper alternate adjacent channel. The second limit value is ignored but must be indicated for reasons of compatibility with the FSE family.
Example:	`"CALC:LIM:ACP:ALT2 30DB, 30DB"`
	'Sets the relative limit value in screen A for the power in the lower and upper alternate adjacent channel to 30 dB below the channel power.
Characteristics:	*RST value: 0DB
	SCPI: device-specific
Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1...11>[:RELative]:STATe   ON | OFF

This command activates the limit check for the alternate adjacent channels in the selected measurement window for adjacent channel power measurements. Before the command, the limit check must be activated using `CALCulate:LIMit:ACPower:STATe ON`.

The numeric suffix after ALTernate<1...11> denotes the alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

The result can be queried with `CALCulate:LIMit:ACPower:ALTernate<1...11>:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are obtained.

Example: `"CALC:LIM:ACP:ALT2 30DB, 30DB"`
'Sets the relative limit value in screen A for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.

`"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM"`
'Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.

`"CALC:LIM:ACP ON"`
'Switches on globally the limit check for the channel/adjacent channel measurement in screen A.

`"CALC:LIM:ACP:ACH:REL:STAT ON"`
'Switches on the check of the relative limit values for the alternate adjacent channels in screen A.

`"CALC:LIM:ACP:ACH:ABS:STAT ON"`
'Switches on the check of absolute limit values for the alternate adjacent channels in screen A.

`"INIT;*WAI"`
'Starts a new measurement and waits for the sweep end.

`"CALC:LIM:ACP:ACH:RES?"`
'Queries the limit check result in the second alternate adjacent channels in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1...11>:ABSolute   -200DBM to 200DBM, -200DBM to 200DBM

This command defines the absolute limit value for the lower/upper alternate adjacent channel power measurement (Adjacent Channel Power) in the selected measurement window.

The numeric suffix after ALTernate<1...11> denotes the alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

It should be noted that the absolute limit value for the limit check has no effect as soon as it is below the relative limit value defined with `CALCulate:LIMit:ACPower:ALTernate<1...11>:RELative`. This mechanism allows automatic checking of the absolute basic values defined in mobile radio standards for the power in adjacent channels.

Parameter: The first value is the limit for the lower and the upper alternate adjacent channel. The second limit value is ignored but must be indicated for reasons of compatibility with the FSE family.

Example:	`"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM"`
	'Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.

Characteristics:	*RST value: -200DBM
	SCPI: device-specific

Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1...11>:ABSolute:STATe   ON | OFF

This command activates the limit check for the alternate adjacent channels in the selected measurement window for adjacent channel power measurement (Adjacent Channel Power).

Before the command, the limit check must be globally switched on for the channel/adjacent channel power with the command `CALCulate:LIMit:ACPower:STATe ON`.

The numeric suffix after ALTernate<1...11> denotes the alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

The result can be queried with `CALCulate:LIMit:ACPower:ALTernate<1...11>:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are available.

Example:	`"CALC:LIM:ACP:ALT2 30DB, 30DB"`
	'Sets the relative limit value in screen A for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.
	`"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM"`
	'Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.
	`"CALC:LIM:ACP ON"`
	'Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
	`"CALC:LIM:ACP:ACH:REL:STAT ON"`
	Switches on the check of the relative limit values for the alternative adjacent channels in screen A.
	`"CALC:LIM:ACP:ACH:ABS:STAT ON"`
	'Switches on the check of absolute limit values for the alternative adjacent channels in screen A.
	`"INIT;*WAI"`
	'Starts a new measurement and waits for the sweep end.
	`"CALC:LIM:ACP:ACH:RES?"`
	'Queries the limit check result in the second alternate adjacent channels in screen A.

Characteristics:	*RST value: OFF
	SCPI: device-specific

Mode:	A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1...11>:RESult?

This command queries the result of the limit check for the alternate adjacent channels in the selected measurement window for adjacent channel power measurements.

The numeric suffix after ALTernate<1...11> denotes the alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

If the power measurement of the adjacent channel is switched off, the command produces a query error.

Parameter:	The result is returned in the form <result>, <result> where <result> = PASSED | FAILED and where the first (second) returned value denotes the lower (upper) alternate adjacent channel.

Example: `"CALC:LIM:ACP:ALT2 30DB, 30DB"`
'Sets the relative limit value in screen A for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.

`"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM"`
'Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.

`"CALC:LIM:ACP ON"`
'Switches on globally the limit check for the channel/adjacent channel measurement in screen A.

`"CALC:LIM:ACP:ALT:STAT ON"`
'Switches on the limit check for the adjacent channels in screen A.

`"INIT;*WAI"`
'Starts a new measurement and waits for the sweep end.

`"CALC:LIM:ACP:ALT:RES?"`
'Queries the limit check result in the second alternate adjacent channels in screen A.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

This command is a query and therefore has no *RST value.

CALCulate:LIMit:CONTrol Subsystem

The CALCulate:LIMit:CONTrol subsystem defines the x axis (CONTrol-axis).

CALCulate<1|2>:LIMit<1 to 8>:CONTrol[:DATA]   <numeric_value>,<numeric_value>..

This command defines the X axis values (frequencies or times) of the upper or lower limit lines. The values are defined independently of the measurement window.

The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit lines have to be identical. Otherwise default values are entered for missing values or not required values are deleted.

In analyzer mode, the unit of values depends on the frequency or time domain of the X axis, i.e. it is HZ with CALC:LIM:CONT:DOM FREQ and S with CALC:LIM:CONT:DOM TIME.

Example: "CALC:LIM2:CONT 1MHz,30MHz,100MHz, 300MHz,1GHz"
'Defines 5 reference values for the X axis of limit line 2

"CALC:LIM2:CONT?"
'Outputs the reference values for the X axis of limit line 2 separated by a comma.

Characteristics: *RST value: - (LIMit:STATe is set to OFF)
SCPI: conforming

Mode: R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:DOMain   FREQuency | TIME

This command defines the frequency or time domain for the x axis values.

Example: "CALC:LIM2:CONT:DOM TIME"
'Defines the time domain for the X axis of limit line 2.

Characteristics: *RST value: FREQuency
SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:OFFSet   <numeric_value>

This command defines an offset for the X axis value of the selected relative limit line in the frequency or time domain.

The unit of values depends on the frequency or time domain of the X axis, i.e. it is HZ with CALC:LIM:CONT:DOM FREQ and S with CALC:LIM:CONT:DOM TIME.

Example: "CALC:LIM2:CONT:OFFS 100us"
'Sets the X offset for limit line 2 (defined in the time domain) to 100µs.

Characteristics: *RST value: 0
SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:MODE RELative | ABSolute

This command selects the relative or absolute scaling for the X axis of the selected limit line. The definition is independent of the measurement window.

Example: `"CALC:LIM2:CONT:MODE REL"`
'Defines the X axis of limit line 2 as relatively scaled.

Characteristics: *RST value: ABSolute
SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:SHIFt <numeric_value>

This command moves a limit line by the indicated value in x direction. In contrast to `CALC:LIM:CONT:OFFS`, the line is shifted by modifying the individual x values and not by means of an additive offset. The shift is independent of the measurement window.

In the analyzer mode, the unit of values depends on the frequency or time domain of the X axis, i.e. it is HZ with `CALC:LIM:CONT:DOM FREQ and S with CALC:LIM:CONT:DOM TIME.`

Example: `"CALC:LIM2:CONT:SHIF 50KHZ"`
'Shifts all reference values of limit line 2 by 50 kHz.

Characteristics: *RST value: --
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:LIMit<1 ... 8>:CONTrol:SPACing LINear | LOGarithmic

This command selects linear or logarithmic interpolation for the calculation of limit lines from frequency points.

Example: `"CALC:LIM:CONT:SPAC LIN"`

Characteristics: *RST value: LIN
SCPI: device-specific

Mode: R, A

CALCulate:LIMit:LOWer Subsystem

The CALCulate:LIMit:LOWer subsystem defines the lower limit line. This subsystem is not available in receiver mode.

CALCulate<1|2>:LIMit<1 to 8>:LOWer[:DATA]   <numeric_value>,<numeric_value>..

This command defines the values for the selected lower limit line independently of the measurement window.

The number of values for the CONTrol axis and for the corresponding LOWer limit line has to be identical. Otherwise default values are entered for missing values or not necessary values are deleted.

The unit must be identical with the unit selected by CALC:LIM:UNIT. If no unit is indicated, the unit defined with CALC:LIM:UNIT is automatically used.

If the measured values are smaller than the LOWer limit line, the limit check signals errors.

The units DEG, RAD, S, HZ, PCT are not available in the *RECEIVER* mode.

Example:	"CALC:LIM2:LOW -30,-40,-10,-40,-30" 'Defines 5 lower limit values for limit line 2 in the preset unit.
	"CALC:LIM2:LOW?" 'Outputs the lower limit values of limit line 2 separated by a comma.
Characteristics:	*RST value: - (LIMit:STATe is set to OFF) SCPI: conforming
Mode:	A, FM

CALCulate<1|2>:LIMit<1 to 8>:LOWer:STATe   ON | OFF

This command switches on or off the indicated limit line in the selected measurement window. The limit check is activated separately with CALC:LIM:STAT ON.

In analyzer mode, the result of the limit check can be queried with CALCulate:LIMit<1 to 8>: FAIL?.

Example:	"CALC:LIM4:LOW:STAT ON" 'Switches on limit line 4 (lower limit) in screen A.
	"CALC2:LIM4:LOW:STAT ON" 'Switches on limit line 4 (lower limit) also in screen B.
Characteristics:	*RST value: OFF SCPI: conforming
Mode:	A, FM

CALCulate<1|2>:LIMit<1 to 8>:LOWer:OFFSet   <numeric_value>

This command defines an offset for the Y axis of the selected relative lower limit line. In contrast to CALC:LIM:LOW:SHIFt, the line is not shifted by modifying the individual Y values but by means of an additive offset. The offset is independent of the measurement window.

Example:	"CALC:LIM2:LOW:OFFS 3dB" 'Shifts limit line 2 in the corresponding measurement windows by 3 dB upwards.
Characteristics:	*RST value: 0 SCPI: device-specific
Mode:	A, FM

CALCulate<1|2>:LIMit<1 to 8>:LOWer:MARGin   <numeric_value>

This command defines a margin to a lower limit line, at which out-of-limit values are signaled (if the limit check is active), but not handled as a violation of the limit value. The margin is independent of the measurement window.

Example: `"CALC:LIM:LOW:MARG 10dB"`

Characteristics: *RST value: 0
                         SCPI: device-specific

Mode: A, FM

CALCulate<1|2>:LIMit<1 to 8>:LOWer:MODE   RELative | ABSolute

This command selects the relative or absolute scaling for the Y axis of the selected lower limit line. The setting is independent of the measurement window.

Selecting RELative causes the unit to be switched to DB.

Example: `"CALC:LIM:LOW:MODE REL"`
                       'Defines the Y axis of limit line 2 as relative scaled.

Characteristics: *RST value: ABSolute
                         SCPI: device-specific

Mode: A, FM

CALCulate<1|2>:LIMit<1 to 8>:LOWer:SHIFt   <numeric_value>

This command shifts a limit line by the indicated value in Y direction. In contrast to `CALC:LIM:LOW:OFFS`, the line is shifted by modifying the individual Y values but not by means of an additive offset. The shift is independent of the measurement window.

Example: `"CALC:LIM3:LOW:SHIF 20DB"`
                       'Shifts all Y values of limit line 3 by 20 dB.

Characteristics: *RST value: --
                         SCPI: device-specific

Mode: A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:LIMit<1 to 8>:LOWer:SPACing   LINear | LOGarithmic

This command selects linear or logarithmic interpolation for the lower limit line.

Example: `"CALC:LIM:LOW:SPAC LIN"`

Characteristics: *RST value: LIN
                         SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:LOWer:THReshold   <numeric_value>

This command defines an absolute threshold value for limit lines with relative Y axis scaling independently of the measurement window. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with `CALC:LIM:UNIT` (except dB which is not allowed). If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used (exception: dBm instead of dB).

Example: `"CALC:LIM2:LOW:THR -35DBM"`
                    'Defines an absolute threshold value for limit line 2.

Characteristics: *RST value: -200 dBm

                      SCPI: device-specific

Mode: R, A, FM

CALCulate:LIMit:UPPer Subsystem

The CALCulate:LIMit:UPPer subsystem defines the upper limit line.

CALCulate<1|2>:LIMit<1 to 8>:UPPer[:DATA]   <numeric_value>,<numeric_value>..

     This command defines the values for the upper limit lines independently of the measurement window.

     The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit line have to be identical. Otherwise default values are entered for missing values or not necessary values are deleted.

     The unit must be identical with the unit selected by CALC:LIM:UNIT. If no unit is indicated, the unit defined with CALC:LIM:UNIT is automatically used.

Example:	"CALC:LIM2:UPP -10,0,0,-10,-5" 'Defines 5 upper limit values for limit line 2 in the preset unit. "CALC:LIM2:UPP?" 'Outputs the upper limit values for limit line 2 separated by a comma.
Characteristics:	*RST value: - (LIMit:STATe is set to OFF) SCPI: conforming
Mode:	R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:UPPer:STATe   ON | OFF

     This command switches on or off the indicated limit line in the selected measurement window. The limit check is activated separately with CALC:LIM:STAT ON.

Example:	"CALC1:LIM4:UPP:STAT ON" 'Switches on limit line 4 (upper limit) in screen A. "CALC2:LIM4:UPP:STAT ON" 'Switches on limit line 4 (upper limit) in screen B.
Characteristics:	*RST value: OFF SCPI: conforming
Mode:	R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:UPPer:OFFSet   <numeric_value>

     This command defines an offset for the Y axis of the selected relative upper limit line. In contrast to CALC:LIM:UPP:SHIFt, the line is not shifted by modifying the individual Y values but by means of an additive offset. The offset is independent of the measurement window.

Example:	"CALC:LIM2:UPP:OFFS 3dB" 'Shifts limit line 2 by 3 dB upwards in the corresponding measurement windows.
Characteristics:	*RST value: 0 SCPI: device-specific
Mode:	R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:UPPer:MARGin   <numeric_value>

This command defines a margin to an upper limit line, at which out-of-limit values are signaled (if the limit check is active), but not handled as a violation of the limit value. The margin is independent of the measurement window.

Example:	"`CALC:LIM2:UPP:MARG 10dB`"
	'Defines the margin of limit line 2 to 10 dB below the limit value.

Characteristics:	*RST value: 0
	SCPI: device-specific

Mode:	R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:UPPer:MODE   RELative | ABSolute

This command selects the relative or absolute scaling for the Y axis of the selected upper limit line. The setting is independent of the measurement window.

Selecting RELative causes the unit to be switched to DB.

Example:	"`CALC:LIM2:UPP:MODE REL`"
	'Defines the Y axis of limit line 2 as relative scaled.

Characteristics:	*RST value: ABSolute
	SCPI: device-specific

Mode:	R, A, FM

CALCulate<1|2>:LIMit<1 to 8>:UPPer:SHIFt   <numeric_value>

This command moves a limit line by the indicated value in Y direction. In contrast to `CALC:LIM:UPP:OFFS`, the line is shifted by modifying the individual Y values and not by means of an additive offset. The shift is independent of the measurement window.

Example:	"`CALC:LIM3:UPP:SHIF 20DB`"
	'Shifts all Y values of limit line 3 by 20 dB.

Characteristics:	*RST value: --
	SCPI: device-specific

Mode:	R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:LIMit<1 to 8>:UPPer:SPACing   LINear | LOGarithmic

This command selects linear or logarithmic interpolation for the upper limit line.

Example:	"`CALC:LIM:UPP:SPAC LIN`"

Characteristics:	*RST value: LIN
	SCPI: device-specific

Mode:	R, A

CALCulate<1|2>:LIMit<1 to 8>:UPPer:THReshold   <numeric_value>

This command defines an absolute threshold value for limit lines with relative Y axis scaling independently of the measurement window. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with `CALC:LIM:UNIT` (except dB which is not possible). If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used (exception: dBm instead of dB).

Example: `"CALC:LIM2:UPP:THR -35DBM"`
'Defines an absolute threshold value

for limit line 2.

Characteristics: *RST value: -200 dBm

SCPI: device-specific

Mode: R, A, FM

CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the instrument. The measurement windows are assigned to CALCulate 1 (screen A) or 2 (screen B).

In receiver mode the markers can only be activated after a scan is carried out.

CALCulate<1|2>:MARKer<1 to 4>[:STATe]   ON | OFF

This command switches on or off the currently selected marker in the selected measurement window. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

Example: `"CALC:MARK3 ON"`
                    'Switches marker 3 in screen A on or to marker mode.

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:MARKer<1 to 4>:AOFF

This command switches off all active markers in the selected measurement window. All delta markers and active marker/delta marker measurement functions are switched off.

Example: `"CALC:MARK:AOFF"`
                    'Switches off all markers in screen A.

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:TRACe   1 to 3

This command assigns the selected marker (1 to 4) to the indicated measurement curve in the selected measurement window. The corresponding trace must be active, i.e. its status must be different from "BLANK".

If necessary the corresponding marker is switched on prior to the assignment.

Example: `"CALC:MARK3:TRAC 2"`
                    'Assigns marker 3 in screen A to trace 2.

                    `"CALC2:MARK:TRAC 3"`
                    'Assigns marker 1 in screen B to trace 3.

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:MARKer<1 to 4>:X   0 to MAX (frequency | sweep time)

This command positions the selected marker to the indicated frequency (span > 0), time (span = 0) or level (APD measurement or CCDF measurement ON) in the selected measurement window. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

Example: `"CALC1:MARK2:X 10.7MHz"`
                      'Positions marker 2 in screen A to frequency 10.7 MHz.

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits[:STATe]   ON | OFF

This command switches between a limited (ON) and unlimited (OFF) search range in the selected measurement window. The function is independent of the selection of a marker, i.e. the numeric suffix MARKer<1 to 4> is irrelevant.

If the time domain power measurement is active, this command limits the evaluation range on the trace.

Example: `"CALC:MARK:X:SLIM ON"`
                      'Switches on search limitation in screen A.

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits:LEFT   0 to MAX (frequency | sweep time)

This command sets the left limit of the search range for markers and delta markers in the selected measurement window. Depending on the x axis domain the indicated value defines a frequency (span > 0) or time (span = 0). The function is independent of the selection of a marker, i.e. the numeric suffix in MARKer<1 to 4> is irrelevant.

If the time domain power measurement is active, this command limits the evaluation range to the trace.

Note

The function is only available if the search limit for marker and delta marker is switched on (`CALC:MARK:X:SLIM ON`).

Example: `"CALC:MARK:X:SLIM ON"`
                      'Switches the search limit function on for screen A.

                      `"CALC:MARK:X:SLIM:LEFT 10MHz"`
                      'Sets the left limit of the search range in screen A to 10 MHz.

Characteristics: *RST value: - (is set to the left diagram border on switching on search limits)
                      SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits:RIGHt   0 to MAX (frequency | sweep time)

This command sets the right limit of the search range for markers and delta markers in the selected measurement window. Depending on the x axis domain the indicated value defines a frequency (span > 0) or time (span = 0). The function is independent of the selection of a marker, i.e. the numeric suffix in MARKer<1 to 4> is irrelevant.

If the time domain power measurement is active, this command limits the evaluation range to the trace.

Note

The function is only available if the search limit for marker and delta marker is switched on (`CALC:MARK:X:SLIM ON`).

Example: `"CALC:MARK:X:SLIM ON"`
'Switches the search limit function on for screen A.

`"CALC:MARK:X:SLIM:RIGH 20MHz"`
'Sets the right limit of the search range in screen A to 20 MHz.

Characteristics: *RST value: - (is set to the right diagram border on switching on search limits)
SCPI: device-specific

Mode: R, A, FM

CALCulate<1|2>:MARKer<1 to 4>:COUNt   ON | OFF

This command switches on or off the frequency counter at the marker position in the selected measurement window. The count result is queried with `CALCulate:MARKer:COUNt:FREQuency?`.

Frequency counting is possible only for one marker at a time for each measurement window. If it is activated for another marker, it is automatically de-activated for the previous marker.

It should be noted that a complete sweep must be performed after switching on the frequency counter to ensure that the frequency to be measured is actually reached. The synchronization to the sweep end required for this is possible only in single-sweep mode.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

`"CALC:MARK ON"`
'Switches on marker 1 in screen A.

`"CALC:MARK:COUN ON"`
'Switches on the frequency counter for marker 1.

`"INIT;*WAI"`
'Starts a sweep and waits for the end.

`"CALC:MARK:COUN:FREQ?"`
'Outputs the measured value in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, FM

CALCulate<1|2>:MARKer<1 to 4>:COUNt:RESolution   0.1 | 1 | 10 | 100 | 1000 | 10000 Hz

This command specifies the resolution of the frequency counter in the selected measurement window. The setting is independent of the selected marker, i.e. the numeric suffix in MARKer<1 to 4> is irrelevant.

Example:	`"CALC:MARK:COUN:RES 1kHz"` 'Sets the resolution of the frequency counter to 1 kHz.
Characteristics:	*RST value: 1kHz SCPI: device-specific
Mode:	A, FM

CALCulate<1|2>:MARKer<1 to 4>:COUNt:FREQuency?

This command queries the result of the frequency counter for the indicated marker in the selected measurement window. Before the command, the frequency counter should be switched on and a complete measurement performed to obtain a valid count result. Therefore, a single sweep with synchronization must be performed between switching on the frequency counter and querying the count result.

Example:	`"INIT:CONT OFF"`
	'Switches to single-sweep mode.
	
	`"CALC:MARK2 ON"`
	'Switches marker 2 in screen A.
	
	`"CALC:MARK2:COUN ON"`
	'Switches the frequency counter for marker 2.
	
	`"INIT;*WAI"`
	'Starts a sweep and waits for the end.
	
	`"CALC:MARK2:COUN:FREQ?"`
	'Outputs the measured value of marker 2 in screen A.

Characteristics:	*RST value: - SCPI: device-specific
Mode:	A

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:COUPled[:STATe]   ON | OFF

This command switches the coupling of the receiver frequency to the marker on or off.

Example:	`"CALC:MARK:COUP ON"` 'marker coupling is switched on
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	R

The numeric suffix in MARKer<1 to 4> is irrelevant.

CALCulate<1|2>:MARKer<1 to 4>:SCOupled[:STATe]   ON | OFF

This command switches the coupling of the receiver frequency settings from the corresponding subscans to the marker frequency on or off.

Example: ":CALC:MARK:SCO ON"

Characteristics: *RST value: ON
                      SCPI: device-specific

Mode: R

The numeric suffix in MARKer<1 to 4> is not significant.

CALCulate<1|2>:MARKer<1 to 4>:LOEXclude   ON | OFF

This command switches the local oscillator suppression for peak search on or off. This setting is valid for all markers and delta markers in all measurement windows. The numeric suffixes 1|2 and 1 to 4 are irrelevant.

Example: "CALC:MARK:LOEX ON"

Characteristics: *RST value: ON
                      SCPI: device-specific

Mode: A-F, FM

CALCulate<1|2>:MARKer<1 to 4>:Y?

This command queries the measured value of the selected marker in the selected measurement window. The corresponding marker is activated before or switched to marker mode, if necessary.

To obtain a valid query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the marker and the query of the y value. This is only possible in single sweep mode.

The query result is output in the unit determined with CALCulate:UNIT.

In the default setting, the output is made depending on the unit determined with CALC:UNIT; only with linear level scaling is the output in %.

If the FM Demodulator (FS-K7) is activated, the query result is output in the following units:

*   Result display FM: Hz

*   Result display RF POWER LOG: dBm

*   Result display RF POWER LIN: %

*   Result display SPECTRUM LOG: dBm

*   Result display SPECTRUM LIN: %

Example: "INIT:CONT OFF"
                      'Switches to single-sweep mode.

                      "CALC:MARK2 ON"
                      'Switches marker 2 in screen A.

                      "INIT;*WAI"
                      'Starts a sweep and waits for the end.

                      "CALC:MARK2:Y?"
                      'Outputs the measured value of marker 2 in screen A.

Characteristics:	*RST value: - SCPI: device-specific
Mode:	A, FM

CALCulate<1|2>:MARKer<1 to 4>:Y:PERCent　　0 to100%

This command positions the selected marker in the selected window to the given probability. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

> **Note**
>
> The command is only available with the CCDF measurement switched on.
> The associated level value can be determined with the CALC:MARK:X? command.

Example:	`"CALC1:MARK:Y:PERC 95PCT"` 'Positions marker 1 in screen A to a 'probability of 95%.
Characteristics:	*RST value: - SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1 to 4>:MAXimum[:PEAK]

This command positions the marker to the current maximum value of the corresponding trace in the selected measurement window. The corresponding marker is activated first or switched to the marker mode.

> **Note**
>
> If no maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example:	`"CALC:MARK2:MAX"` 'Positions marker 2 in screen A to the maximum value of 'the trace.
Characteristics:	*RST value: - SCPI: device-specific
Mode:	R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:NEXT

This command positions the marker to the next smaller maximum value of the corresponding trace in the selected measurement window.

Note

If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example: "`CALC:MARK2:MAX:NEXT`"
                            'Positions marker 2 in screen A to the next 'lower maximum value.

Characteristics: *RST value: -
                            SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:RIGHt

This command positions the marker to the next smaller maximum value to the right of the current value (i.e. in ascending X values) on the corresponding trace in the selected measurement window.

Note

If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example: "`CALC:MARK2:MAX:RIGH`"
                            'Positions marker 2 in screen A to the next lower maximum value to the right of the current value.

Characteristics: *RST value: -
                            SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:LEFT

This command positions the marker to the next smaller maximum value to the left of the current value (i.e. in descending X values) on the trace in the selected measurement window.

> **Note**
>
> If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example: `"CALC:MARK2:MAX:LEFT"`
'Positions marker 2 in screen A to the next lower maximum value to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum[:PEAK]

This command positions the marker to the current minimum value of the corresponding trace in the selected measurement window. The corresponding marker is activated first or switched to marker mode, if necessary.

> **Note**
>
> If no minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example: `"CALC:MARK2:MIN"`
'Positions marker 2 in screen A to the minimum value of the trace.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:NEXT

This command positions the marker to the next higher minimum value of the corresponding trace in the selected measurement window.

Note

If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example: "CALC:MARK2:MIN:NEXT"
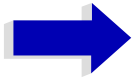'Positions marker 2 in screen A to the next higher maximum value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:RIGHt

This command positions the marker to the next higher minimum value to the right of the current value (i.e. in ascending X direction) on the corresponding trace in the selected measurement window.

Note

If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example: "CALC:MARK2:MIN:RIGH"
'Positions marker 2 in screen A to the next higher minimum value to the right of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:LEFT

This command positions the marker to the next higher minimum value to the left of the current value (i.e. in descending X direction) on the corresponding trace in the selected measurement window.

Note

If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.

Example: `"CALC:MARK2:MIN:LEFT"`
'Positions marker 2 in screen A to the next higher minimum value to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A, FM

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:PEXCursion   <numeric_value>

This command defines the peak excursion, i.e. the spacing below a trace maximum which must be attained before a new maximum is recognized, or the spacing above a trace minimum which must be attained before a new minimum is recognized. The set value is valid for all markers and delta markers. The unit depends on the selected operating mode.

Example: `"CALC:MARK:PEXC 10dB"`
'Defines peak excursion 10 dB in SPECTRUM mode

`"CALC:MARK:PEXC 100 HZ"`
Defines peak excursion 100 Hz in FM DEMOD mode

Characteristics: *RST value: 6dB
SCPI: device-specific

Mode: R, A, FM

The numeric suffix in MARKer<1 to 4> is irrelevant.

CALCulate:MARKer:FUNCtion Subsystem

The measurement window is selected by CALCulate 1 (screen A) or 2 (screen B).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:FPEaks[:IMMediate]   <numeric_value>

This command searches the selected trace for the indicated number of maxima. The results are entered in a list and can be queried with commands `CALC:MARK:FUNC:FPEaks:X?` and `CALC:MARK:FUNC:FPEaks:Y?`. The number of maxima found can be queried with `CALC:MARK:FUNC:FPEaks:COUNt?`. The trace to be examined is selected with `CALC:MARK:TRACe`. The order of the results in the list can be defined with `CALC:MARK:FUNC:FPEaks:SORT`.

> **Note**
>
> The number of maxima found depends on the waveform and value set for the Peak Excursion parameter (CALC:MARK:PEXC), however, a maximum number of 50 maxima are determined. Only the signals which exceed their surrounding values at least by the value indicated by the peak excursion parameter will be recognized as maxima. Therefore, the number of maxima found is not automatically the same as the number of maxima desired.

Example: `"INIT:CONT OFF"`
'switches to single-sweep mode

`"INIT;*WAI"`
'starts measurement and synchronizes to end

`"CALC:MARK:TRAC 1"`
'sets marker 1 in screen A to trace 1

`"CALC:MARK:FUNC:FPE:SORT X"`
'sets the sort mode to increasing X values

`"CALC:MARK:FUNC:FPE 3"`
'searches the 3 highest maxima for trace 1

`"CALC:MARK:FUNC:COUN?"`
'queries the number of maxima found

`"CALC:MARK:FUNC:Y?"`
'queries the level of maxima found

`"CALC:MARK:FUNC:X?"`
'queries the frequencies (span <> 0) or time (span = 0) of maxima found.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:FPEaks:COUNt?

This query reads out the number of maxima found during the search. If no search for maxima has been performed, 0 is returned.

Example: `"CALC:MARK:FUNC:FPE 3"`
'searches the 3 highest maxima for trace 1

`"CALC:MARK:FUNC:FPE:COUN?"`
'queries the number of maxima found

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:FPEaks:X?

This query reads out the list of X values of the maxima found. The number of available values can be queried with `CALC:MARK:FUNC:FPEaks:COUNt?`.

With sort mode X, the X values are in increasing order; with sort mode Y the order corresponds to the decreasing order of the Y values.

Example: `"CALC:MARK:FUNC:FPE:SORT Y"`
'sets the sort mode to decreasing y values

`"CALC:MARK:FUNC:FPE 3"`
'searches the 3 highest maxima for trace 1

`"CALC:MARK:FUNC:FPE:COUN?"`
'queries the number of maxima found

`"CALC:MARK:FPE:FUNC:X?"`
'queries the frequencies (span <> 0) or time (span = 0) of the maxima found.

Return value: `"107.5E6,153.8E6,187.9E6"`
'frequencies in increasing order

`"2.05E-3,2.37E-3, 3.71e-3"`
'times in increasing order

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:FPEaks:Y?

This query reads out the list of X values of the maxima found. The number of available values can be queried with `CALC:MARK:FUNC:FPEaks:COUNt?`.

With sort mode X, the X values are in increasing order; with sort mode Y the order corresponds to the decreasing order of the Y values.

Example:	`"CALC:MARK:FUNC:FPE:SORT Y"` 'sets the sort mode to decreasing y values
	`"CALC:MARK:FUNC:FPE 3"` 'searches the 3 highest maxima for trace 1
	`"CALC:MARK:FUNC:FPE:COUN?"` 'queries the number of maxima found
	`"CALC:MARK:FUNC:FPE:Y?"` 'queries the levels of the maxima found.
Return value:	`"-37.5,-58.3,-59.6"` 'level in decreasing order
Characteristics:	*RST value: -- SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:FPEaks:SORT   X | Y

This command sets the sort mode for the search for maxima:

Parameter:	X: the maxima are sorted in the list of responses according to increasing X values
	Y: the maxima are sorted in the list of responses according to decreasing Y values
Example:	`"CALC:MARK:FUNC:FPE:SORT Y"` 'sets the sort mode to decreasing y values
Characteristics:	*RST value: -- SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown   <numeric_value>

This command defines the level spacing of the two delta markers to the right and left of marker 1 in the selected measurement window. Marker 1 is always used as the reference marker. The numeric suffix <1 to 4> is irrelevant for this command.

The temporary markers T1 and T2 are positioned by n dB below the active reference marker. The frequency spacing of these markers can be queried with `CALCulate:MARKer:FUNCtion:NDBDown:RESult?`.

Example:	`"CALC:MARK:FUNC:NDBD 3dB"` 'Sets the level spacing in screen A to 3 dB.
Characteristics:	*RST value: 6dB SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:STATe   ON | OFF

This command switches the "N dB Down" function on or off in the selected measurement window. Marker 1 is activated first, if necessary. The numeric suffix <1 to 4> is irrelevant for this command.

Example: `"CALC:MARK:FUNC:NDBD:STAT ON"`
'Switches on the N-dB-down function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:RESult?

This command queries the frequency spacing (bandwidth) of the N-dB-down markers in the selected measurement window. The numeric suffix <1 to 4> is irrelevant for this command.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value in order to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

                      `"CALC:MARK:FUNC:NDBD ON"`
'Switches on the n-dB-down function in screen A.

                      `"INIT;*WAI"`
'Starts a sweep and waits for the end.

                      `"CALC:MARK:FUNC:NDBD:RES?"`
'Outputs the measured value of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:FREQuency?

This command queries the two frequencies of the N-dB-down marker in the selected measurement window. The numeric suffix <1 to 4> is irrelevant for this command. The two frequency values are separated by comma and output in ascending order.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

                      `"CALC:MARK:FUNC:NDBD ON"`
'Switches on the n-dB-down function in screen A.

                      `"INIT;*WAI"`
'Starts a sweep and waits for the end.

                      `"CALC:MARK:FUNC:NDBD:FREQ?"`
'Outputs the frequencies of the temporary markers in screen A.

Characteristics: *RST value: -
                        SCPI: device-specific

Mode: A

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:TIME?

This command queries the two time values of the "N dB Down" markers in the specified measurement window. The suffix <1 to 4> has no meaning with this command. The two time values are output in ascending order, separated by commas.

To obtain a valid query response, a complete sweep with synchronization to the sweep end must have been performed in between activating the function and querying the measurement results. This is possible only in single-sweep mode.

Example: `"INIT:CONT OFF"`
                        'Switches to single-sweep mode.

                        `"CALC:MARK:FUNC:NDBD ON"`
                        'Switches on the "N dB Down" function in screen A.

                        `"INIT;*WAI"`
                        'Starts a sweep and waits for the end.

                        `"CALC:MARK:FUNC:NDBD:TIME?"`
                        'Outputs the time values of the temporary markers in screen A.

Characteristics: *RST value: -
                        SCPI: device-specific

Mode: A-T

This command is a query only and thus has no *RST value

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ZOOM   <numeric_value>

This command defines the range to be zoomed around marker 1 in the selected measurement window. Marker 1 is activated first, if necessary.

The frequency at the marker position becomes the new center frequency at the diagram. The results of a previous measured scan are displayed in the activated frequency range.

Example: `"INIT:CONT OFF"`
                        'Switches to single-sweep mode

                        `"CALC:MARK:FUNC:ZOOM 1kHz;*WAI"`
                        'Activates zooming in screen A and waits for its end.

Characteristics: *RST value: -
                        SCPI: device-specific

Mode: R, A

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe[:STATe]   ON | OFF

This command switches the noise measurement on or off for all markers of the indicated measurement window. The noise power density is measured at the position of the markers. The result can be queried with `CALCulate:MARKer:FUNCtion:NOISe:RESult?`.

Example: `"CALC2:MARK:FUNC:NOIS ON"`
                     'Switches on the noise measurement for screen B.

Characteristics: *RST value: OFF
                     SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe:RESult?

This command queries the result of the noise measurement.

A complete sweep with synchronization to the sweep end must be performed between switching on the function and querying the measured value in order to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
                     'Switches to single-sweep mode.

                     `"CALC:MARK2 ON"`
                     'Switches on marker 2 in screen A.

                     `"CALC:MARK:FUNC:NOIS ON"`
                     'Switches on noise measurement in screen A.

                     `"INIT;*WAI"`
                     'Starts a sweep and waits for the end.

                     `"CALC:MARK2:NOIS:RES?"`
                     'Outputs the noise result of marker 2 in screen A.

Characteristics: *RST value: -
                     SCPI: device-specific

Mode: A

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:SELect   AM | FM

This command selects the demodulation type for the audio demodulator. The command is independent of the measurement window and of the selected marker, i.e. suffixes 1|2 and 1 to 4 are irrelevant.

Note

In receiver mode the audio demodulator is controlled by the SENSe:DEMod subsystem.

Example:	`"CALC:MARK:FUNC:DEM:SEL FM"`
Characteristics:	*RST value: AM SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation[:STATe]   ON | OFF

This command switches on or off the audio demodulator when the indicated marker is reached in the selected measurement window. In the frequency domain (span > 0) the hold time can be defined at the corresponding marker position with `CALCulate:MARKer:FUNCtion: DEModulation:HOLD`. In the time domain (span = 0) the demodulation is permanently active.

Example:	`"CALC2:MARK3:FUNC:DEM ON"` 'Switches on the demodulation for marker 3 in screen B.
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:HOLDoff   10ms to 1000s

This command defines the hold time at the marker position for the demodulation in the frequency domain (span > 0). The setting is independent of the measurement window and the selected marker, i.e. the suffixes <1|2> and <1 to 4> are irrelevant

Example:	`"CALC:MARK:FUNC:DEM:HOLD 3s"`
Characteristics:	*RST value: - (DEModulation is set to OFF) SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:CONTinuous   ON | OFF

This command switches on or off the continuous demodulation in the frequency domain (span >0) in the selected measurement window. Thus acoustic monitoring of the signals can be performed in the frequency domain. The function does not depend on the selected marker, i.e. the numeric suffix <1 to 4> is irrelevant.

Example:	`"CALC2:MARK3:FUNC:DEM:CONT ON"` 'Switches on the continuous demodulation in screen B.
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SQUelch[:STATe]   ON | OFF

This command enables or disables the squelch function for the audio output.

Example:	`"CALC:MARK:FUNC:DEM:SQU ON"`
Characteristics:	*RST value: OFF
Mode:	A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SQUelch:LEVel   0...100 PCT

This command sets the trigger level for the squelch function.

Example: `"CALC:MARK:FUNC:DEM:SQU:LEV 80 PCT"`

Characteristics: *RST value: 50%

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth[:STATe]

This command switches on the measurement of the AM modulation depth. An AM-modulated carrier is required on the screen for correct operation. If necessary, marker 1 is previously activated and set to the largest signal available.

The level value of marker 1 is regarded as the carrier level. On activating the function, marker 2 and marker 3 are automatically set as delta markers symmetrically to the carrier to the adjacent maxima of the trace.

If the position of delta marker 2 is changed, delta marker 3 is moved symmetrically with respect to the reference marker (marker 1). If the position of delta marker 3 is changed, fine adjustment can be performed independently of delta marker 2.

The R&S ESU calculates the power at the marker positions from the measured levels.

The AM modulation depth is calculated from the ratio of power values at the reference marker and the delta markers. If the two AM sidebands differ in power, the average value of the two power values is used for calculating the AM modulation depth.

The numeric suffix <1 to 4> of :MARKer is irrelevant with this command.

Example: `"CALC:MARK:X 10MHZ"`
'Sets the reference marker (marker 1) to the carrier signal at 10 MHz

                    `"CALC:MARK:FUNC:MDEP ON"`
'Switches on the modulation depth measurement in screen A.

                    `"CALC:DELT2:X 10KHZ"`
'Sets delta markers 2 and 3 to the signals at 10 kHz from the carrier signal

                    `"CALC:DELT3:X 9.999KHZ"`
'Corrects the position of delta marker 3 relative to delta marker 2.

Characteristics: *RST value: OFF
                    SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth:RESult?

This command queries the AM modulation depth in the indicated measurement window.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

The numeric suffix <1 to 4> of :MARKer is irrelevant for this command.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

`"CALC:MARK:X 10MHZ"`
'Sets the reference marker (marker 1) to the carrier signal at 10 MHz.

`"CALC:MARK:FUNC:MDEP ON"`
'Switches on the modulation depth measurement in screen A.

`"INIT;*WAI"`
'Starts a sweep and waits for the end.

`"CALC:MARK:FUNC:MDEP:RES?"`
'Outputs the measured value of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:TOI[:STATe]   ON | OFF

This command initiates the measurement of the third-order intercept point.

A two-tone signal with equal carrier levels is expected at the RF input of the instrument. Marker 1 and marker 2 (both normal markers) are set to the maximum of the two signals. Delta marker 3 and delta marker 4 are positioned to the intermodulation products. The delta markers can be modified separately afterwards with the commands `CALCulate:DELTamarker3:X` and `CALCulate:DELTamarker4:X`.

The third-order intercept is calculated from the level spacing between the normal markers and the delta markers.

The numeric suffix <1 to 4> of :MARKer is irrelevant for this command.

Example: `"CALC:MARK:FUNC:TOI ON"`
'Switches on the measurement of the third-order intercept in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:TOI:RESult?

This command queries the third-order intercept point measurement in the indicated measurement window.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

The numeric suffix <1 to 4> of :MARKer is irrelevant of this command.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

`"CALC:MARK:FUNC:TOI ON"`
'Switches the intercept measurement in screen A.

`"INIT;*WAI"`
'Starts a sweep and waits for the end.

`"CALC:MARK:FUNC:TOI:RES?"`
'Outputs the measured value of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CENTer

This command sets the receiver or center frequency of the selected measurement window equal to the frequency of the indicated marker.

If marker 2, 3 or 4 is selected and used as delta marker, it is switched to the marker mode.

Example: `"CALC:MARK2:FUNC:CENT"`
'Sets the receiver frequency to the frequency of marker 2.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A-F

This command is an "event" and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CSTep

This command sets the step width of the receiver or center frequency in the selected measurement window to the X value of the current marker.   If marker 2, 3 or 4 is selected and used as delta marker, it is switched to the marker mode.

Example: `"CALC2:MARK2:FUNC:CST"`
'Sets the receiver frequency to the same value as the frequency of marker 2.

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A-F

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:REFerence

This command sets the reference level in the selected measurement window to the power measured by the indicated marker. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

Example:	`"CALC:MARK2:FUNC:REF"`
	'Sets the reference level of screen A to the level of marker 2.

Characteristics:	*RST value: -
	SCPI: device-specific

Mode:	R, A

This command is an event and therefore has no *RST value and no query.

CALCulate:MARKer:FUNCtion:HARMonics Subsystem

The CALCulate:MARKer:FUNCtion:HARMonics subsystem contains the commands for Harmonic Distortion measurement

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:HARMonics[:STATe]   ON | OFF

This command switches on or off the measurement of the harmonics of a carrier signal. The carrier signal is the first harmonic. The function is independent of the marker selection, i.e. the suffix `<1|2>` or `<1 to 4>` of `CALCulate` or `MARKer` is irrelevant. It is only available in the frequency domain (span > 0).

If the measurement is started in the frequency domain (span > 0), the last span will define the search range for the first harmonic. The level for the first harmonic will also be calculated in the frequency domain. However, the measurement can also be started in the time domain (span = 0), in which case the center frequency and the level used will remain unchanged.

Example: `"CALC:MARK:FUNC:HARM ON"`
                      'Switches on the measurement of harmonics.

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:HARMonics:NHARmonics   1 to 10

This command defines the number of harmonics of a carrier signal to be measured. The function is independent of the marker selection, i.e. the suffix `<1|2>` or `<1 to 4>` of `CALCulate` or `MARKer` is irrelevant.

Example: `"CALC:MARK:FUNC:HARM:NHARM 3"`
                      'Sets the number of harmonics to be measured to 3.

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: A-F

CALCulate:MARKer:FUNCtion:POWer Subsystem

The CALCulate:MARKer:FUNCtion:POWER subsystem contains the commands for control of power measurement.

CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect ACPower | CPOWer | MCACpower | OBANdwidth | OBWidth | CN | CN0

This command selects – and switches on – one of the above types of power measurement in the selected measurement window. This function is independent of the selected marker, i.e. the numerical suffix <1...4> appended to MARKer has no effect.

The channel spacings and channel bandwidths are configured in the `SENSe:POWer:ACHannel` subsystem.

Please note the following:

If CPOWer is selected, the number of adjacent channels (command: `[SENSe:]POWer:ACHannel:ACPairs`) is set to 0. If ACPower is selected, the number of adjacent channels is set to 1, unless adjacent-channel power measurement is switched on already.

Note

The channel/adjacent-channel power measurement is performed for the trace selected with `SENSe:POWer:TRACe 1|2|3`.

The occupied bandwidth measurement is performed for the trace on which marker 1 is positioned. To select another trace for the measurement, marker 1 is to be positioned on the desired trace by means of `CALC:MARK:TRAC 1|2|3`.

Parameter:	ACPower: Adjacent-channel power measurement with a single carrier signal
	CPOWer: Channel power measurement with a single carrier signal (equivalent to adjacent-channel power measurement with *NO. OF ADJ CHAN* = 0)
	MCACpower: Channel/adjacent-channel power measurement with several carrier signals
	OBANdwidth	OBWidth: Measurement of occupied bandwidth
	CN: Measurement of carrier-to-noise ratio
	CN0: Measurement of carrier-to-noise ratio referenced to 1 Hz bandwidth
Example:	`"CALC:MARK:FUNC:POW:SEL ACP"` 'Switches on adjacent-channel power measurement in window A.
Characteristics:	*RST value: - SCPI: device-specific
Mode:	A-F

CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? ACPower | CPOWer | MCACpower |
OBANdwidth | OBWidth | CN | CN0

This command queries the result of the power measurement performed in the selected window. If necessary, the measurement is switched on prior to the query.

The channel spacings and channel bandwidths are configured in the `SENSe:POWer:ACHannel` subsystem.

To obtain a valid result, a complete sweep with synchronization to the end of the sweep must be performed before a query is output. Synchronization is possible only in the single-sweep mode.

Parameters:

ACPower: Adjacent-channel power measurement

Results are output in the following sequence, separated by commas:

1. Power of transmission channel

2. Power of lower adjacent channel

3. Power of upper adjacent channel

4. Power of lower alternate channel 1

5. Power of upper alternate channel 1

6. Power of lower alternate channel 2

7. Power of upper alternate channel 2

The number of measured values returned depends on the number of adjacent/ alternate channels selected with `SENSe:POWer:ACHannel:ACPairs`.

With logarithmic scaling (RANGE LOG), the power is output in the currently selected level unit; with linear scaling (RANGE LIN dB or LIN %), the power is output in W. If `SENSe:POWer:ACHannel:MODE REL` is selected, the adjacent/ alternate-channel power is output in dB.

CPOWer: Channel power measurement

With logarithmic scaling (RANGE LOG), the channel power is output in the currently selected level unit; with linear scaling (RANGE LIN dB or LIN %), the channel power is output in W.

MCACpower: Channel/adjacent-channel power measurement with several carrier signals

Results are output in the following sequence, separated by commas:

1. Power of carrier signal 1
2. Power of carrier signal 2
3. Power of carrier signal 3
4. Power of carrier signal 4
5. Total power of all carrier signals
6. Power of lower adjacent channel
7. Power of upper adjacent channel
8. Power of lower alternate channel 1
9. Power of upper alternate channel 1
10. Power of lower alternate channel 2
11. Power of upper alternate channel 2

The number of measured values returned depends on the number of carrier signals and adjacent/alternate channels selected with `SENSe:POWer:ACHannel:TXCHannel:COUNt` and `SENSe:POWer:ACHannel:ACPairs`.

If only one carrier signal is measured, the total value of all carrier signals will not be output.

With logarithmic scaling (RANGE LOG), the power is output in dBm; with linear scaling (RANGE LIN dB or LIN %), the power is output in W. If `SENSe:POWer:ACHannel:MODE REL` is selected, the adjacent/alternate-channel power is output in dB.

OBANdwidth | OBWidth: Measurement of occupied bandwidth

The occupied bandwidth in Hz is returned.

CN: Measurement of carrier-to-noise ratio

The carrier-to-noise ratio in dB is returned.

CN0: Measurement of carrier-to-noise ratio referenced to 1 Hz bandwidth.

The carrier-to-noise ratio in dB/Hz is returned.

Example of channel/adjacent-channel power measurement:

`"SENS2:POW:ACH:ACP 3"`	'Sets the number of adjacent/alternate channels in screen B to 3.
`"SENS2:POW:ACH:BAND 30KHZ"`	'Sets the bandwidth of the transmission channel to 30 kHz.
`"SENS2:POW:ACH:BAND:ACH 40KHZ"`	'Sets the bandwidth of each adjacent channel to 40 kHz.
`"SENS2:POW:ACH:BAND:ALT1 50KHZ"`	'Sets the bandwidth of each alternate channel to 50 kHz.
`"SENS2:POW:ACH:BAND:ALT2 60KHZ"`	'Sets the bandwidth of alternate channel 2 to 60 kHz.
`"SENS2:POW:ACH:SPAC 30KHZ"`	'Sets the spacing between the transmission channel and the adjacent channel to 30 kHz, the spacing between the transmission channel and alternate channel 1 to 60 kHz, and the spacing between the transmission channel and alternate channel 2 to 90 kHz.
`"SENS2:POW:ACH:SPAC:ALT1 100KHZ"`	'Sets the spacing between the transmission channel and alternate channel 1 to 100 kHz, and the spacing between the transmission channel and alternate channel 2 to 150 kHz.
`"SENS2:POW:ACH:SPAC:ALT2 140KHZ"`	'Sets the spacing between the transmission channel and alternate channel 2 to 140 kHz.
`"SENS2:POW:ACH:MODE ABS"`	'Switches on absolute power measurement.
`"CALC2:MARK:FUNC:POW:SEL ACP"`	'Switches on the adjacent-channel power measurement in screen B.
`"INIT:CONT OFF"`	'Switches over to single-sweep mode.
`"INIT;*WAI"`	'Starts a sweep and waits for the end of the sweep.
`"CALC2:MARK:FUNC:POW:RES? ACP"`	'Queries the result of adjacent-channel power measurement in screen B.
`"SENS2:POW:ACH:REF:AUTO ONCE"`	'Defines the measured channel power as the reference value for relative power measurements.

If the **channel power only** is to be measured, all commands relating to adjacent/alternate channel bandwidth and channel spacings are omitted. The number of adjacent/alternate channels is set to 0 with `SENS2:POW:ACH:ACP 0`.

Example of occupied bandwidth measurement:

`"SENS2:POW:BAND 90PCT"`	'Defines 90% as the percentage of the power to be contained in the bandwidth range to be measured.
`"INIT:CONT OFF"`	'Switches over to single-sweep mode.
`"INIT;*WAI"`	'Starts a sweep and waits for the end of the sweep.
`"CALC2:MARK:FUNC:POW:RES? OBW"`	'Queries the occupied bandwidth measured in screen B.

Characteristics: *RST value: -
                        SCPI: device-specific

Mode: A-F

This command is a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult:PHZ   ON | OFF

This command switches the query response of the power measurement results in the indicated measurement window between output of absolute values (OFF) and output referred to the measurement bandwidth (ON).

The measurement results are output with `CALCulate:MARKer:FUNCtion:POWer:RESult?`

Parameter: **ON:** Results output referred to measurement bandwidth.
                        OFF: Results output in absolute values.

Example of channel/adjacent channel measurement:

`"SENS2:POW:ACH:ACP 3"`	'Sets the number of adjacent channels in screen B to 3.
`"SENS2:POW:ACH:BAND 30KHZ"`	'Sets the bandwidth of the main channel to 30 kHz.
`"SENS2:POW:ACH:BAND:ACH 40KHZ"`	'Sets the bandwidth of all adjacent channels to 40 kHz.
`"SENS2:POW:ACH:BAND:ALT1 50KHZ"`	'Sets the bandwidth of all alternate adjacent channels to 50 kHz.
`"SENS2:POW:ACH:BAND:ALT2 60KHZ"`	'Sets the bandwidth of alternate adjacent channel 2 to 60 kHz.
`"SENS2:POW:ACH:SPAC 30KHZ"`	'Sets the spacing between channel and adjacent channel as well as between all adjacent channels to 30 kHz.
`"SENS2:POW:ACH:SPAC:ALT1 40KHZ"`	'Sets the spacing between adjacent channel and alternate adjacent channel as well as between all alternate adjacent channels to 40 kHz.
`"SENS2:POW:ACH:SPAC:ALT2 50KHZ"`	'Sets the spacing between alternate adjacent channel 1 and alternate adjacent channel 2 to 50 kHz.
`"SENS2:POW:ACH:MODE ABS"`	'Switches on absolute power measurement.
`"CALC2:MARK:FUNC:POW:SEL ACP"`	'Switches the adjacent channel power measurement in screen B.
`"INIT:CONT OFF"`	'Switches to single-sweep mode.
`"INIT;*WAI"`	'Starts a sweep and waits for the end.
`"CALC2:MARK:FUNC:POW:RES:PHZ ON"`	'Output of results referred to the channel bandwidth.
`"CALC2:MARK:FUNC:POW:RES? ACP"`	'Queries the result of the adjacent channel power measurement in screen B referred to the channel bandwidth.

If only the **channel power** is to be measured, all commands for defining the bandwidths of adjacent channels as well as the channel spacings are not necessary. The number of adjacent channels is set to 0 with `SENS2:POW:ACH:ACP 0`.

Characteristics: *RST value: -
                  SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer[:STATe]   OFF

This command switches off the power measurement in the selected measurement window.

Example: `"CALC:MARK:FUNC:POW OFF"`
                  'Switches off the power measurement in screen B.

Characteristics: *RST value: -
                  SCPI: device-specific

Mode: A-F

This command is an event and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:PRESet   NADC | TETRA | PDC | PHS | CDPD | FWCDma | RWCDma | F8CDma | R8CDma | F19Cdma | R19Cdma | FW3Gppcdma | RW3Gppcdma | D2CDma | S2CDma | M2CDma | FIS95A | RIS95A | FIS95C0 | RIS95C0 | FJ008 | RJ008 | FIS95C1 | RIS95C1 | TCDMa | NONE | AWLan | BWLan

This command selects the power measurement setting for a standard in the indicated measurement window and previously switches on the corresponding measurement, if required. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of MARKer is irrelevant.

The configuration for a standard comprises of the parameters weighting filter, channel bandwidth and spacing, resolution and video bandwidth, as well as detector and sweep time.

Meaning of the CDMA standard abbreviations:

FIS95A, F8CDma	CDMA IS95A forward
RIS95A, R8CDma	CDMA IS95A reverse
FJ008, F19CDma	CDMA J-STD008 forward
RJ008, R19CDma	CDMA J-STD008 reverse
FIS95C0	CDMA IS95C Class 0 forward
RIS95C0	CDMA IS95C Class 0 reverse
FIS95C1	CDMA IS95C Class 1 forward
RIS95C1	CDMA IS95C Class 1 reverse
FWCDma	W-CDMA 4.096 MHz forward
RWCDma	W-CDMA 4.096 MHz reverse
FW3Gppcdma	W-CDMA 3.84 MHz forward
RW3Gppcdma	W-CDMA 3.84 MHz reverse
D2CDma	CDMA 2000 direct sequence
S2CDma	CDMA 2000 MC1 multi carrier with 1 carrier
M2CDma	CDMA 2000 MC3 multi carrier with 3 carriers
TCDMa	TD-SCDMA
AWLan	WLAN 802.11a
BWLan	WLAN 802.11b

Note

The settings for standards IS95A and C differ as far as the calculation method of channel spacings is concerned. For IS95A and J-STD008 the spacing is calculated from the center of the main channel to the center of the corresponding adjacent channel, for IS95C from the center of the main channel to the nearest border of the adjacent channel.

Example: `"CALC2:MARK:FUNC:POW:PRES NADC"`
                       'Selects the standard setting for NADC in screen B

Characteristics: *RST value: -
                       SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:MODE   WRITe | MAXHold

This command selects the Clear Write or Maxhold for Channel Power values.

Example: `"CALC:MARK:FUNC:POW:MODE MAXH"`
                       'Maxhold for Channel Power values

Characteristics: *RST value: WRITe
                       SCPI: device-specific

Mode: A-F

CALCulate:MARKer:FUNCtion:STRack Subsystem

The CALCulate:MARKer:FUNCtion:STRack subsystem defines the settings of the signal track.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack[:STATe]   ON | OFF

This command switches the signal-track function on or off for the selected measurement window. The function is independent of the selected marker, i.e. the numeric suffix <1 to 4> of MARKer is irrelevant.

With signal track activated, the maximum signal is determined after each frequency sweep and the center frequency is set to the frequency of this signal. Thus with drifting signals the center frequency follows the signal.

Example: `"CALC:MARK:FUNC:STR ON"`
                  'Switches on the signal track function for screen A.

Characteristics: *RST value: OFF
                     SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:BANDwidth   10Hz to MAX(SPAN)

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:BWIDth   10Hz to MAX(SPAN)

These commands have the same function. For the selected measurement window they define the bandwidth around the center frequency within which the largest signal is searched. The function is independent of the selected marker, i.e. the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the frequency domain (span > 0).

Note

The entry of the search bandwidth is only possible if the Signal Track function is switched on (`CALC:MARK:FUNC:STR ON`).

Example: `"CALC:MARK:FUNC:STR:BAND 1MHZ"`
                  'Sets the search bandwidth for screen A to 1 MHz.

                  `"CALC:MARK:FUNC:STR:BWID 1MHZ"`
                  'Alternative command for the same function.

Characteristics: *RST value: -- (= span/10 on activating the function)
                     SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:THReshold   -330dBm to +30dBm

This command defines the threshold above which the largest signal is searched for in the selected measurement window. The function is independent of the selected marker, i.e. the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the frequency domain (span > 0).

The response unit depends on the settings defined with `CALC:UNIT`.

Note

The entry of the search bandwidth is only possible if the Signal Track function is switched on (`CALC:MARK:FUNC:STR ON`).

Example: `"CALC:MARK:FUNC:STR:THR -50DBM"`
'Sets the threshold for signal tracking in screen A to -50 dBm.

Characteristics: *RST value: -120 dBm
SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:TRACe   1 to 3

This command defines the trace on which the largest signal is searched for in the selected measurement window. The function is independent of the selected marker, i.e. the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the frequency domain (span > 0).

Example: `"CALC2:MARK:FUNC:STR:TRAC 3"`
'Defines trace 3 in screen B as the trace for signal tracking.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: A-F

CALCulate:MARKer:FUNCtion:SUMMary Subsystem

This subsystem contains the commands for controlling the time domain power functions. These are provided in the marker subsystem for reasons of compatibility with the FSE family.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary[:STATe]   ON | OFF

This command switches on or off the previously selected time domain power measurements. Thus one or several measurements can be first selected and then switched on and off together with `CALC:MARK:FUNC:SUMMary:STATe`.

The function is independent of the marker selection, i.e. the suffix of MARKer is irrelevant. It is only available in the time domain (span = 0).

Example: `"CALC:MARK:FUNC:SUMM:STAT ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak[:STATe]   ON | OFF

This command switches on or off the measurement of the positive peak value in the selected measurement window.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the time domain (span = 0).

Example: `"CALC:MARK:FUNC:SUMM:PPE ON"`
'Switches on the function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:RESult?

This command is used to query the result of the measurement of the positive peak value in the selected measurement window. The measurement may have to be switched on previously.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

`"CALC:MARK:FUNC:SUMM:PPE ON"`
'Switches on the function in screen A.

`"INIT;*WAI"`
'Starts a sweep and waits for the end.

`"CALC:MARK:FUNC:SUMM:PPE:RES?"`
'Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:AVERage:RESult?

This command is used to query the result of the measurement of the averaged positive peak value in the selected measurement window. The query is only possible if averaging has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage`.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> in MARKer is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

`"CALC:MARK:FUNC:SUMM:PPE ON"`
'Switches on the function in screen A.

`"CALC:MARK:FUNC:SUMM:AVER ON"`
'Switches on the calculation of average in screen A.

`"INIT;*WAI"`
'Starts a sweep and waits for the end.

`"CALC:MARK:FUNC:SUMM:PPE:AVER:RES?"`
'Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:PHOLd:RESult?

This command is used to query the result of the measurement of the positive peak value with active peak hold function. The query is only possible if the peak hold function has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd`.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"` 'Switches to single-sweep mode.
	`"CALC:MARK:FUNC:SUMM:PPE ON"` 'Switches on the function in screen A.
	`"CALC:MARK:FUNC:SUMM:PHOL ON"` 'Switches on the measurement of the peak value in screen A.
	`"INIT;*WAI"` 'Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:SUMM:PPE:PHOL:RES?"` 'Outputs the result of screen A.

Characteristics:	*RST value: - SCPI: device-specific
Mode:	A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS[:STATe]   ON | OFF

This command switches on or off the measurement of the effective (RMS) power in the selected measurement window. If necessary the function is switched on previously.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

Example:	`"CALC2:MARK:FUNC:SUM:RMS ON"` 'Switches on the function in screen B.

Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:RESult?

This command queries the result of the measurement of the RMS power value in the selected measurement window.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"` 'Switches to single-sweep mode.
	`"CALC:MARK:FUNC:SUMM:RMS ON"` 'Switches on the function in screen A.
	`"INIT;*WAI"` 'Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:SUMM:RMS:RES?"` 'Outputs the result of screen A.

Characteristics: *RST value: -
                         SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:AVERage:RESult?

This command queries the result of the measurement of the averaged RMS value in the selected measurement window. The query is only possible if averaging has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage`.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
                     'Switches to single-sweep mode.

                     `"CALC:MARK:FUNC:SUMM:RMS ON"`
                     'Switches on the function in screen A.

                     `"CALC:MARK:FUNC:SUMM:AVER ON"`
                     Switches on the average value calculation in screen A.

                     `"INIT;*WAI"`
                     'Starts a sweep and waits for the end.

                     `"CALC:MARK:FUNC:SUMM:RMS:AVER:RES?"`
                     'Outputs the result of screen A.

Characteristics: *RST value: -
                         SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:PHOLd:RESult?

This command queries the result of the measurement of the RMS value with active peak hold in the selected measurement window. The query is only possible only if the peak hold function has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd`.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode.

`"CALC:MARK:FUNC:SUMM:RMS ON"`
'Switches on the function in screen A.

`"CALC:MARK:FUNC:SUMM:PHOL ON"`
'Switches on the peak value measurement in screen A.

`"INIT;*WAI"`
'Starts a sweep and waits for the end.

`"CALC:MARK:FUNC:SUMM:RMS:PHOL:RES?"`
'Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN[:STATe] ON | OFF

This command switches on or off the measurement of the mean value in the selected measurement window.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

Note

The measurement is performed on the trace on which marker 1 is positioned. In order to evaluate another trace, marker 1 must be positioned on another trace with `CALC:MARK:TRAC 1|2|3`.

Example: `"CALC:MARK:FUNC:SUMM:MEAN ON"`
'Switches on the function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:RESult?

This command queries the result of the measurement of the mean value in the selected measurement window.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
                     'Switches to single-sweep mode.

                     `"CALC:MARK:FUNC:SUMM:MEAN ON"`
                     'Switches on the function in screen A.

                     `"INIT;*WAI"`
                     'Starts a sweep and waits for the end.

                     `"CALC:MARK:FUNC:SUMM:MEAN:RES?"`
                     'Outputs the result of screen A.

Characteristics: *RST value: -
                     SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:AVERage:RESult?

This command queries the result of the measurement of the averaged mean value in the selected measurement window. The query is only possible if averaging has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage`.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
                     'Switches to single-sweep mode.

                     `"CALC:MARK:FUNC:SUMM:MEAN ON"`
                     'Switches on the function in screen A.

                     `"CALC:MARK:FUNC:SUMM:AVER ON"`
                     'Switches on the average value calculation in screen A.

                     `"INIT;*WAI"`
                     'Starts a sweep and waits for the end.

                     `"CALC:MARK:FUNC:SUMM:MEAN:AVER:RES?"`
                     'Outputs the result of screen A.

Characteristics: *RST value: -
                     SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:PHOLd:RESult?

This command queries the result of the measurement of the mean value with active peak hold in the selected measurement window. The query is only possible if the peak hold function has been switched on previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd`.

The query is possible only if the peak hold function is active. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
'Switches to single-sweep mode

                          `"CALC:MARK:FUNC:SUMM:MEAN ON"`
'Switches on the function in screen A

                          `"CALC:MARK:FUNC:SUMM:PHOL ON"`
'Switches on the peak value measurement in screen A

                          `"INIT;*WAI"`
'Starts a sweep and waits for the end

                          `"CALC:MARK:FUNC:SUMM:MEAN:PHOL:RES?"`
'Outputs the result of screen A.

Characteristics: *RST value: -
                          SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation[:STATe]   ON | OFF

This command switches on or off the measurement of the standard deviation in the selected measurement window. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

On switching on the measurement, the mean power measurement is switched on as well.

Example: `"CALC2:MARK:FUNC:SUMM:SDEV ON"`
'Switches on the measurement of the standard deviation in screen B.

Characteristics: *RST value: OFF
                          SCPI: device-specific

Mode: A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation:RESult?

This command queries the results of the standard deviation measurement. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of :MARKer is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: "INIT:CONT OFF"
'Switches to single-sweep mode.

"CALC:MARK:FUNC:SUMM:SDEV ON"
'Switches on the function in screen A.

"INIT;*WAI"
'Starts a sweep and waits for the end.

"CALC:MARK:FUNC:SUMM:SDEV:RES?"
'Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation:AVERage:RESult?

This command queries the result of the averaged standard deviation determined in several sweeps in the selected measurement window. The query is possible only if averaging is active. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of :MARKer is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: "INIT:CONT OFF"
'Switches to single-sweep mode.

"CALC:MARK:FUNC:SUMM:SDEV ON"
'Switches on the function in screen A.

"CALC:MARK:FUNC:SUMM:AVER ON"
'Switches on the calculation of average in screen A.

"INIT;*WAI"
'Starts a sweep and waits for the end.

"CALC:MARK:FUNC:SUMM:MEAN:SDEV:RES?"
'Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation:PHOLd:RESult?

This command queries the maximum standard deviation value determined in several sweeps in the selected measurement window. The query is possible only if the peak hold function is active.

The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of :MARKer is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example: "INIT:CONT OFF"
'Switches to single-sweep mode.

"CALC:MARK:FUNC:SUMM:SDEV ON"
'Switches on the function in screen A.

"CALC:MARK:FUNC:SUMM:PHOL ON"
'Switches on the peak value measurement in screen A.

"INIT;*WAI"
'Starts a sweep and waits for the end.

"CALC:MARK:FUNC:SUMM:SDEV:PHOL:RES?"
'Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd   ON | OFF

This command switches on or off the peak-hold function for the active time domain power measurement in the indicated measurement window. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of :MARKer is irrelevant. It is only available in the time domain (span = 0).

The peak-hold function is reset by switching it off and on again.

Example: "CALC:MARK:FUNC:SUMM:PHOL ON"
'Switches on the function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T

The peak-hold function is reset by switching off and on, again.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage   ON | OFF

This command switches on or off averaging for the active time domain power measurement in the indicated window. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of :MARKer is irrelevant. It is only available in the time domain (span = 0).

Averaging is reset by switching it off and on again.

The number of results required for the calculation of average is defined with [SENSe<1|2>:]AVERage:COUNt.

It should be noted that synchronization to the end of averaging is only possible in single sweep mode.

Example: `"INIT:CONT OFF"`
                      'Switches to single-sweep mode.

                      `"CALC2:MARK:FUNC:SUMM:AVER ON"`
                      'Switches on the calculation of average in screen B.

                      `"AVER:COUN 200"`
                      'Sets the measurement counter to 200.

                      `"INIT;*WAI"`
                      'Starts a sweep and waits for the end.

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MODE   ABSolute | RELative

This command selects absolute or relative time domain power measurement in the indicated measurement window. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

The reference power for relative measurement is defined with `CALCulate:MARKer:FUNCtion:SUMMary:REFerence:AUTO ONCE`. If the reference power is not defined, the value 0 dBm is used.

Example: `"CALC:MARK:FUNC:SUMM:MODE REL"`
                      'Switches the time domain power measurement to relative.

Characteristics: *RST value: ABSolute
                      SCPI: device-specific

Mode: A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:REFerence:AUTO   ONCE

With this command the currently measured average value (`…:SUMMary:MEAN`) and RMS value (`…:SUMMary:RMS`) are declared as reference values for relative measurements in the indicated measurement window. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

If the measurement of RMS value and average is not activated, the reference value 0 dBm is used.

If the function `…:SUMMary:AVERage` or `…:SUMMary:PHOLd` is switched on, the current value is the accumulated measurement value at the time considered.

Example: `"CALC:MARK:FUNC:SUMM:REF:AUTO ONCE"`
                      'Takes the currently measured power in screen A as reference value for the relative time domain power measurement.

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: A-T

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AOFF

This command switches off all time domain measurements in the selected measurement window. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

Example: `"CALC2:MARK:FUNC:SUMM:AOFF"`
                     'Switches off the time domain power measurement functions in screen B.

Characteristics: *RST value: _
                     SCPI: device-specific

Mode: A-T

This command is an event and therefore has no *RST value and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MSUMmary?   <time offset of first pulse>,
<measurement time>, <period>, < # of pulses to measure>

The commands of this subsystem are used to determine the power of a sequence of signal pulses having the same interval. The number of pulses to be measured as well as the measurement time and the period can be set. To define the position of the first pulse in the trace, a suitable offset can be entered.

The evaluation is performed on the measurement data of a previously recorded trace. The data recorded during the set measurement time is combined to a measured value for each pulse according to the detector specified and the indicated number of results is output as a list.
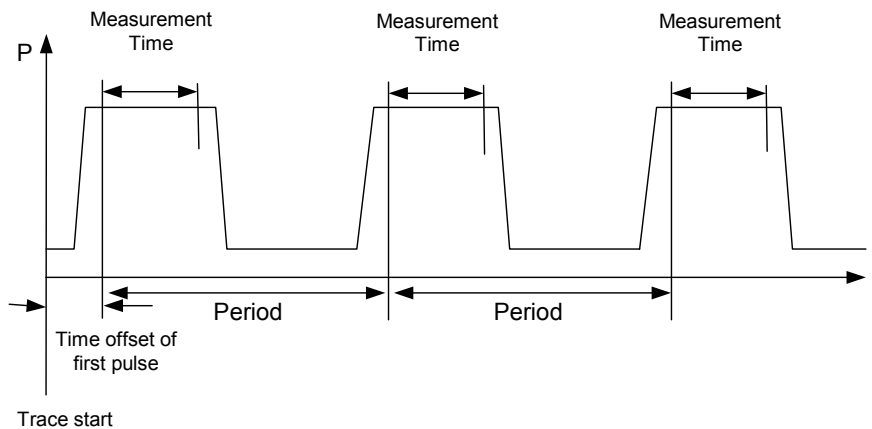
TRACE 1 of the selected screen is always used by the function. The suffix of MARKer will be ignored.

Example: `"DISP:WIND:TRAC:Y:RLEV –10dBm"`
'Sets the reference level to 10 dB

`"INP:ATT 30 dB"`
'Sets the input attenuation to 30 dB

`"FREQ:CENT 935.2MHz;SPAN 0Hz"`
'Sets the receive frequency to 935.2 MHz and the span to 0 Hz

`"BAND:RES 1MHz;VID 3MHz"`
'Sets the resolution bandwidth to 1 MHz and the video bandwidth to 3 MHz

`"DET RMS"`
'Sets the RMS detector

`"TRIG:SOUR VID;LEV:VID 50 PCT"`
'Selects the trigger source VIDeo and sets the level of the video trigger source to 50 PCT

`"SWE:TIME 50ms"`
'Sets the sweep time to 50 ms

`"INIT;*WAI"`
'Starts the measurement with synchronization

`"CALC:MARK:FUNC:MSUM? 50US,450US,576.9US,8"`
'Queries 8 bursts with an offset of 50 μs, a test time of 450 μs and a period of 576.9 μs

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T

CALCulate:MATH Subsystem

The CALCulate:MATH subsystem allows to process data from the SENSe-subsystem in numeric expressions. The measurement windows are selected by CALCulate1 (screen A) or CALCulate2 (screen B).

CALCulate<1|2>:MATH[:EXPression][:DEFine]   <expr>

This command defines the mathematical expression for relating traces to trace1.

The zero point of the result display can be defined with `CALC:MATH:POS`. Command `CALCulate:MATH:STATe` switches the mathematical relation of traces on or off.

Parameter:	<expr>::= 'OP1 - OP2' OP1 ::= TRACE1 OP2 ::= TRACE2 | TRACE3

Example:	`"CALC1:MATH (TRACE1 – TRACE2)"`
	'Selects the subtraction of trace 1 from trace 2 in screen A.
	
	`"CALC2:MATH (TRACE1 – TRACE3)"`
	'Selects the subtraction of trace 1 from trace 3 in screen B.

Characteristics:	*RST value: - SCPI: conforming
Mode:	A

CALCulate<1|2>:MATH:POSition   -100PCT to 200PCT

This command defines the position of the result of the trace mathematics in the selected measurement window. The indication is in % of the screen height, with 100% corresponding to the upper diagram border.

Example:	`"CALC:MATH:POS 50PCT"` 'Sets the position in screen A to the horizontal diagram center.
Characteristics:	*RST value: 50 % SCPI: device-specific
Mode:	A-T

CALCulate<1|2>:MATH:STATe   ON \| OFF

This command switches the mathematical relation of traces on or off.

Example:	`"CALC:MATH:STAT ON"` 'Switches on the trace mathematics in screen A.
Characteristics:	*RST value: OFF SCPI: conforming
Mode:	A

CALCulate<1|2>:MATH:MODE   LINear | LOGarithmic

This command selects linear or logarithmic (= video) calculation of the mathematical functions related to the traces. The calculation of the average is one of the affected functions. The setting is valid for all measurement windows, i.e. the numeric suffix `<1|2>` of `CALCulate` is irrelevant.

Example: `"CALC:MATH:MODE LIN"`
                      'Switches on the linear calculation.

Characteristics: *RST value: LOG
                      SCPI: device-specific

Mode: A

CALCulate:PEAKsearch | PSEarch Subsystem

CALCulate<1|2>:PEAKsearch|PSEarch[:IMMediate]

This command activates the generation of a peak list.

The numeric suffix in CALCULATE<1|2> is not significant.

Example: ":CALC:PEAK"

Characteristics: *RST value: -
SCPI: device specific

Mode: R

CALCulate<1|2>:PEAKsearch|PSEarch:MARGin   MINimum .. MAXimum

This command defines the margin for the peak search.

The numeric suffix in CALCULATE<1|2> is not significant.

Example: ":CALC:PEAK:MARG 5 dB"

Characteristics: *RST value: 6 dB
SCPI: device specific

Mode: R

CALCulate<1|2>:PEAKsearch|PSEarch:SUBRanges   1 to 500

This command defines the number of subranges for the peak search.

The numeric suffix in CALCULATE<1|2> is not significant.

Example: ":CALC:PEAK:SUBR 10"

Characteristics: *RST value: 25
SCPI: device specific

Mode: R

CALCulate<1|2>:PEAKsearch|PSEarch:METHod   SUBRange | PEAK

This command defines the method that is used to determine the level maxima of a scan.

The numeric suffix in CALCULATE<1|2> is not significant.

Example: "CALC:PEAK:METH SUBR"

Characteristics: *RST value: PEAK
SCPI: device specific

Mode: R

CALCulate:STATistics Subsystem

The CALCulate:STATistics subsystem controls the statistical measurement functions in the instrument. The measurement window cannot be selected with these functions. The numeric suffix in CALCulate is therefore ignored.

CALCulate:STATistics:APD[:STATe] ON | OFF

This command switches on or off the measurement of amplitude distribution (APD). On activating this function, the CCDF measurement is switched off.

Example:	`"CALC:STAT:APD ON"` 'Switches on the APD measurement.
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A

CALCulate:STATistics:CCDF[:STATe] ON | OFF

This command switches on or off the measurement of the complementary cumulative distribution function (CCDF). On activating this function, the APD measurement is switched off.

Example:	`"CALC:STAT:CCDF ON"` 'Switches on the `CCDF` measurement.
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A

CALCulate:STATistics:CCDF:X<1...3>? P0_1 | P1 | P10

This command reads out the level values for the probabilities 0.1%, 1% and 10%. The trace is selected by means of the numeric suffix <1 to 3>.

The desired result is selected by means of the following parameters:

Parameter:	P0_1: Level value for 0.1% probability
	P1: Level value for 1% probability
	P10: Level value for 10% probability
Example:	`"CALC:STAT:CCDF:X? P1"` 'Reads out the level values for 1% probability.
Characteristics:	*RST value: -- SCPI: device-specific
Mode:	A

CALCulate:STATistics:NSAMples   100 to 1E9

This command sets the number of measurement points to be acquired for the statistical measurement functions.

Example: `"CALC:STAT:NSAM 500"`
                   'Sets the number of measurement points to be acquired to 500.

Characteristics: *RST value: 100000
                   SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:AUTO   ONCE

This command optimizes the level setting of the instrument depending on the measured peak power, in order to obtain maximum instrument sensitivity.

To obtain maximum resolution, the level range is set as a function of the measured spacing between peak power and the minimum power for the APD measurement and of the spacing between peak power and mean power for the CCDF measurement. In addition, the probability scale for the number of test points is adapted.

Note

Subsequent commands have to be synchronized with *WAI, *OPC or *OPC? to the end of the auto range process which would otherwise be aborted.

Example: `"CALC:STAT:SCAL:AUTO ONCE;*WAI"`
                   'Adapts the level setting for statistical measurements.

Characteristics: *RST value: --
                   SCPI: device-specific

Mode: A

This command is an event and therefore has no *RST value and no query.

CALCulate:STATistics:SCALe:X:RLEVel   -130dBm to 30dBm

This command defines the reference level for the X axis of the measurement diagram. The setting is identical to the reference level setting using the command `DISPlay:WINDow:TRACe:Y:RLEVel`.

With the reference level offset <> 0 the indicated value range of the reference level is modified by the offset.

The unit depends on the setting performed with `CALC:UNIT`.

Example: `"CALC:STAT:SCAL:X:RLEV –60dBm"`

Characteristics: *RST value: -20dBm
                   SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:X:RANGe   10dB to 200dB

This command defines the level range for the X axis of the measurement diagram. The setting is identical to the level range setting defined with the command `DISPlay:WINDow:TRACe:Y:SCALe`.

Example: `"CALC:STAT:SCAL:X:RANG 20dB"`

Characteristics: *RST value: 100dB
                      SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:Y:UNIT   PCT | ABS

This command toggles the scaling of Y axis between percentage and absolute.

Example: `"CALC:STAT:SCAL:Y:UNIT PCT"`
                      'toggle to percentage

Characteristics: *RST value: ABS
                      SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:Y:UPPer   1E-8 to 1.0

This command defines the upper limit for the Y axis of the diagram in statistical measurements. Since probabilities are specified on the Y axis, the entered numerical values are dimensionless.

Example: `"CALC:STAT:Y:UPP 0.01"`

Characteristics: *RST value: 1.0
                      SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:Y:LOWer   1E-9 to 0.1

This command defines the lower limit for the Y axis of the diagram in statistical measurements. Since probabilities are specified on the Y axis, the entered numerical values are dimensionless.

Example: `"CALC:STAT:SCAL:Y:LOW 0.001"`

Characteristics: *RST value: 1E-6
                      SCPI: device-specific

Mode: A

CALCulate:STATistics:PRESet

This command resets the scaling of the X and Y axes in a statistical measurement. The following values are set:

- X axis ref level: -20 dBm

- X axis range APD: 100 dB

- X axis range CCDF: 20 dB

- Y axis upper limit: 1.0

- Y axis lower limit: 1E-6

Example:	`"CALC:STAT:PRES"`
	' Resets the scaling for statistical functions

Characteristics:	*RST value: --
	SCPI: device-specific

Mode:	A

This command is an event and therefore has no *RST value and no query.

CALCulate:STATistics:RESult<1 to 3>?   MEAN | PEAK | CFACtor | ALL

This command reads out the results of statistical measurements of a recorded trace. The trace is selected with the numeric suffix <1 to 3> attached to RESult.

The required result is selected via the following parameters:

Parameter:	MEAN: Average (=RMS) power in dBm measured during the measurement time.
	PEAK: Peak power in dBm measured during the measurement time.
	CFACtor: Determined CREST factor (= ratio of peak power to average power) in dB.
	ALL: Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example:	`"CALC:STAT:RES2? ALL"`
	'Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, CREST factor 13.69 dB

Characteristics:	*RST value: --
	SCPI: device-specific

Mode:	A

CALCulate:THReshold Subsystem

The CALCulate:THReshold subsystem controls the threshold value for the maximum/minimum search of markers. The measurement windows are selected by CALCulate 1 (screen A) or 2 (screen B).

CALCulate<1|2>:DLINe<1|2>   MINimum .. MAXimum (depending on current unit)

This command defines the position of Display Line 1 or 2. These lines enable the user to mark any levels in the diagram. The unit depends on the setting made with `CALC:UNIT`.

Example:	`"CALC:DLIN -20dBm"`

Characteristics:	*RST value: - (STATe to OFF) SCPI: device-specific

Mode:	R, A

CALCulate<1|2>:DLINe<1|2>:STATe   ON | OFF

This command switches Display Line 1 or 2 (level lines) on or off.

Example:	`"CALC:DLIN2:STAT OFF"`

Characteristics:	*RST value: OFF SCPI: device-specific

Mode:	R, A

CALCulate<1|2>:THReshold   MINimum to MAXimum (depending on current unit)

This command defines the threshold value for the maximum/minimum search of markers with marker search functions MAX PEAK, NEXT PEAK, etc. in the selected measurement window. The associated display line is automatically switched on.

Example:	`"CALC:THR -82DBM"` 'Sets the threshold value for screen A to -82 dBm.

Characteristics:	*RST value: - (STATe to OFF) SCPI: device-specific

Mode:	R, A, FM

CALCulate<1|2>:THReshold:STATe   ON | OFF

This command switches on or off the threshold line in the selected measurement window. The unit depends on the setting performed with `CALC:UNIT`.

Example:	`"CALC2:THR:STAT ON"` 'Switches on the threshold line in screen B.

Characteristics:	*RST value: OFF SCPI: device-specific

Mode:	R, A, FM

CALCulate<1|2>:FLINe<1|2> $0...f_{max}$

This command defines the position of the frequency lines.

The frequency lines mark the frequencies specified in the measurement window. Frequency lines are only available with SPAN > 0.

Example: `"CALC:FLIN2 120MHz"`

Characteristics: *RST value: - (STATe to OFF)
                             SCPI: device-specific

Mode: R, A-F

CALCulate<1|2>:FLINe<1|2>:STATe   ON | OFF

This command switches the frequency line on or off.

Example: `"CALC:FLIN2:STAT ON"`

Characteristics: *RST value: OFF
                             SCPI: device-specific

Mode: R, A-F

CALCulate<1|2>:TLINe<1|2>   0 ... 1000s

This command defines the position of the time lines.

The time lines mark the times specified in the measurement window. Time lines are only available with SPAN = 0.

Example: `"CALC:TLIN 10ms"`

Characteristics: *RST value: - (STATe auf OFF)
                             SCPI: device-specific

Mode: R, A-T

CALCulate<1|2>:TLINe<1|2>:STATe   ON | OFF

This command switches the time line on or off.

Example: `"CALC:TLIN2:STAT ON"`

Characteristics: *RST value: OFF
                             SCPI: device-specific

Mode: R, A-T

CALibration Subsystem

The commands of the CALibration subsystem determine the data for system error correction in the instrument.

CALibration[:ALL]?

This command initiates the acquisition of system error correction data. A "0" is returned if the acquisition was successful.

Note

During the acquisition of correction data the instrument does not accept any remote control commands, except
```
*RST
CALibration:ABORt
```

In order to recognize when the acquisition of correction data is completed, the MAV bit in the status byte can be used. If the associated bit is set in the Service Request Enable Register, the instrument generates a service request after the acquisition of correction data has been completed.

Example: `"*CLS"`
'Resets the status management.

`"*SRE 16"`
'Enables MAV bit in the Service Request Enable Register.

`"*CAL?"`
'Starts the correction data recording and then a service request is generated.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

CALibration:ABORt

This command aborts the acquisition of correction data and restores the last complete correction data set.

Example: `"CAL:ABOR"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value and no query.

CALibration:RESult?

This command outputs the results of the correction data acquisition. The lines of the result table (see chapter "Instrument Functions", section "Recording the Correction Data – CAL" on page 4.159) are output as string data separated by commas:

```
"Total Calibration Status: PASSED","Date (dd/mm/yyyy): 12/07/1999",
"Time: 16:24:54","Runtime:00.06"
```

Example: "CAL:RES?"

Characteristics: *RST value: --
                       SCPI: device-specific

Mode: all

CALibration:STATe   ON | OFF

This command determines whether the current calibration data are taken into account by the instrument (ON) or not (OFF).

Example: "CAL:STAT OFF"
                    'Sets up the instrument to ignore the calibration data.

Characteristics: *RST value: -
                       SCPI: conforming

Mode: all

DIAGnostic Subsystem

The DIAGnostic subsystem contains the commands which support instrument diagnostics for maintenance, service and repair. In accordance with the SCPI standard, all of these commands are device-specific.

The measurement windows are selected by DIAGnostic1 (screen A) or DIAGnostic2 (screen B).

DIAGnostic<1|2>:SERVice:INPut[:SELect]   CALibration | RF

This command toggles between the RF input on the front panel and the internal 128-MHz reference signal in the selected measurement window. The level of the 128-MHz signals can be selected by command `DIAG:SERV:CSOurce`.

Example: `"DIAG:SERV:INP CAL"`

Characteristics: *RST value: RF
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:INPut:PULSed[:STATe]   ON | OFF

This command toggles the calibration signal in the selected measurement window between pulsed and non-pulsed. The selection takes effect only if the RF input has been set to the internal reference signal using `DIAG:SERV:INP CAL`.

Example: `"DIAG:SERV:INP CAL;`
`DIAG:SERV:INP:PULS ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:INPut:PULSed:PRATe   10 kHz | 62.5 kHz | 1 MHz | 128 MHz | 640 MHz

This command selects the pulse rate for the pulsed calibration signal in the selected measurement window.

Available pulse frequencies are 10 kHz, 62.5 kHz, 100 kHz, 1 MHz, 128 MHz and 640 MHz.

Example: `"DIAG:SERV:INP:PRAT 128 MHz"`

Characteristics: *RST value: 128 MHz
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:INPut:RECTangle[:STATe]   ON | OFF

This command switches the rectangle calibration signal on or off in the selected measurement window (suffix <1|2>). The setting takes effect only if the RF input is set to the internal reference signal (`DIAG: SERV:INP CAL` command).

> **Note**
>
> If the rectangle calibration signal is switched on, the pulsed calibration signal is switched off.

Example:	`"DIAG:SERV:INP CAL;` `DIAG:SERV:INP:RECT ON"`
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	all

DIAGnostic<1|2>:SERVice:INPut:RECTangle:PRATe   5 kHz | 31.25 kHz | 50 kHz | 250 kHz | 500 kHz

This command sets the frequency of the rectangle calibration signal in the selected measurement window (suffix <1|2>).

5 kHz | 31.25 kHz | 50 kHz | 250 kHz | 500 kHz can be set.

Example:	`"DIAG:SERV:INP:RECT:PRAT 128 MHz`
Characteristics:	*RST value: 5 kHz SCPI: device-specific
Mode:	all

DIAGnostic<1|2>:SERVice:SFUNction   <string>...

This command activates a service function which can be selected by indicating the five parameters: function group number, board number, function number, parameter 1 and parameter 2 (see service manual). The contents of the parameter string is identical to the code to be entered in the data entry field of manual operation.

The entry of a service function is accepted only if the system password Level 1 or Level 2 has been entered previously (command: `SYSTem:SECurity`).

The numeric suffix <1|2> is ignored with this command.

> **Note**
>
> The service functions of the instrument are not identical to those of the FSE family. That is why the IEC/IEEE-bus command differs in syntax and data format.

Example:	`"DIAG:SERV:SFUN '2.0.2.12.1'"`

Characteristics:	*RST value: - SCPI: device-specific

Mode:	all

DIAGnostic<1|2>:SERVice:NSOurce   ON | OFF

This command switches the 28-V supply of the noise source at the rear panel on or off.

The numeric suffix <1|2> is ignored with this command.

Example:	`"DIAG:SERV:NSO ON"`

Characteristics:	*RST value: OFF SCPI: device-specific

Mode:	all

DIAGnostic<1|2>:SERVice:CSOource[:POWer]   <numeric_value>

This command switches the level of the 128 MHz reference signal source between 0 dBm and -30 dBm in the selected measurement window.

Example:	`"DIAG:SERV:CSO 0DBM"`

Characteristics:	*RST value: -30 dBm SCPI: device-specific

Mode:	all

DIAGnostic<1|2>:SERVice:STESt:RESult?

This command reads the results of the selftest out of the instrument. The lines of the result table are output as string data separated by commas:

```
"Total Selftest Status: PASSED","Date (dd/mm/yyyy): 09/07/1999
TIME: 16:24:54","Runtime: 00:06","...
```

The numeric suffix <1|2> is ignored with this command.

Example:	`"DIAG:SERV:STES:RES?"`

Characteristics:	*RST value: -- SCPI: device-specific

Mode:	all

DIAGnostic<1|2>:SERVice:HWINfo?

This command queries the contents of the module info table. Table lines are output as string data and are separated by commas.

"<component 1>|<serial #>|<order #>|<model>|<HWC>|<rev>|<sub rev>",
"<component 2>|<serial #>|<order #>|<model>|<HWC>|<rev>|<sub rev>",...

The individual columns of the table are separated from each other by '|'.

The numeric suffix <1|2> is ignored with this command.

Example: `"DIAG:SERV:HWIN?"`

Result (shortened):

```
"RF_ATTEN_7|650551/007|1067.7684|02|00|20|04",
"IF-FILTER|648158/037|1093.5540|03|01|07|05",
...
```

Characteristics: *RST value: --
                       SCPI: device-specific

Mode: all

DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

The measurement windows are selected by WINDow1 (screen A) or WINDow2 (screen B).

DISPlay:FORMat SINGle | SPLit

This command switches the measurement result display between FULL SCREEN and SPLIT SCREEN. The coupling of settings between screen A and screen B can be selected with the command `INSTrument:COUPle`.

In full-screen display the active measurement window can be selected with `DISPlay:WINDow<1|2>: SELect`.

Example:	"DISP:FORM SPL" 'Switches the display to 2 measurement windows.
Characteristics:	*RST value: SINGle SCPI: device-specific
Mode:	R, A

DISPlay:ANNotation:FREQuency ON | OFF

This command switches the X axis annotation on or off.

Example:	"DISP:ANN:FREQ OFF"
Characteristics:	*RST value: ON SCPI: conforming
Mode:	all

DISPlay:LOGO ON | OFF

This command switches the company logo on the screen on or off.

Example:	"DISP:LOGO OFF"
Characteristics:	*RST value: ON SCPI: device-specific
Mode:	all

DISPlay:PSAVe[:STATe] ON | OFF

This command switches on or off the power-save mode of the display. With the power-save mode activated the display including backlight is completely switched off after the elapse of the response time (see command `DISPlay:PSAVe:HOLDoff`).

Note

This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.

Example:	`"DISP:PSAVe ON"`
	'Switches on the power-save mode.

Characteristics:	*RST value: OFF
	SCPI: device-specific

Mode:	all

DISPlay:PSAVe:HOLDoff   1 to 60

This command sets the hold off time for the power-save mode of the display. The available value range is 1 to 60 minutes, the resolution 1 minute. The entry is dimensionless.

Example:	`"DISP:PSAV:HOLD 30"`

Characteristics:	*RST value: 15
	SCPI: device-specific

Mode:	all

DISPlay:CMAP<1...34>:DEFault<1|2>

This command resets the screen colors of all display items to their default settings. Two default settings DEFault1 and DEFault2 are available. The numeric suffix of CMAP is irrelevant.

Example:	`"DISP:CMAP:DEF2"`
	'Selects default setting 2 for setting the colors.

Characteristics:	*RST value: --
	SCPI: conforming

Mode:	all

This command is an event and therefore has no query and no *RST value.

DISPlay:CMAP<1...34>:HSL   <hue>,<sat>,<lum>

This command defines the color table of the instrument.

Each numeric suffix of CMAP is assigned one or several graphical elements which can be modified by varying the corresponding color setting. The following assignment applies:

CMAP1	Background
CMAP2	Grid
CMAP3	Function field + status field + data entry text
CMAP4	Function field LED on
CMAP5	Function field LED warn
CMAP6	Enhancement label text
CMAP7	Status field background
CMAP8	Trace 1
CMAP9	Trace 2
CMAP10	Trace 3
CMAP11	Marker
CMAP12	Lines
CMAP13	Measurement status + limit check pass
CMAP14	Limit check fail

CMAP15   Table + softkey background

CMAP16   Table + softkey text

CMAP17   Table selected field text

CMAP18   Table selected field background

CMAP19   Table + data entry field opaque title bar

CMAP20   Data entry field opaque text

CMAP21   Data entry field opaque background

CMAP22   3D shade bright part

CMAP23   3D shade dark part

CMAP24   Softkey state on

CMAP25   Softkey state data entry

CMAP26   Logo

CMAP27   Bar graph PK+

CMAP28   Bar graph PK-

CMAP29   Bar graph QPK

CMAP30   Bar graph AVER

CMAP31   Bar graph RMS

CMAP32   Final Meas

CMAP33   Bar graph CAV

CMAP34   Bar graph CRMS

Parameter: hue = TINT
sat = SATURATION
lum = BRIGHTNESS

The value range is 0 to 1 for all parameters.

Example: `"DISP:CMAP2:HSL 0.3,0.8,1.0"`
'Changes the grid color.

Characteristics: *RST value: --
SCPI: conforming

Mode: all

The values set are not changed by *RST.

DISPlay:CMAP<1...34>:PDEFined   BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

This command defines the color table of the instrument using predefined color values. Each numeric suffix of CMAP is assigned one or several graphical elements which can be modified by varying the corresponding color setting.
The same assignment as for `DISPlay:CMAP<1 to 26>:HSL` applies.

Example: `"DISP:CMAP2:PDEF GRE"`

Characteristics: *RST value: --
SCPI: conforming

Mode: all

The values set are not changed by *RST.

DISPlay[:WINDow<1|2>]:SELect

This command selects the active measurement window. WINDow1 corresponds to SCREEN A, WINDow2 to SCREEN B.

In FULL SCREEN mode, the measurements are only performed in the active measurement window. Measurements are therefore initiated in the active window and result queries (marker, trace data and other results) answered also in the active window.
Initiating measurements and querying results in the inactive window yields an error message (execution error).

In split screen mode, the selection of the active window for result queries is irrelevant.

Note

- In FULL SCREEN mode, settings can also be performed in the inactive measurement window. They become effective as soon as the corresponding window becomes active.

- This command is not available in FM mode. In FM mode, the display is always set to FULL SCREEN, which corresponds to SCREEN A and thus to `WINDow1`. `WINDow1` is automatically selected when the FM mode is activated with command `INSTrument:SELect:ADEMod`.

Example: `"DISP:WIND2:SEL"`
'Selects SCREEN B as active measurement window.

Characteristics: *RST value: SCREEN A active
SCPI: device-specific

Mode: A

This command is an event and therefore has no query.

DISPlay[:WINDow<1|2>]:SIZE LARGe | SMALl

This command switches the measurement window for channel and adjacent-channel power measurements or for active FM demodulator (FS-K7) to full screen or half screen. Only "1" is allowed as a numerical suffix.

Example: `"DISP:WIND1:SIZE LARG"`
'Switches the measurement window to full screen.

Characteristics: *RST value: SMALl
SCPI: device-specific

Mode: A, FM

DISPlay[:WINDow<1|2>]:TEXT[:DATA]   <string>

This command defines a comment (max. 20 characters) which can be displayed on the screen in the selected measurement window.

Example: `"DISP:WIND2:TEXT 'Noise Measurement'"`
                      'Defines the title for screen B

Characteristics: *RST value: "" (empty)
                      SCPI: conforming

Mode: all

DISPlay[:WINDow<1|2>]:TEXT:STATe   ON | OFF

This command switches on or off the display of the comment (screen title) in the selected measurement window.

Example: `"DISP:TEXT:STAT ON"`
                      'Switches on the title of screen B.

Characteristics: *RST value: OFF
                      SCPI: conforming

Mode: all

DISPlay[:WINDow<1|2>]:TIME   ON | OFF

This command switches on or off the screen display of date and time. The numeric suffix in WINDow<1| 2> is irrelevant.

Example: `"DISP:TIME ON"`

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: all

DISPlay[:WINDow<1|2>]:TRACE<1 to 3>:X:SPACing   LINear | LOGarithmic

This command toggles between linear and logarithmic display in receiver mode

Example: `"DISP:TRAC:X:SPAC LIN"`

Characteristics: *RST value: LOGarithmic
                      SCPI: conforming

Mode: R, A

The numeric suffix in TRACE<1 to 3> is irrelevant.

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]   10dB to 200dB

This command defines the display range of the Y axis (level axis) in the selected measurement window with logarithmic scaling (`DISP:TRAC:Y:SPAC LOG`).
For linear scaling, (`DISP:TRAC:Y:SPAC LIN | PERC`) the display range is fixed and cannot be modified. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example: `"DISP:TRAC:Y 110dB"`

Characteristics: *RST value: 100dB
SCPI: device-specific

Mode: all

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:MODE   ABSolute | RELative

This command defines the scale type of the Y axis (absolute or relative) in the selected measurement window. `SYSTem:DISPlay` is set to `OFF`, this command has no immediate effect on the screen. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example: `"DISP:TRAC:Y:MODE REL"`

Characteristics: *RST value: ABS
SCPI: device-specific

Mode: A

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RLEVel   –130dBm to 30dBm

This command defines the reference level in the selected measurement window. Depending on the coupling of the measurement windows, it is valid for both screens (`INSTrument:COUPle ALL`) or only for the selected measurement window (`INSTrument:COUPle NONE`).

With the reference level offset <> 0 the indicated value range of the reference level is modified by the offset.

The unit depends on the setting defined with `CALCulate:UNIT`. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example: `"DISP:TRAC:Y:RLEV –60dBm"`

Characteristics: *RST value: -20dBm
SCPI: conforming

Mode: A, FM

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RLEVel:OFFSet   –200dB to 200dB

This command defines the offset of the reference level in the selected measurement window. Depending on the coupling of the measurement windows, it is valid for both screens (`INSTrument:COUPle ALL`) or only for the selected measurement window (`INSTrument:COUPle NONE`).

The numeric suffix at TRACe<1 to 3> is irrelevant.

Example: `"DISP:TRAC:Y:RLEV:OFFS –10dB"`

Characteristics: *RST value: 0dB
SCPI: conforming

Mode: A

DISPlay[:WINDow<1|2>]:TRACE<1 to 3>:Y[:SCALe]:RVALue   <numeric_value>

If the tracking generator option or the external generator control option (R&S FSU-B9/R&S FSP-B10) is mounted and the normalization in the NETWORK mode is activated, this value defines the power value assigned to the reference position in the selected measurement window. This value corresponds to the parameter REFERENCE VALUE in manual operation.

The numeric suffix at TRACe<1 to 3> is irrelevant.

Characteristics:	`"DISP:TRAC:Y:RVAL 0"`
	'Sets the power value assigned to the reference position to 0 dB (Tracking Generator/Ext. Generator Control option) or 0 Hz (FM demodulator option).
	*RST value:
	0 dB (Mode NETWORK)
	0 Hz (FM demodulator mode with FM display)
	2.5 MHz (FM demodulator mode with AF spectrum display of FM)
	SCPI: device specific
Mode:	A, FM

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RPOSition   0 to 100PCT

This command defines the position of the reference value in the selected measurement window. The numeric suffix in TRACe<1 to 3> is irrelevant.

In operating mode NETWORK (Tracking Generator /Ext. Generator Option R&S FSU-B9/R&S FSP-B10) with active normalization, RPOSition defines the reference point for the output of the normalized measurement results.

With the FM demodulator (FS-K7) switched on, the reference position for result display RF POWER and SPECTRUM is kept separate from that for result display FM.

Example:	`"DISP:TRAC:Y:RPOS 50PCT"`
Characteristics:	*RST value:
	100PCT(SPECTRUM mode)
	50 PCT (NETWORK and FM DEMOD mode)
	50 PCT (Mode FM-DEMOD with FM display)
	100 PCT (Mode FM-DEMOD with AF spectrum display of FM)
	SCPI: conforming
Mode:	A, FM

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:BOTTom   <numeric_value>

This command defines the minimum grid level in the current unit for the scan display in the receiver mode.

Example:	`"DISP:TRAC:Y:BOTT –20"`
	'The minimum grid level is set to -20 dBuV (pre-condition: the default unit has not been changed)
Characteristics:	*RST value: 0
	SCPI: conforming
Mode:	R

The numeric suffix in TRACE<1 to 3> is irrelevant.

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y:SPACing   LINear | LOGarithmic| LDB

This command toggles between linear and logarithmic display in the selected measurement window. On a linear scale, switch over between the unit % (command `DISP:WIND:TRAC:Y:SPAC LIN`) and the unit dB (command `DISP:WIND:TRAC:Y:SPAC LDB`) is also possible.

If the FM demodulator (FS-K7) is active and result display AF spectrum of FM is selected, only the parameters LINear and LOGarithmic are permissible.

The numeric suffix in TRACe<1 to 3> is irrelevant.

Example: `"DISP:TRAC:Y:SPAC LIN"`

Characteristics: *RST value: LOGarithmic
                  SCPI: conforming

Mode: A, FM

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:MODE   WRITe | VIEW | AVERage | MAXHold | MINHold

This command defines the type of display and the evaluation of the traces in the selected measurement window. WRITE corresponds to the Clr/Write mode of manual operation. The trace is switched off (= BLANK in manual operation) with `DISP:WIND:TRAC:STAT OFF`.

The number of measurements for AVERage, MAXHold and MINHold is defined with the command `SENSe:AVERage:COUNt` or `SENSe:SWEep:COUN`t. It should be noted that synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

If calculation of average values is active, selection between logarithmic and linear averaging is possible. For more detail see command `SENSe:AVERage:TYPE`.

Example: `"SWE:CONT OFF"`
'Switching to single-sweep mode.

                  `"SWE:COUN 16"`
'Sets the number of measurements to 16.

                  `"DISP:WIND1:TRAC3:MODE MAXH"`
'Switches on the calculation of the for trace 3 in screen A.

                  `"INIT;*WAI"`
'Starts the measurement and waits for the end of the 16 sweeps.

Characteristics: *RST value: WRITe for TRACe1, STATe OFF for TRACe2/3
                  SCPI: device-specific

Mode: all

DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE:HCONtinuous   ON | OFF

This command specifies whether or not the traces with peak or minimum value detection are reset after specific parameter changes.

Usually the measurement must be restarted after a parameter change, before an evaluation of the measurement results is performed (e.g. with a marker). In cases in which a change causes a compulsory new measurement, the trace is automatically reset in order to prevent erroneous measurements of previous measurement results (e.g. when the span changes). For applications in which this behavior is not desired, this mechanism can be switched off.

Parameter: OFF: The traces are reset after specific parameter changes.

                ON: The reset mechanism is switched off.

Example: `"DISP:WIND1:TRAC3:MODE:HCON ON"`
'The reset mechanism is switched off for measurement window 1.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

DISPlay[:WINDow<1|2>]:TRACE<1 to 3>[:STATe] ON | OFF

This command switches on or off the display of the corresponding trace in the selected measurement window.

Example: `"DISP:WIND1:TRAC3 ON"`

Characteristics: *RST value: ON for TRACe1, OFF for TRACe2 to 4
SCPI: conforming

Mode: all

DISPlay[:WINDow<1|2>]:TRACE<1 to 3>:SYMBol CROSs | OFF

This command switches on or off the indication of the peak list or the final measurement result on the trace.

Parameter: CROSs: The single value is indicated as x.

OFF: No indication.

Example: `"DISP:TRAC:SYMB CROS"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R

DISPlay:BARGraph:LEVel:LOWer?

This command queries the minimum level of the bar graph.

Example: `":DISP:BARG:LEV:LOW?"`

Characteristics: *RST value: --
SCPI: device-specific

Mode: R

DISPlay:BARGraph:LEVel:UPPer?

This command queries the maximum level of the bar graph.

Example: `":DISP:BARG:LEV:UPP?"`

Characteristics: *RST value: --
SCPI: device-specific

Mode: R

DISPlay:BARGraph:PHOLd   ON | OFF

This command switches the indication of the maxhold value of the bar graph measurement on or off.

Example: ":DISP:BARG:PHOL ON"

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R

DISPlay:BARGraph:PHOLd:PRESet

This command resets the maxhold value of the numeric indication of the bar graph measurement.

Example: ":DISP:BARG:PHOL:PRES"

Characteristics: *RST value: --
SCPI: device-specific

Mode: R

This command is an event and thus has no *RST value and no query.

FORMat Subsystem

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

FORMat[:DATA]   ASCii | REAL | UINT[, 8 | 32]

This command specifies the data format for the data transmitted from the instrument to the control PC.

The format settings below are valid for the binary transmission of trace data (see also `TRACE:DATA?`):

Example: `"FORM REAL,32"`

`"FORM ASC"`

`"FORM UINT,8"`

Characteristics: *RST value: ASCII
SCPI: conforming

Mode: all

The data format is either ASCII or one of the formats REAL. ASCII data are transmitted in plain text, separated by commas. REAL data are transmitted as 32-bit IEEE 754 floating-point numbers in the "definite length block format".

The FORMat command is valid for the transmission of trace data and the results of the bar graph measurement. The data format of trace data received by the instrument is automatically recognized, regardless of the format which is programmed.

Format setting for the binary transmission of trace data (see also `TRACE:DATA?`):

Note

Incorrect format setting will result in numerical conversion, which may lead to incorrect results.

FORMat:DEXPort:DSEParator   POINt | COMMA

This command defines which decimal separator (decimal point or comma) is to be used for outputting measurement data to the file in ASCII format. Different languages of evaluation programs (e.g. MS-Excel) can thus be supported.

Example: `"FORM:DEXP:DSEP POIN`
'Sets the decimal point as separator.

Characteristics: *RST value: -- (factory setting is POINt; *RST does not affect setting)
SCPI: device-specific

Mode: all

HCOPy Subsystem

The HCOPy subsystem controls the output of display information for documentation purposes on output devices or files. The instrument allows two independent printer configurations which can be set separately with the numeric suffix <1|2>.

HCOPy:ABORt

This command aborts a running hardcopy output.

Example:	`"HCOP:ABOR"`

Characteristics:	*RST value: - SCPI: conforming

Mode:	all

This command is an event and therefore has no *RST value and no query.

HCOPy:CMAP<1...34>:DEFault<1|2|3>

This command resets the colors for a hardcopy to the selected default settings. DEFault1(SCREEN COLORS, but background white), DEFault2 (OPTIMIZED COLOR SET) and DEFault3 (USER DEFINED). The numeric suffix in CMAP is not significant.

Example:	`"HCOP:CMAP:DEF2"` 'selects OPTIMIZED COLOR SET for the color settings of a hardcopy.

Characteristics:	*RST value: -- SCPI: conforming

Mode:	all

This command is an event and therefore has no query and no *RST value.

HCOPy:CMAP<1...34>:HSL   <hue>,<sat>,<lum>

This command defines the color table in USER DEFINED COLORS mode.

To each numeric suffix of CMAP is assigned one or several picture elements which can be modified by varying the corresponding color setting. The following assignment applies:

CMAP1	Background
CMAP2	Grid
CMAP3	Function field + status field + data entry text
CMAP4	Function field LED on
CMAP5	Function field LED warn
CMAP6	Enhancement label text
CMAP7	Status field background
CMAP8	Trace 1
CMAP9	Trace 2
CMAP10	Trace 3
CMAP11	Marker
CMAP12	Lines
CMAP13	Measurement status + limit check pass

CMAP14   Limit check fail

CMAP15   Table + softkey background

CMAP16   Table + softkey text

CMAP17   Table selected field text

CMAP18   Table selected field background

CMAP19   Table + data entry field opaque title bar

CMAP20   Data entry field opaque text

CMAP21   Data entry field opaque background

CMAP22   3D shade bright part

CMAP23   3D shade dark part

CMAP24   Softkey state on

CMAP25   Softkey state data entry

CMAP26   Logo

CMAP27   Bar graph PK+

CMAP28   Bar graph PK-

CMAP29   Bar graph QPK

CMAP30   Bar graph AVER

CMAP31   Bar graph RMS

CMAP32   Final Meas

CMAP33   Bar graph CAV

CMAP34   Bar graph CRMS

Parameter:	hue = tint sat = saturation lum = brightness
	The value range is 0 to 1 for all parameters
Example:	`"HCOP:CMAP2:HSL 0.3,0.8,1.0"` 'changes the grid color
Characteristics:	*RST value: -- SCPI: conforming
Mode:	all

The values set are not changed by *RST.

HCOPy:CMAP<1...34>:PDEFined   BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

This command defines the color table in USER DEFINED COLORS using predefined color values. To each numeric suffix of CMAP is assigned one or several picture elements which can be modified by varying the corresponding color setting. The same assignment as for `:HCPOy:CMAP<1 to 26>:HSL` applies

Example:　　　　"HCOP:CMAP2:PDEF GRE"

Characteristics:　*RST value: --
　　　　　　　　　　SCPI: conforming

Mode:　　　　　all

The values set are not changed by *RST.

HCOPy:DESTination<1|2>　　<string>

This command selects the printer output medium (Disk, Printer or Clipboard) associated with configuration 1 or 2.

Note

The type of instrument is selected with SYSTem:COMMunicate:PRINter: SELect, which will automatically select a default output medium. Therefore the command HCOPy:DESTination should always be sent <u>after</u> setting the device type.

Parameter:　　　<string>::= 'SYST:COMM:GPIB' | 'SYST:COMM:SER' | 'SYST:COMM:CENT' |
　　　　　　　　　　'MMEM' | 'SYST:COMM:PRIN' | 'SYST:COMM:CLIP'

　　　　　　　　　　'MMEM': Directs the hardcopy to a file. Command MMEM:NAME '<file_name>' defines the file name. All formats can be selected for HCOPy:DEVice:LANGuage.

　　　　　　　　　　'SYST:COMM:PRIN': Directs the hardcopy to the printer. The printer is selected with command SYSTEM:COMMunicate:PRINter:SELect.
　　　　　　　　　　GDI should be selected for HCOPy:DEVice:LANGuage.

　　　　　　　　　　'SYST:COMM:CLIP': Directs the hardcopy to the clipboard. EWMF should be selected for HCOPy:DEVice:LANGuage.

Example:　　　　"SYST:COMM:PRIN:SEL2 'LASER on LPT1'"
　　　　　　　　　　'Selects the printer and output medium for device 2

　　　　　　　　　　"HCOP:DEST2 'SYST:COMM:PRIN'"
　　　　　　　　　　'Selects the printer interface as device 2.

Characteristics:　*RST value: -
　　　　　　　　　　SCPI: conforming

Mode:　　　　　all

This command is an event and therefore has no *RST value and no query.

HCOPy:DEVice:COLor　　ON|OFF

This command selects between color and monochrome hardcopy of the screen.

Example:　　　　"HCOP:DEV:COL ON"

Characteristics:　*RST value: OFF
　　　　　　　　　　SCPI: conforming

Mode:　　　　　all

HCOPy:DEVice:LANGuage<1|2>   GDI | WMF | EWMF | BMP | HTML | PDF | RTF

This command determines the data format for the printed output.

Parameter:	GDI (Graphics Device Interface): Default format for output to a printer that has been configured under Windows. Must be selected for output to the printer interface (`HCOPy:DEVice 'SYST:COMM:PRIN'`). Can be used for output to a file (`HCOPy:DEVice 'SYST:COMM:MMEM'`). The printer driver that was configured under Windows is used to generate a file format that is specific to the printer. GDI is available only for HCOPY:MODE SCReen.
	WMF (WINDOWS Metafile) and EWMF (Enhanced Metafile Format): Data formats for output to files which can be directly processed at a later point in time for documentation purposes using suitable software. WMF can be used only for output to a file (`HCOPy:DEVice 'SYST:COMM:MMEM'`), EWMF can also be used for output to the clipboard (`HCOPy:DEVice 'SYST:COMM:CLIP'`).
	BMP (Bitmap): Data format, exclusively for output to files (`HCOPy:DEVice 'SYST:COMM:MMEM'`).
	BMP is available only for HCOPY:MODE SCReen.
	HTML 4.0 (Hypertext Markup Language): Test reports can be exported to files in HTML format. It is then possible to view these files using a web browser.
	HTML is available only for HCOPY:MODE TREPort.
	Adobe Acrobat (Portable Document Format): Test reports can be exported to files in PDF format. These files can then be opened using a PDF reader such as Adobe Acrobat.
	PDF is available only for HCOPY:MODE TREPort.
	Rich Text Format: Test reports can be exported to files in RTF format. It is then possible to open these files for further processing using word processing software such as Microsoft Word.
	RTF is available only for HCOPY:MODE TREPort.
Example:	`"HCOP:DEV:LANG WMF"`
Characteristics:	*RST value: - SCPI: conforming
Mode:	all

HCOPy[:IMMediate<1|2>]

This command starts a hardcopy output. The numeric suffix selects which printer configuration (1 or 2) is to be used for the hardcopy output. If there is no suffix, configuration 1 is automatically selected.

Example:	`"HCOP"`
	`"HCOPy:IMM[1]"` 'Starts the hardcopy output to device 1 (default).
	`"HCOPy:IMM2"` 'Starts the output to device 2.
Characteristics:	*RST value: - SCPI: conforming
Mode:	all

This command is an event and therefore has no *RST value and no query.

HCOPy:ITEM:ALL

This command selects the complete screen to be output.

Example: `"HCOP:ITEM:ALL"`

Characteristics: *RST value: OFF
SCPI: conforming

Mode: all

The hardcopy output is always provided with comments, title, time and date. As an alternative to the whole screen, only traces (commands `'HCOPy:ITEM:WINDow:TRACe:STATe  ON'`) or tables (command `'HCOPy:ITEM:WINDow:TABLe:STATe ON'`) can be output.

HCOPy:ITEM:WINDow<1|2>:TABle:STATe   ON | OFF

This command selects the output of the currently displayed tables.

Example: `"HCOP:ITEM:WIND:TABL:STAT ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

The command `HCOPy:DEVice:ITEM:WINDow<1|2>:TABle:STATe   OFF` as well as command `HCOPy:DEVice:ITEM:ALL` enables the output of the whole screen.

HCOPy:ITEM:WINDow<1|2>:TEXT   <string>

This command defines the comment text for measurement window 1 or 2 for printout, with a maximum of 100 characters; line feed by means of character @).

Example: `"HCOP:ITEM:WIND2:TEXT 'comment'"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

HCOPy:ITEM:WINDow<1|2>:TRACe:STATe   ON | OFF

This command selects the output of the currently displayed trace.

Example: `"HCOP:ITEM:WIND:TRACe:STAT ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

The command `HCOPy:ITEM:WINDow<1|2>:TRACe:STATe  OFF` as well as command `HCOPy:ITEM:ALL` enables the output of the whole screen.

HCOPy:MODE   SCReen | TREPort:

This command selects the type of output that is used to document the measurements.

SCReen outputs the information that is visible on the screen in a graphical format.

TREPort prepares a configurable collection of measurement results and the instrument settings that had an influence on the measurement results.

Example: ":HCOP:MODE SCR"

Characteristics: *RST value: SCR
                      SCPI: device-specific

Mode: R, A

HCOPy:PAGE:ORIentation<1|2>   LANDscape | PORTrait

The command selects the format of the output (portrait and landscape) (hardcopy unit 1 or 2).

Note

The command is only available provided that the output device "printer" (`HCOP:DEST 'SYST:COMM:PRIN'`) has been selected.

Example: "HCOP:PAGE:ORI LAND"

Characteristics: *RST value: -
                      SCPI: conforming

Mode: all

HCOPy:TREPort:APPend

This command adds a new test report to an existing document in accordance with the test report configuration settings. This report document is initially stored internally until it is printed using the HCOPy:IMMediate command or exported to a portable file format.

Example: ":HCOP:TREP:APP"

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A

This command is an event, so it has neither an *RST value nor a query function.

HCOPy:TREPort:NEW

This command generates a new test report in a new document in accordance with the test report configuration settings. An existing report document is deleted. This report document is initially stored internally until it is printed using the HCOPy:IMMediate command or exported to a portable file format.

Example: ":HCOP:TREP:NEW"

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A

This command is an event, so it has neither an *RST value nor a query function.

HCOPy:TREPort:ITEM:DEFault

This command sets the test report configuration to a defined default status.

A newly generated test report will then contain the following:

Header line
Diagram
Scan table
Final measured values
Time of day and date
Page number

Example: `":HCOP:TREP:ITEM:DEF"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:LOGO:CONTrol ALWays | ONCE | NEVer

In the current test report configuration, this command switches the output of the diagram on the test instrument screen either on or off.

Example: `":HCOP:TREP:ITEM:LOGO:CONT ALW"`

Characteristics: *RST value: NEVer
SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:HEADer:LINE<1…7>:CONTrol ALWays | ONCE | NEVer

In the current test report configuration, this command controls whether the line indicated in the numeric suffix of the report header is output.

The meanings are as follows:

ALWays   On each page

ONCE   Only on the first page

NEVer   Not on any page

A further condition for the output is that outputting of the report header must be switched on with `":HCOP:TREP:ITEM:HEAD:STAT ON"`.

Example: `":HCOP:TREP:ITEM:HEAD:LINE2:CONT ALW"`

Characteristics: *RST value: ALWays
SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:HEADer:LINE<1…7>:TEXT <string>

This command defines the text used for the line of the report header indicated in the numeric suffix.

Example: ":HCOP:TREP:ITEM:HEAD:LINE2:TEXT 'radiated test'"

Characteristics: *RST value: "
                      SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:HEADer:LINE<1…7>:TITLe <string>

This command defines a name for the line of the report header indicated in the numeric suffix. This name is also output in the test report.

Example: ":HCOP:TREP:ITEM:HEAD:LINE2:TITL 'Specification'"

Characteristics: *RST value:
                      LINE1 'Heading'
                      LINE2 'Meas Type'
                      LINE3 'Equipment under Test'
                      LINE4 'Manufacturer'
                      LINE5 'OP Condition'
                      LINE6 'Operator'
                      LINE6 'Test Spec'
                      SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:HEADer: STATe ON | OFF

In the current test report configuration, this command switches the output of the report header either on or off. The individual lines can also be controlled individually with ":HCOP:TREP:ITEM:HEAD:LINE:CONT ALW | ONCE | NEV".

Example: ":HCOP:TREP:ITEM:HEAD:STAT ON"

Characteristics: *RST value: ON
                      SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:DIAGram:STATe ON | OFF

In the current test report configuration, this command switches the output of the diagram on the test instrument screen either on or off.

Example: ":HCOP:TREP:ITEM:DIAG:STAT ON"

Characteristics: *RST value: -
                      SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:FRESults:STATe ON | OFF

In the current test report configuration, this command switches the output of the final measured values in tabular format either on or off.

Example:	`":HCOP:TREP:ITEM:FRES:STAT ON"`
Characteristics:	*RST value: ON SCPI: device-specific
Mode:	R

HCOPy:TREPort:ITEM:PAGecount:STATe ON | OFF

In the current test report configuration, this command switches the output of the page numbering either on or off.

Example:	`":HCOP:TREP:ITEM:PAG:STAT ON"`
Characteristics:	*RST value: ON SCPI: device-specific
Mode:	R, A

HCOPy:TREPort:ITEM:SCANtable:STATe ON | OFF

In the current test report configuration, this command switches the output of the scan table with the measurement settings either on or off.

Example:	`":HCOP:TREP:ITEM:SCAN:STAT ON"`
Characteristics:	*RST value: ON SCPI: device-specific
Mode:	R, A

HCOPy:TREPort:ITEM:SRESults:STATe ON | OFF

In the current test report configuration, this command switches the output of the results on the preliminary measurement in tabular format either on or off. Depending on the current scan settings, this table can be very long in certain cases.

Example:	`":HCOP:TREP:ITEM:SRES:STAT ON"`
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	R

HCOPy:TREPort:ITEM:TDSTamp:STATe ON | OFF

In the current test report configuration, this command switches the output of the date and time of day at the start of the documented measurement either on or off.

Example:	`":HCOP:TREP:ITEM:TDST:STAT ON"`
Characteristics:	*RST value: ON SCPI: device-specific
Mode:	R, A

HCOPy:TREPort:ITEM:TRANsducer:STATe   ON | OFF

In the current test report configuration, this command switches the output of the enabled transducer factor(s) either on or off.

Example: `":HCOP:TREP:ITEM:TRAN:STAT ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:TEMPlate:CATalog?

This command outputs a list showing the complete test report configuration.

The syntax of the output format is as follows: `'template1','template2',...`

Example: `":HCOP:TREP:ITEM:TEMP:CAT?"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:TEMPlate:DELete   <string>

This command deletes the specified test report configuration.

Example: `":HCOP:TREP:ITEM:TEMP:DEL 'short test'"`

Characteristics: *RST value: ''
SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:TEMPlate:LOAD   <string>

This command loads the specified test report configuration.

Example: `":HCOP:TREP:ITEM:TEMP:LOAD 'short test'"`

Characteristics: *RST value: ''
SCPI: device-specific

Mode: R, A

HCOPy:TREPort:ITEM:TEMPlate:SAVE   <string>

This command saves the current test report configuration using the specified name.

Example: `":HCOP:TREP:ITEM:TEMP:SAVE 'short test'"`

Characteristics: *RST value: ''
SCPI: device-specific

Mode: R, A

INITiate Subsystem

The INITiate subsystem is used to control the init measurement function in the selected measurement window. In receiver mode, a distinction is made between single measurement (INITiate1) and scan (INITiate2). In signal analyzer mode, a distinction is made between INITiate1 (screen A) and INITiate2 (screen B) in split screen representation.

INITiate<1|2>:CONTinuous   ON | OFF

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

Setting "`INITiate:CONTinuous ON`" corresponds to function SCAN/SWEEP CONTinuous, i.e. the scan/sweep of the receiver/analyzer is cyclically repeated. The setting "`INITiate:CONTinuous OFF`" corresponds to function SCAN/SWEEP SINGLE.

Example:	"`INIT2:CONT OFF`" 'Switches the sequence in screen B to single scan/sweep.
	"`INIT2:CONT ON`" 'Switches the sequence to continuous scan/sweep.
Characteristics:	*RST value: ON SCPI: conforming
Mode:	all

INITiate<1|2>:CONMeas

This command continues an aborted scan measurement at the current receiver frequency.

Example:	"`INIT:CONT OFF`" 'Switches to single-sweep mode.
	"`DISP:WIND:TRAC:MODE AVER` 'Switches on trace averaging.
	"`SWE:COUN 20`" Setting the sweep counter to 20 sweeps.
	"`INIT;*WAI`" 'Starts the measurement and waits for the end of the 20 sweeps.
	"`INIT:CONM;*WAI`" 'Continues the measurement (next 20 sequences) and waits for the end.
Characteristics:	*RST value: - SCPI: device-specific
Mode:	R, A

This command is an event and therefore has no *RST value and no query.

INITiate<1|2>[:IMMediate]

The command initiates a new sweep in the indicated measurement window.

In receiver mode with *SINGLE* selected, the ESU performs a single scan and stops at the end frequency. With *CONTINUOUS* selected, the scan is performed continuously until it is deliberately stopped.

In analyzer mode, with Sweep Count > 0 or Average Count > 0, this means a restart of the indicated number of measurements. With trace functions MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

In single sweep mode, synchronization to the end of the indicated number of measurements can be achieved with the command *OPC, *OPC? or *WAI. In continuous-sweep mode, synchronization to the sweep end is not possible since the overall measurement never ends.

Example: `"INIT:CONT OFF"`
                     'Switches to single-sweep mode.

                     `"DISP:WIND:TRAC:MODE AVER`
                     'Switches on trace averaging.

                     `"SWE:COUN 20"`
                     Setting the sweep counter to 20 sweeps.

                     `"INIT;*WAI"`
                     'Starts the measurement and waits for the end of the 20 sweeps.

Characteristics: *RST value: -
                     SCPI: conforming

Mode: all

This command is an event and therefore has no *RST value and no query.

INITiate<1|2>:DISPlay   ON | OFF

This command configures the behavior of the display during a single sweep.
`INITiate:DISPlay  OFF` means that the display is switched off during the measurement,
`INITiate:DISPlay ON` means that the display is switched on during the measurement.
The numeric suffix of INITiate is irrelevant with this command.

Example: `"INIT:CONT OFF"`
                     'Switches to single-sweep mode

                     `"INIT:DISP OFF"`
                     'Sets the display behavior to `OFF`

                     `"INIT;*WAI"`
                     'Starts the measurement with display switched off.

Characteristics: *RST value: ON
                     SCPI: device-specific

Mode: A

INITiate<1|2>:FMEasurementINITiate<1|2>: FMEasurement

In the receiver mode, this command starts the final measurement based on the peak list.

Example: `"INIT:FME"` 'Starts the final measurement

Characteristics: *RST value: -
SCPI: device-specific

Mode: R

This command is an event, so it has neither an *RST value nor a query function.

INITiate<1|2>:EMItestINITiate<1|2>:EMItest

In the receiver mode, this command starts an automatic sequence consisting of the preliminary measurement, determination of the peak list and subsequent final measurement.

Example: `"INIT:EMI"` 'Starts the sequence preliminary measurement, peak search and final measurement

Characteristics: *RST value: -
SCPI: device-specific

Mode: R

This command is an event, so it has neither an *RST value nor a query function.

INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument. In receiver mode, the suffix is irrelevant. In the analyzer mode, the measurement windows are assigned to INPut1 (screen A) and INPut2 (screen B).

INPut<1|2>:ATTenuation   0 to 70 dB

In the default state with analyzer mode, the attenuation set on the step attenuator is coupled to the reference level of the instrument. If the attenuation is programmed directly, the coupling to the reference level is switched off.

With receiver mode, if the attenuation is programmed directly, the auto range function is switched off if necessary. Setting 0 dB can be prevented by activating the protection function (`INPut:ATTenuation:PROTection ON`).

Example:	`"INP:ATT 40dB"` Analyzer: 'Sets the attenuation on the attenuator to 40 dB and switches off the coupling to the reference level. Receiver: 'Sets the attenuation on the attenuator to 40 dB and switches off the auto ranging.
Characteristics:	*RST value: 10 dB (AUTO is set to ON) SCPI: conforming
Mode:	all

INPut<1|2>:ATTenuation:AUTO   ON | OFF

In analyzer mode, this command automatically couples the input attenuation to the reference level (state ON) or switches the input attenuation to manual entry (state OFF). The minimum input attenuation set with the coupling switched on is 10 dB.

In receiver mode, this command automatically sets the attenuation so that a good S/N ratio is obtained without the receiver stages being overdriven (state ON).

Example:	`"INP:ATT:AUTO ON"` 'Switches the auto ranging function on.
Characteristics:	*RST value: ON SCPI: conforming
Mode:	all

INPut<1|2>:ATTenuation:PROTection   ON | OFF

This command defines whether the 0 dB position of the attenuator is to be used in manual or automatic adjustment.

Example:	`"INP:ATT:PROT ON"`
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	R

INPut<1|2>:ATTenuation:PROTection:RESet

The R&S ESU is equipped with an overload protection mechanism. This mechanism becomes active as soon as the power at the input mixer exceeds a value of 27 dBm. It ensures that the connection between RF input and input mixer is cut off.

The command resets the attenuator into the state that it had before the overload condition was detected. It re-connects the RF input with the input mixer.

Note

This command comes into effect only if the reason for the overload condition has been eliminated. Otherwise the connection between RF input and input mixer is left open.

INPut:COUPling AC | DC

This command switches the input coupling of the RF input between AC and DC.

Example: `"INP:COUP DC"`

Characteristics: *RST value: AC
SCPI: conforming

Mode: A, R

INPut<1|2>:LISN[:TYPE] TWOPhase | FOURphase | ESH3Z5 | ESH2Z5 | ENV4200 | ENV216 | OFF

This command selects the V-network that is controlled via the USER port. This setting is used in the receiver mode also for the preliminary measurement

TWOPhase and ESH3Z5	R&S ESH3-Z5 (two phases and protective earth are controllable)
FOURphase and ESH2Z5	R&S ESH2-Z5 (four phases and protective earth are controllable)
ENV4200	R&S ENV 4200 (four phases are controllable)
ENV216	R&S ENV 216 (two phases and highpass are controllable)
OFF	Remote control deactivated

Example: `":INP:LISN:TWOP"`

Characteristics: *RST value: OFF
SCPI: device specific

Mode: R, A

INPut<1|2>:LISN:PHASe   L1 | L2 | L3 | N

This command selects the phase of the V-network that is used and which is controlled via the USER port. This setting is used in the receiver mode also for the preliminary measurement. The permissible selection depends on the selected V-network.

Example: ":INP:LISN:PHAS L1"

Characteristics: *RST value: L1
                       SCPI: device specific

Mode: R, A

INPut<1|2>:LISN:PEARth   GROunded | FLOating

This command selects the setting of the Protective EARth that is controlled via the USER port. This setting is used in the receiver mode also for the preliminary measurement. The availability depends on the selected V-network.

Example: ":INP:LISN:PEAR GRO"

Characteristics: *RST value: GROunded
                       SCPI: device specific

Mode: R, A

INPut<1|2>:LISN:FILTer:HPAS[:STATe]   ON | OFF

This command selects the setting for the highpass on the V-network that is controlled via the USER port. This setting is used in the receiver mode also for the preliminary measurement. This command is available only for the R&S ENV 216 V-network (INP:LISN ENV216).

Example: ":INP:LISN:FILT:HPAS ON"

Characteristics: *RST value: OFF
                       SCPI: device-specific

Mode: R

INPut<1|2>:TYPE   INPUT1 | INPUT2

The command selects the signal input. INPUT1 is RF input 1 and INPUT2 is RF input 2.

Example: "INP:TYPE INPUT1"

Characteristics: *RST value: INPUT1
                       SCPI: conform

Mode: R, A

INPut<1|2>:UPORt[:VALue]?

This command queries the control lines of the user ports.

Example: "INP:UPOR?"

Characteristics: *RST value: -
                       SCPI: device-specific

Mode: all

This command is a query and therefore has no *RST value.

INPut<1|2>:UPORt:STATe   ON | OFF

This command toggles the control lines of the user ports between INPut and OUTPut.

Example: `"INP:UPOR:STAT ON"`

Characteristics: *RST value: ON
SCPI: device-specific

Mode: all

With ON, the user port is switched to INPut, with OFF to OUTPut.

INPut<1|2>:IMPedance   50 | 75

This command sets the nominal input impedance of the instrument. The set impedance is taken into account in all level indications of results.

The setting 75 Ω should be selected, if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The correction value in this case is 1.76 dB = 10 log (75Ω / 50Ω).

Example: `"INP:IMP 75"`

Characteristics: *RST value: 50 Ω
SCPI: conforming

Mode: A, FM

INPut<1|2>:GAIN:STATe   ON | OFF

This command switches on the preamplifier for the instrument. The switchable gain is fixed to 20 dB.

In analyzer mode, the command is only available, if the preselector measurement has been activated.

Example: `"INP:GAIN ON"`
'Switches on 20 dB preamplification

Characteristics: *RST value: OFF
SCPI: conforming

Mode: all

INPut<1|2>:GAIN:AUTO   ON | OFF

This command includes the preamplifier into the autoranging function of the receiver.

Example: `":INP:GAIN:AUTO ON"`
'Includes the preamplifier into the auto range function

Characteristics: *RST value: OFF
SCPI: conforming

Mode: R

INPut<1|2>:PRESelection[:STATe]   ON | OFF

In analyzer mode, this command switches the preselection on or off.

Example: `":INP:PRES:STAT ON"`

Characteristics: *RST value: OFF
                       SCPI: device-specific

Mode: A

INPut<1|2>:MIXer[:POWer]   <numeric value>

This command defines the desired power at the input mixer of the analyzer. On any change to the reference level the RF attenuation will be adjusted in a way that makes the difference between reference level and RF attenuation come as close to the desired mixer level as possible.

Example: `"INP:MIX -30"`

Characteristics: *RST value: - 25 dBm
                       SCPI: device-specific

Mode: A

INPut<1|2>:MIXer:AUTO   ON | OFF

This command enables/disables the automatic setup of the mixer level.

Example: `"INP:MIX:AUTO ON"`

Characteristics: *RST value: ON
                       SCPI: device-specific

Mode: A

INSTrument Subsystem

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

INSTrument[:SELect]   SANalyzer | RECeiver | IFANalyzer | ADEMod

This command enables you to switch between modes by entering the mode designation.

Parameter:	SANalyzer: spectrum analysis
	ADEMod: FM demodulator
	RECeiver: Receiver mode
	IFANalyzer: IF analysis mode
Example:	`"INST SAN"`
	'Switches the instrument to *SPECTRUM*.
Characteristics:	*RST value: RECeiver
	SCPI: conforming
Mode:	all

Changeover to ADEMod is only possible with FM Demodulator FS-K7 option installed.

INSTrument:NSELect   <numeric value>

This command enables you to switch between the modes by using numbers.

Parameter:	1: Spectrum analysis mode
	3: FM demodulator mode
	6: Receiver mode
	23: TD-SCDMA MS mode
Example:	`"INST:NSEL 1"`
	'Switches to the *SPECTRUM* mode.
Characteristics:	*RST value: 23
	SCPI: conforming
Mode:	all

Changeover to 23 is only possible with FM Demodulator FS-K7 option installed.

INSTrument:COUPle   NONE | RLEVel | CF_B | CF_A

In operating mode *SPECTRUM* this command selects the parameter coupling between the two measurement windows screen A and B.

Parameter:	NONE: No coupling. The two measurement windows are operated like two independent "virtual" devices.
	RLEVel: The reference levels of the two measurement windows are coupled.
	CF_B: The center frequency of screen B is coupled to the frequency of marker 1 in screen A.
	CF_A: The center frequency of screen A is coupled to the frequency of marker 1 in screen B.

Example:	`"INST:COUP NONE"`
	'Switches off the coupling of measurement windows. This leads to two independent "virtual" devices.

Characteristics:	*RST value: NONE
	SCPI: device specific

Mode:	A

INSTrument:COUPle:ATTenuation   ALL | NONE

This command couples die RF attenuation settings for the analyzer and receiver modes with one another.

The RF attenuation unit and level unit are then set to the same value in the analyzer and receiver screen.

Example:	`"INST:COUP:ATT ALL"`

Characteristics:	*RST value:ALL
	SCPI:device-specific

Mode:	R, A

INSTrument:COUPle:BANDwidth|BWIDth   ALL | NONE

This command couples the bandwidth settings for the analyzer and receiver modes with one another.

The resolution bandwidth (RBW) and filter type are then set to the same value on the analyzer and receiver screen. In some cases, other settings (e.g. the quasi-peak detector) can block these settings.

Example:	`"INST:COUP:BWID ALL"`

Characteristics:	*RST value:NONE
	SCPI:device-specific

Mode:	:R, A

INSTrument:COUPle:CENTer   ALL | NONE

This command couples the center frequency and receive frequency settings for the analyzer and receiver modes with one another.

Example:	`"INST:COUP:CENT ALL"`

Characteristics:	*RST value:ALL
	SCPI:device-specific

Mode:	R, A

INSTrument:COUPle:DEModulation   ALL | NONE

This command couples the settings of the audio demodulator for the analyzer and receiver modes with one another.

Example:	`"INST:COUP:DEM ALL"`

Characteristics:	*RST value:NONE
	SCPI:device-specific

Mode:	R, A

INSTrument:COUPle:GAIN ALL | NONE

This command couples gain settings for the analyzer and receiver modes with one another.

Example: `"INST:COUP:GAIN ALL"`

Characteristics: *RST value:ALL
SCPI:device-specific

Mode: R, A

INSTrument:COUPle:PRESelector ALL | NONE

This command couples the activation of the preselector for the analyzer and receiver modes with one another.

In the receiver mode, the preselector cannot be deactivated. In normal operation, this means that the preselector is always automatically activated when a change to the analyzer mode occurs and coupling has been activated.

Example: `"INST:COUP:PRES ALL"`

Characteristics: *RST value:ALL
SCPI:device-specific

Mode: R, A

INSTrument:COUPle:PROTection ALL | NONE

This command couples the RF protection attenuation of 10 dB for the analyzer and receiver modes with one another.

To prevent damage to the RF input, activate this coupling.

Example: `"INST:COUP:PROT ALL"`

Characteristics: *RST value:ALL
SCPI:device-specific

Mode: R, A

INSTrument:COUPle:SPAN ALL | NONE

This command couples the start and stop frequencies of sweep and scan for the analyzer and receiver modes with one another.

Example: `"INST:COUP:SPAN ALL"`

Characteristics: *RST value:NONE
SCPI:device-specific

Mode: R, A

MMEMory Subsystem

The MMEMory (mass memory) subsystem provides commands which allow for access to the storage media of the instrument and for storing and loading various instrument settings.

The various drives can be addressed via the "mass storage unit specifier" <msus> using the conventional DOS syntax. The internal hard disk is addressed by "D:", a memory stick by "F:".

Note

For reasons of compatibility with the FSE instruments, addressing the hard disk by "C:" is also accepted. Since hard disk "C:" is reserved for instrument software, all read and write operations are rerouted to hard disk "D:" in normal operation (service level 0).

The file names <file_name> are indicated as string parameters with the commands being enclosed in quotation marks. They also comply with DOS conventions.

DOS file names consist of max. 8 ASCII characters and an extension of up to three characters separated from the file name by a dot ".". Both, the dot and the extension are optional. The dot is not part of the file name. DOS file names do not distinguish between uppercase and lowercase notation. All letters and digits are permitted as well as the special characters "_", "^", "$", "~", "!", "#", "%", "&", "-", "{", "}", "(", ")", "@" and "`". Reserved file names are CLOCK$, CON, AUX, COM1 to COM4, LPT1 to LPT3, NUL and PRN.

The two characters "*" and "?" have the function of so-called "wildcards", i.e., they are variables for selection of several files. The question mark "?" replaces exactly one character, the asterisk means any of the remaining characters in the file name. "*.*" thus means all files in a directory.

MMEMory:CATalog?   <path>

This command reads the indicated directory. According to DOS convention, wild card characters can be entered in order to query e.g. a list of all files of a certain type.

The path name should be in conformance with DOS conventions and may also include the drive name.

Parameter:	<path>::= DOS Path name

Example:	`"MMEM:CAT? 'D:\USER\DATA'"`
	'Returns the contents of the D:\USER\DATA directory
	
	`"MMEM:CAT? 'D:\USER\DATA\*.LOG'"`
	'Returns all files in D:\USER\DATA with extension ".LOG"
	
	`"MMEM:CAT? 'D:\USER\DATA\SPOOL?.WMF'"`
	'Returns all files in D:\USER\DATA whose names start with SPOOL, have 6 letters and the extension ".WMF".

Return value:	List of file names in the form of strings separated by commas, i.e. `'SPOOL1.WMF','SPOOL2.WMF','SPOOL3.WMF'`
Characteristics:	*RST value: - SCPI: conformal
Mode:	all

MMEMory:CATalog:LONG?   <path>

This command queries the directories and files in the given path.

Parameter:	<path>::= DOS path

Example:	`"MMEM:CAT:LONG? 'D:\USER\DATA'` 'queries the contents of directory D:\USER\DATA

Return value: <used_bytes_in_this_directory>,<free_bytes_on_this_disk>,
"<file_name>,<file_type>,<filesize_in_bytes>",
"<file_name>,<file_type>,<filesize_in_bytes>", …

with
<file_name>: name of file or directory
<file_type>: DIR (directory), ASCii (ASCII file), BINary (binary file) and STATe (file with device settings)
<filesize_in_bytes>: size of file, 0 for directories

Characteristics:	*RST value: - SCPI: conformal

Mode:	all

MMEMory:CDIRectory   <directory_name>

This command changes the current directory.

In addition to the path name, the indication of the directory may contain the drive name. The path name complies with the DOS conventions.

Parameter:	<directory_name>::= DOS path name

Example:	`"MMEM:CDIR 'D:\USER\DATA'"` 'Returns the list of files in directory D:\USER\DATA.

Characteristics:	*RST value: - SCPI: conforming

Mode:	all

MMEMory:COPY   <file_source>,<file_destination>

This command copies the files indicated in <file_source> to the destination directory indicated with <file_destination> or to the destination file indicated by <file_destination> when <file_source> is just a file.

The indication of the file name may include the path and the drive name. The file names and path information must be in accordance with the DOS conventions.

Parameter:	<file_source>,<file_destination> ::= <file_name> <file_name> ::= DOS file name

Example:	`"MMEM:COPY 'D:\USER\DATA\SETUP.CFG','F:'"`

Characteristics:	*RST value: - SCPI: conforming

Mode:	all

This command is an event and therefore has no *RST value and no query.

MMEMory:DATA   <file_name>[,<block data>]

This command writes the block data contained in <block> into the file characterized by <file_name>. The IEC/IEEE-bus delimiter must be set to EOI to obtain error-free data transfer.

The associated query command reads the indicated file from the mass memory and transfers it to the control computer via the IEC/IEEE bus. It should be noted that the buffer memory of the control computer should be large enough to store the file. The setting of the IEC/IEEE-bus delimiter is irrelevant in this case.

The command is useful for reading stored device settings or trace data from the instrument or for transferring them to the instrument.

- `MMEMory:DATA <file_name>,<block data>`
  Data transfer from control computer to instrument.

- `MMEMory:DATA? <file_name>`
  Data transfer from instrument to control computer.

<file_name> selects the file to be transferred.

The binary data block <block> has the following structure:

– it always begins with the character '#',

– followed by a digit for the length of the length information,

– followed by the indicated number of digits as length information (number of bytes) for the binary data themselves,

– finally the binary data with the indicated number of bytes

Example:	`"MMEM:DATA 'TEST01.HCP',#216This is the file"`
	 'means:
	 '#2: the next 2 characters are the length indication
	 '16: number of subsequent binary data bytes
	 'This is the file: 16 bytes stored as binary data in the file TEST01.HCP.
	
	 `"MMEM:DATA? 'TEST01.HCP'"`
	 'Transfers the file TEST01.HCP from the instrument to the control computer.

Characteristics:	*RST value: - SCPI: conforming
Mode:	all

MMEMory:DELete   <file_name>

This command deletes the indicated files.

The indication of the file name contains the path and, optionally, the drive name. Indication of the path complies with DOS conventions.

Parameter:	<file_name> ::= DOS file name
Example:	`"MMEM:DEL 'TEST01.HCP'"` 'The file TEST01.HCP is deleted.
Characteristics:	*RST value: - SCPI: conforming
Mode:	all

This command is an event and therefore has no *RST value and no query.

MMEMory:LOAD:STATe   1,<file_name>

This command loads device settings from files. The contents of the file are loaded and set as the new device state.

The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Parameter: <file_name> ::= DOS file name without extension, extensions see table

Example: `"MMEM:LOAD:STAT 1,'F:TEST'"`

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and therefore has no *RST value and no query.

MMEMory:LOAD:AUTO   1,<file_name>

This command defines which device setting is automatically loaded after the device is switched on. The contents of the file are read after switching on the device and used to define the new device state. The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

> **Note**
>
> The data set defined as auto recall set will also be restored by a *RST-command.

Parameter: <file_name> ::= DOS file name without extension;
FACTORY denotes the data set previously in the instrument

Example: `"MMEM:LOAD:AUTO 1,'D:\USER\DATA\TEST'"`

Characteristics: *RST value: FACTORY
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value and no query.

MMEMory:LOGO:CDIRectory   <directory_name>

This command selects the directory in which the graphics file is saved which contains the logo for the test report. The indication of the directory must contain the drive name in addition to the path indication. That path indication should comply with DOS conventions.

Parameter: <directory_name>::= DOS path indication

Example: `"MMEM:LOGO:CDIR 'D:\USER\DATA'"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: All

MMEMory:LOGO:NAME   <file_name>

This command selects a graphics file which will appear as the logo in the header of the test report.

The file name should comply with DOS conventions.

Parameter:	<file_name> ::= DOS file name
Example:	`"MMEM:LOGO:NAME 'COMPANY.BMP'"`
Characteristics:	*RST value: - SCPI: device-specific
Mode:	All

MMEMory:MDIRectory   <directory_name>

This command creates a new directory. The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Parameter:	<directory_name>::= DOS path name
Example:	`"MMEM:MDIR 'D:\USER\DATA'"`
Characteristics:	*RST value: - SCPI: device-specific
Mode:	all

This command is an event and therefore has no *RST value and no query.

MMEMory:MOVE   <file_source>,<file_destination>

This command renames existing files, if <file_destination> contains no path indication. Otherwise the file is moved to the indicated path and stored under the file name specified there, if any.

The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

Parameter:	<file_source>,<file_destination> ::= <file_name> <file_name> ::= DOS file name

Example:	`"MMEM:MOVE 'D:\TEST01.CFG','SETUP.CFG'"`
	 'Renames TEST01.CFG in SETUP.CFG in directory D:\.
	
	 `"MMEM:MOVE 'D:\TEST01.CFG','D:\USER\DATA'"`
	 'Moves TEST01.CFG from D:\ to D:\USER\DATA.
	
	 `"MMEM:MOVE 'D:\TEST01.CFG','D:\USER\DATA\SETUP.CFG'"`
	 'Moves TEST01.CFG from D:\ to D:\USER\DATA and renames the file in SETUP.CFG.

Characteristics:	*RST value: - SCPI: conforming
Mode:	all

This command is an event and therefore has no *RST value and no query.

MMEMory:MSIS   <device>

This command changes to the drive indicated. The drive may be the internal hard disk D: or a memory stick F:.

Example: `"MMEM:MSIS 'F:'"`

Characteristics: *RST value: "D:'
                 SCPI: conforming

Mode: all

MMEMory:NAME   <file_name>

This command defines a destination file for the printout started with the command `HCOPy:IMMediate`. In this case the printer output must be routed to destination *FILE* using the command `"HCOP:DEST 'MMEM' "`.

The file name includes indication of the path and may also include the drive name. The file name and path information comply with DOS conventions.

Parameter: <file_name> ::= DOS file name

Example: `"HCOP:DEV:LANG BMP"`
                 'Selection of data format.

                 `"HCOP:DEST 'MMEM' "`
                 'Selection of the output device

                 `"MMEM:NAME 'PRINT1.BMP'"`
                 'Selection of file name.

                 `"HCOP:IMM"`
                 'Start of the printout.

Characteristics: *RST value: -
                 SCPI: conforming

Mode: all

This command is an event and therefore has no *RST value and no query.

MMEMory:RDIRectory   <directory_name>

This command deletes the indicated directory. The directory name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Parameter: <directory_name>::= DOS path name

Example: `"MMEM:RDIR 'D:\TEST'"`

Characteristics: *RST value: -
                 SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value and no query.

MMEMory:STORe<1|2>:STATe   1,<file_name>

This command stores the current device settings in a series of files which have the indicated file name, but different extensions. The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions. The numeric suffix in STORe<1|2> is irrelevant with this command.

Parameter: <file_name> := DOS file name without extension

Example: `"MMEM:STOR:STAT 1,'TEST'"`

Characteristics: *RST value: -
                                SCPI: conforming

Mode: all

This command is an event and therefore has no *RST value and no query.

MMEMory:STORe<1|2>:TRACe   1 to 3,<file_name>

This command stores the selected trace (1 to 3) in the measurement window indicated by STORe<1|2> (screen A or B) in a file with ASCII format. The file format is described in chapter "Instrument Functions", section "ASCII FILE EXPORT" on page 4.150.

The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the command `FORMat:DEXPort:DSEParator`.

The file name includes indication of the path and the drive name. Indication of the path complies with DOS conventions.

Parameter: 1 to 3 := selected measurement curve Trace 1 to 3
                                <file_name> := DOS file name

Example: `"MMEM:STOR2:TRAC 3,'F:\TEST.ASC'"`
                                'Stores trace 3 from screen B in the file TEST.ASC on a memory stick.

Characteristics: *RST value: -
                                SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value and no query.

For Spurious Measurement in Analyzer Mode an extended file format is used:

	File contents	Explanation
File header	Type;ESU;	Model
	Version;3.97;	Firmware version
	Date;02.Feb 2005;	Storage date of data set
	Mode;ANALYZER;SPURIOUS;	Operating mode of the device Format for Spurious Emissions measurement
	Start;9000.000000;Hz Stop;8000000000.000000;Hz	Start/stop of the span Unit: Hz
	x-Axis;LIN;	Linear (LIN) or logarithmic (LOG) (future feature) scaling of the x-axis
	Sweep Count;1;	Selected number of sweeps
	Range 1:	Loop across all defined sweep ranges (1 to 20)
	Start; 9000.000000;Hz	Range start frequency in Hz
	Stop; 150000.000000;Hz	Range stop frequency in Hz
	Filter Type;NORMAL;	Range filter type: NORMAL, RRC or CFILTER
	RBW;10000.000000;Hz	Resolution bandwidth of the measurement filter
	VBW;30000.000000;Hz	Resolution bandwidth of the video filter
	Auto Sweep time;ON	
	Sweep time; 0.145000;s	Selected sweep time in the current range
	Detector;RMS;	Detector: MAX PEAK, MIN PEAK, RAVERAGE
	REF-Level; -10.000000;dBm	Setting of the reference level in the current range
	Auto RF-Attenuator; OFF;	Manual (OFF) or automatic (ON) setting of the RF attenuator
	RF Att;15.000000;dB	Range input attenuation
	Sweep Points;625;	Number of sweep points in the current range
	Preamp; 0.000000;dB	Range preamplifier, on (20 dB) or off (0 dB)
	Stop after range;OFF;	Stop after range, switched on (ON) or off (OFF) for the current range
	Transducer;TRD1;	Transducer name (if activated) repeated for all sweep list ranges
File data section	TRACE 1:	Selected trace
	x-Unit;Hz;	Unit of x values:
	y-Unit;dBm;	Unit of y values:
	Values;2500;	Number of measurement points
	9000.000000;-99.619965; 9225.961538;-105.416908; 9451.923077;-100.938057; 9677.884615;-99.483894; 9903.846154;-106.879539; 10129.807692;-108.772316;	Measurement values: <x value>; <y value>

MMEMory:STORe:SPURious   <file_name>

This command stores the peak list in an ASCII file to a file, e.g. on a memory stick.

The file has a header containing important parameters for scaling, several data sections containing the sweep settings per range and a data section containing the peak list.

The header data is made up of three columns, separated by ';':

parameter name; numeric value; basic unit

The data section for the measurement values starts with the key word "TRACE <n>:", where <n> includes the number of the used trace. Next comes the peak list with several columns also separated by ';'.

Spreadsheet programs such as MS Excel can read this format. Use ';' as the delimiter for the table cells.

Note

Different language versions of evaluation programs may require different handling of the decimal point. Using the DECIM SEP softkey, you can thus choose between the delimiters '.' (decimal point) and ',' (comma).

Parameter:	<file_name> := DOS file name
Example:	":MMEM:STOR:SPUR 'D:\TEST.ASC'"
Characteristics:	*RST value: - SCPI: device-specific
Mode:	R

This command is an event and therefore has no *RST value and no query.

MMEMory:STORe:FINal   <file_name>

This command stores the final measurement data in an ASCII file.

The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions.

Parameter:	<file_name> := DOS file name
Example:	":MMEM:STOR:FIN 'F:\TEST.ASC'"
Characteristics:	*RST value: - SCPI: device-specific
Mode:	R

This command is an event and therefore has no *RST value and no query.

MMEMory:CLEar:STATe   1,<file_name>

This command deletes the instrument setting selected by <file_name>. All associated files on the mass memory storage are cleared. A list of the extensions used is included under `MMEMory:LOAD: STATe`.

The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

Parameter:	<file_name> ::= DOS file name without extension
Example:	`"MMEM:CLE:STAT 1,'TEST'"`
Characteristics:	*RST value: - SCPI: device-specific
Mode:	all

This command is an event and therefore has no *RST value and no query.

MMEMory:CLEar:ALL

This command deletes all device settings in the current directory. The current directory can be selected with `MMEM:CDIR`. The default directory is D:.

Example:	`"MMEM:CLE:ALL"`
Characteristics:	*RST value: - SCPI: device-specific
Mode:	all

This command is an event and therefore has no *RST value and no query.

MMEMory:SELect[:ITEM]:HCOPy   ON | OFF

This command copies the test report settings to the list of partial data records of a device setting to be stored/loaded.

Example:	`"MMEM:SEL:HCOP ON"`
Characteristics:	*RST value:OFF SCPI:device-specific
Mode:	R

MMEMory:SELect[:ITEM]:HWSettings   ON | OFF

This command includes the hardware settings in the list of data subsets of a device setting to be stored/loaded. The hardware settings include:

• current configuration of general device parameters (general setup)

• current setting of the measurement hardware including markers

• activated limit lines

• user-defined color setting

• configuration for the hardcopy output

• the activated transducers

- Tracking generator settings
  (only in conjunction with option Tracking Generator B9 or External Generator Control B10)

- Correction data for source calibration
  (only in conjunction with option Tracking Generator B9 or External Generator Control B10)

Example:	`"MMEM:SEL:HWS ON"`

Characteristics:	*RST value: ON SCPI: device-specific

Mode:	all

MMEMory:SELect[:ITEM]:TRACe[:ACTive]   ON | OFF

This command adds the active traces to the list of data subsets of a save/recall device setting. Active traces are all traces whose state is not blank.

Example:	`"MMEM:SEL:TRAC ON"`

Characteristics:	*RST value: OFF, i.e. no traces will be stored SCPI: device-specific

Mode:	all

MMEMory:SELect[:ITEM]:LINes:ALL   ON | OFF

This command adds all limit lines (activated and de-activated) to the list of device settings to be stored/ loaded. The selection MMEM:SEL:LIN:ACT is thus switched off.

Example:	`"MMEM:SEL:LIN:ALL ON"`

Characteristics:	*RST value: ON SCPI: device-specific

Mode:	all

MMEMory:SELect[:ITEM]:FINal   ON | OFF

This command includes the final measurement data in the list of partial data sets of a device setting to be stored/loaded.

Example:	`"MMEM:SEL:FIN ON"` 'inserts the final measurement data in the list of partial data sets

Characteristics:	*RST value: ON SCPI: device-specific

Mode:	R

MMEMory:SELect[:ITEM]:SCData   ON | OFF

This command adds the tracking generator calibration data to the list of device settings to be stored/ loaded.

Example:	`"MMEM:SEL:SCD ON"` 'Inserts the tracking generator correction data in the list of data subsets

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

This command is only available in conjunction with the tracking generator option B9 or external generator control option B10.

MMEMory:SELect[:ITEM]:TRANsducer:ALL ON | OFF

This command includes all transducer factors and sets in the list of data subsets of a device setting to be stored/loaded.

Example: "MMEM:SEL:TRAN:ALL ON"

Characteristics: *RST value: ON
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value.

MMEMory:SELect[:ITEM]:ALL

This command includes all data subsets in the list device settings to be stored/loaded.

Example: "MMEM:SEL:ALL"

Characteristics: *RST value: --
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value.

MMEMory:SELect[:ITEM]:NONE

This command deletes all data subsets from the list of device settings to be stored/loaded.

Example: "MMEM:SEL:NONE"

Characteristics: *RST value: --
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value.

MMEMory:SELect[:ITEM]:DEFault

This command sets the default list of device settings to be stored/loaded. The latter includes:

• current configuration of general device parameters (general setup)

• current setting of the measurement hardware including markers

• activated limit lines

• user-defined color setting

• configuration for the hardcopy output

• Final measurement data

- Tracking generator settings
  (only in conjunction with option Tracking Generator B9 or External Generator Control B10)

- Correction data for source calibration
  (only in conjunction with option Tracking Generator B9 or External Generator Control B10)

Trace data, non-used transducer factors/sets and non-used limit lines are not included.

Example: `"MMEM:SEL:DEFault"`

Characteristics: *RST value: --
                      SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value.

MMEMory:COMMent   <string>

This command defines a comment (max. 60 characters) for a device setting to be stored.

Example: `"MMEM:COMM 'Setup for FM measurement'"`

Characteristics: *RST value: blank comment
                      SCPI: device-specific

Mode: all

OUTPut Subsystem

The OUTPut subsystem controls the output features of the instrument.

In conjunction with the tracking generator option, a distinction is made between OUTPut1 (screen A) and OUTPut2 (screen B).

OUTPut<1|2>[:STATe]   ON | OFF

This command switches the tracking generator on or off.

Notes

- With the tracking generator switched on, the maximum stop frequency is limited to 3 GHz. This upper limit is automatically modified by the set frequency offset of the generator.

- If measurements in compliance with specs are to be performed with the tracking generator, the start frequency has to be $\geq$3 x resolution bandwidth.

- The minimum sweep time for measurements in compliance with the data sheet is 100 ms in the frequency domain (span >0). If a shorter sweep time is selected, the sweep time indicator SWT on the screen is marked with a red asterisk and the message UNCAL is also displayed.

- With the tracking generator switched on, the FFT filters (BAND:MODE:FFT) are not available.

Example: `"OUTP ON"`
'Switches on the tracking generator in screen A.

Characteristics: ***RST value:** -
SCPI: conforming

Mode: A, R

This command is only valid in conjunction with option tracking generator.

OUTPut:UPORt[:VALue]   #B00000000 to #B11111111

This command sets the control lines of the user ports. In manual operation, the control lines are represented by softkeys PORT 0 to 7.

The user port is written to with the given binary pattern. If the user port is programmed to INPut instead of OUTPut, the output value is temporarily stored.

Example: `"OUTP:UPOR #B10100101"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

OUTPut:UPORt:STATe   ON | OFF

This command switches the control line of the user ports between INPut and OUTPut.

The user port is switched to OUTPut with parameter ON, to INPut with OFF.

Example: `"OUTP:UPOR:STAT ON"`

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: all

SENSe Subsystem

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device-specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the receiver. In accordance with the SCPI standard, the key word "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The measurement windows are selected by SENSe1 and SENSe2:

SENSe1 = Modification of screen A settings

SENSe2 = Modification of screen B settings.

Screen A is automatically selected if 1 or 2 is missing.

SENSe:AVERage Subsystem

The SENSe:AVERage subsystem calculates the average of the acquired data. A new test result is obtained from several successive measurements.

There are two types of average calculation: logarithmic and linear. In case of logarithmic average calculation (denoted with VIDeo), the average value of the measured logarithmic power is calculated and in case of linear average calculation, the linear power is averaged before the logarithm is applied.

The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]AVERage:COUNt   0 to 32767

In receiver mode, this command defines the number of scan started with single scan. In analyzer mode, it defines the number of measurements which contribute to the average value.

It should be noted that continuous averaging will be performed after the indicated number has been reached in continuous sweep mode.

In single sweep or scan mode, the scan/sweep is stopped as soon as the indicated number of measurements (scans/sweeps) is reached. Synchronization to the end of the indicated number of measurements is only possible in single scan/sweep mode.

The command `[SENSe<1|2>:]AVERage:COUNt` is the same as command `[SENSe<1|2>:]SWEep:COUNt`. In both cases, the number of measurements is defined whether the average calculation is active or not.

The number of measurements is valid for all traces in the indicated measurement window.

Example:	`"SWE:CONT OFF"` 'Switching to single-sweep mode.
	`"AVER:COUN 16"` 'Sets the number of measurements to 16.
	`"AVER:STAT ON"` 'Switches on the calculation of average.
	`"INIT;*WAI"` 'Starts the measurement and waits for the end of the 16 sweeps.
Characteristics:	***RST value:** 0 SCPI: conforming
Mode:	all

[SENSe<1|2>:]AVERage[:STATe<1 to 3>]   ON | OFF

This command switches on or off the average calculation for the selected trace (STATe<1 to 3>) in the selected measurement window.

Example:	`"AVER OFF"` 'Switches off the average calculation for trace 1 in screen A.
	`"SENS2:AVER:STAT3 ON"` 'Switches on the average calculation for trace 3 in screen B.
Characteristics:	***RST value:** OFF SCPI: conforming
Mode:	all

[SENSe<1|2>:]AVERage:TYPE   VIDeo | LINear

This command selects the type of average function. If VIDeo is selected, the logarithmic power is averaged and, if LINear is selected, the power values are averaged before they are converted to logarithmic values.

The type of average calculation is equally set for all traces in one measurement window.

Example:	`"AVER:TYPE LIN"`
	'Switches screen A to linear average calculation.

Characteristics:	***RST value:** VIDeo
	SCPI: device-specific

Mode:	A

SENSe:BANDwidth Subsystem

This subsystem controls the setting of the instrument's filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]BANDwidth|BWIDth:FFT   WIDE | AUTO | NARROW

This command allows to specify between the following three options for FFT filters.

WIDE: The FFT filters with the greater partial span (this is the span which is covered with one FFT analysis) are used always.

AUTO: The firmware decides whether to use wide or narrow filters to achieve the best performance of the measurement.

NARROW: The FFT filters with the smaller partial span are used, this allows measurements near a carrier with reduced reference level, because of a more narrow analog prefilter.

Example:	`"BWID:FFT:MODE WIDE"`
Characteristics:	*RST value: AUTO SCPI: device-specific
Mode:	A

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]   10 Hz to 10 MHz

This command defines the receiver IF bandwidth or, in *SPECTRUM* mode, the analyzer's resolution bandwidth.

Analog resolution filters of 10 Hz to 10 MHz in 1, 2, 3, 5, 10 steps are available. These filters are implemented as 5-circuit LC filters in the range from 300 kHz to 10 MHz and as digital filters with analog characteristic in the range of 10 Hz to 100 kHz.

The EMI bandwidths are only available when parameter `PULSe` is selected by command `BAND:TYPE`. FFT filters from 1 Hz to 30 kHz (3 dB bandwidth each) are also available in the frequency domain (span > 0) for fast measurements on periodic signals. The instrument automatically switches to analog filters above 30 kHz.

The FFT bandwidths are not available if the preselector is switched on.

A number of especially steep-edged channel filters can be selected provided that parameters `CFILter` or `RRC` are selected using the `BAND:TYPE` command. The possible combinations of filter type and filter bandwidth are listed in the table "List of available channel filters" of chapter "Instrument Functions", section "Setting the Bandwidths and Sweep Time – BW" on page 4.123.

If the resolution bandwidth is modified in SPECTRUM mode, the coupling to the span is automatically switched off.

If the resolution bandwidth is modified in FM DEMOD mode, the coupling to the demodulation bandwidth is automatically switched off.

Example:	`"BAND 120 kHz"` 'Sets the IF bandwidth to 120 kHz
Characteristics:	*RST value: - (AUTO is set to ON) SCPI: conforming
Mode:	all

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO   ON | OFF

In RECEIVER mode with activated quasi peak detector, this command either automatically couples the IF bandwidth of the receiver to the frequency range or cancels the coupling.

In SPECTRUM mode, this command either automatically couples the resolution bandwidth of the instrument to the span or cancels the coupling. In FM DEMOD mode, this command either automatically couples the IF bandwidth of the instrument to the demodulation bandwidth or cancels the coupling ($BW_{RBW} = 10 * BW_{Demod}$).

In FM DEMOD mode, the coupling refers to the demodulation bandwidth ($BW_{RBW} = 10 * BW_{Demod}$).

The automatic coupling adapts the resolution bandwidth to the currently set frequency span according to the relationship between frequency span and resolution bandwidth. The 6 dB bandwidths 200 Hz, 9 kHz and 120 kHz and the channel filters are not set by the automatic coupling.

The ratio resolution bandwidth/span can be modified with the command `[SENSe<1|2>:]BANDwidth[:RESolution]:RATio`.

Example: `"BAND:AUTO OFF"`
'Switches off the coupling of the IF bandwidth to the frequency range (receiver mode).
'Switches off the coupling of the resolution bandwidth to the span (analyzer mode).
'Switches off the coupling of the IF bandwidth to the demodulation bandwidth (FM demod mode).

Characteristics: *RST value: ON
SCPI: conforming

Mode: R, A-F, FM

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio   0.0001 to 1

This command defines the ratio resolution bandwidth (Hz) / span (Hz). The ratio to be entered is reciprocal to the ratio span/RBW used in manual control.

Example: `"BAND:RAT 0.1"`

Characteristics: *RST value: 0.02 with BAND:TYPE NORMal or RBW > 30 kHz
0.01 with BAND:TYPE FFT for RBW $\leq$ 30 kHz
SCPI: conforming

Mode: A

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE   NORMal | FFT | CFILter | RRC | NOISe | PULSe

This command switches the filter type for the resolution bandwidth between "normal" analog or FIR filters in 1, 3, 10 steps and the FFT filtering for bandwidths <100 kHz.

The advantage of FFT filtering is the higher measurement speed compared to digital filters with analog filter characteristic. However, FFT filters are only suitable for periodic signals, and they are only available for span > 0 Hz.

Steep-edged channel filters and filters with RRC (Root Raised Cosine) characteristic are available. The possible combinations of filter type and filter bandwidth are listed in the table "List of available channel filters" in chapter "Instrument Functions", section "Setting the Bandwidths and Sweep Time – BW" on page 4.123.

The filter type NOISe selects the 3 dB bandwidths for spectrum analysis, filter type PULSe selects the 6 dB bandwidths for EMI measurements.

Example: "BAND:TYPE NORM"

Characteristics: *RST value: PULSe
                      SCPI: device-specific

Mode: all

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo   1Hz to 10MHz

This command defines the instrument's video bandwidth. Bandwidths from 10 Hz to 10 MHz in 1, 3, 10 steps are available. The command is not available if FFT filtering is switched on and the set bandwidth is ≤ 30 kHz or if the quasi-peak detector is switched on.

Note

In receiver mode, the video bandwidth is set to ten times the resolution bandwidth.

Example: "BAND:VID 10kHz"

Characteristics: *RST value: - (AUTO is set to ON)
                      SCPI: conforming

Mode: A

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO   ON | OFF

This command either automatically couples the instrument's video bandwidth to the resolution bandwidth or cancels the coupling.

The ratio video bandwidth/resolution bandwidth can be modified with the command [SENSe<1|2>:]BANDwidth:VIDeo:RATio.

Note

In receiver mode, the video bandwidth is set to ten times the resolution bandwidth.

Example: "BAND:VID:AUTO OFF"

Characteristics: *RST value: ON
                      SCPI: conforming

Mode: A

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio   0.01 to 1000

This command defines the ratio video bandwidth (Hz) / resolution bandwidth (Hz).The ratio to be entered is reciprocal to the ratio RBW/VBW used in manual control.

Note

In receiver mode, the video bandwidth is set to ten times the resolution bandwidth.

Example: `"BAND:VID:RAT 3"`
'Sets the coupling of video bandwidth to video bandwidth = 3*resolution bandwidth

Characteristics: *RST value: 3
SCPI: conforming

Mode: A

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:TYPE   LINear | LOGarithmic

This command selects the position of the video filter in the signal path, provided that the resolution bandwidth is ≤100 kHz:

•   If LINear is selected, the video filter is connected ahead of the logarithmic amplifier (default)

•   If LOGarithmic is selected, the video filter follows the logarithmic amplifier

The essential difference between the two modes is the transient response at falling signal edges:

If LINear is selected, the measurement with logarithmic level scaling yields a much "flatter" falling edge than LOGarithmic.

This behavior is due to the conversion of linear power into logarithmic level. If the linear power is halved, the level decreases by only 3 dB.

Example: `"BAND:VID:TYPE LIN"`
'Video filter ahead of the logarithmic amplifier

Characteristics: *RST value: LIN
SCPI: device-specific

Mode: A

[SENSe<1|2>:]BANDwidth|BWIDth:PLL   AUTO | HIGH | MEDium | LOW

This command defines the bandwidth of the main PLL of the instrument synthesizer.

Example: `"BAND:PLL HIGH"`

Characteristics: *RST value: AUTO
SCPI: device-specific

Mode: A

[SENSe<1|2>:]BANDwidth|BWIDth:IF   10 Hz...100 kHz

This command sets the resolution bandwidth of the IF analysis.

Digitally implemented resolution filters from 10 Hz to 100 kHz in steps of 1, 3, and 10 are available (each with 6 dB bandwidths). The reliable value range depends on the selected frequency span of the IF analysis.

Example: `"BAND:IF 10kHz"`'Sets the IF bandwidth to 10 kHz.

Characteristics: *RST value:3 kHz
                      SCPI:device-specific

Mode: R

SENSe:CORRection Subsystem

The SENSe:CORRection subsystem controls the correction of measured results by means of frequency-dependent correction factors (e.g. for antenna or cable attenuation).

This subsystem also controls calibration and normalization during operation with the tracking generator options (B9/B10). The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]CORRection[:STATe]   ON | OFF

This command activates/deactivates the normalization of the measurement results in the selected window provided that the tracking generator is active. The command is available only after acquisition of a reference trace for the selected type of measurement (transmission/reflection, see command `[SENSe<1|2>:]CORRection:COLLect[:ACQire]`).

Example: `"CORR ON "`
                    'Activates normalization in screen A.

Characteristics: *RST value: OFF
                    SCPI: conforming

Mode: A

This command is only valid in conjunction with the tracking generator / ext. generator control option (B9/B10).

[SENSe<1|2>:]CORRection:METHod   TRANsmission | REFLection

This command selects the type of measurement with active tracking generator (transmission/reflection).

Example: `"CORR:METH TRAN "`
                    'Sets the type of measurement in screen A to "transmission".

Characteristics: *RST value: TRANsmission
                    SCPI: device specific

Mode: A

This command is only valid in conjunction with the tracking generator / ext. generator control option (B9/B10).

[SENSe<1|2>:]CORRection:COLLect[:ACQuire]   THRough | OPEN

When the tracking generator is active, this command determines the type of result acquisition for the normalization reference measurement and starts the measurement selected:

Parameter: THRough:
                    "TRANsmission" mode: calibration with direct connection between tracking
                    generator and device input.
                    "REFLection" mode: calibration with short circuit at the input

                    OPEN: only valid in "REFLection" mode: calibration with open input

To obtain a valid reference measurement, a complete sweep with synchronization to the end of the sweep must have been carried out. This is only possible in the single sweep mode.

Example: `"INIT:CONT OFF"`
                       'Selects single sweep operation

                       `"CORR:COLL THR;*WAI"`
                       'Starts the measurement of reference data using direct connection between
                       generator and device input and waits for the sweep end.

Characteristics: *RST value: --
                       SCPI: conforming

Mode: A

This command is an "event" and therefore has no *RST value and no query.

This command is only valid in conjunction with the tracking generator / ext. generator control option
(B9/B10).

[SENSe<1|2>:]CORRection:RECall

This command restores the instrument setting that was valid for the measurement of the reference
data, provided that the tracking generator is active.

Example: `"CORR:REC"`

Characteristics: *RST value: -
                       SCPI: conforming

Mode: A

This command is an event and therefore has no *RST value and no query.

This command is only valid in conjunction with the tracking generator / ext. generator control option
(B9/B10).

[SENSe<1|2>:]CORRection:TRANsducer:CATalog?

This command reads out the names of all transducer factors stored on the hard disk.

Example: `"CORR:TRAN:CAT?"`

Characteristics: *RST value: -
                       SCPI: device-specific

Mode: R, A

[SENSe<1|2>:]CORRection:TRANsducer:GENerate   <name>

This command generates a transducer factor <name> using normalized trace data. The function is
only available when normalization is switched on.

Parameter: <name>::= Name of the transducer factors as string data with up to 8 characters.

Example: `"CORR:TRAN:GEN 'FACTOR1'"`

Characteristics: *RST value: -
                       SCPI: device-specific

Mode: A

[SENSe<1|2>:]CORRection:TRANsducer:SELect   <name>

This command selects the transducer factor designated by <name>. If <name> does not exist yet, a new transducer factor is created.

Note

This command must be sent prior to the subsequent commands for modifying/ activating transducer factors.

Parameter:	<name>::= Name of the transducer factor in string data form with a maximum of 8 characters.
Example:	":CORR:TRAN:SEL 'FACTOR1'"
Characteristics:	*RST value: - SCPI: device-specific
Mode:	R, A

[SENSe<1|2>:]CORRection:TRANsducer:UNIT   <string>

This command specifies the unit for the selected transducer factor.

Note

The command SENS:CORR:TRAN:SEL must be transmitted prior to this command.

Parameter:	<string>::= 'DB'	'DBM'	'DBMV'	'DBUV'	'DBUV/M'	'DBUA'	'DBUA/M'	'DBPW'	'DBPT'
Example:	":CORR:TRAN:UNIT 'DBUV'"
Characteristics:	*RST value: 'DB' SCPI: device-specific
Mode:	R, A

Prior to this command, the command SENS:CORR:TRAN:SEL must be sent.

[SENSe<1|2>:]CORRection:TRANsducer:SCALing LINear | LOGarithmic

This command defines whether the frequency scaling of the transducer factor is linear or logarithmic.

Note

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

Example: `":CORR:TRAN:SCAL LOG"`

Characteristics: *RST value: LINear
SCPI: device-specific

Mode: R, A

[SENSe<1|2>:]CORRection:TRANsducer:COMMent <string>

This command defines the comment for the selected transducer factor.

Note

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

Example: `":CORR:TRAN:COMM 'FACTOR FOR ANTENNA'"`

Characteristics: *RST value: '' (empty comment)
SCPI: device specific

Mode: R, A

[SENSe<1|2>:]CORRection:TRANsducer:DATA <freq>,<level>..

This command defines the reference values of the transducer factor selected. These values are entered as a sequence of frequency/level pairs. The frequencies must be sent in ascending order.

Note

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent. The level values are sent as dimensionless numbers; the unit is specified by means of the command `SENS:CORR:TRAN:UNIT`.

Example: `":CORR:TRAN:TRANsducer:DATA 1MHZ,-30,2MHZ,-40"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A

[SENSe<1|2>:]CORRection:TRANsducer[:STATe]   ON | OFF

This command switches the selected transducer factor on or off.

Note

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

Example: `":CORR:TRAN ON"`

Characteristics: *RST value: OFF
                    SCPI: device-specific

Mode: R, A

[SENSe<1|2>:]CORRection:TRANsducer:DELete

This command deletes the selected transducer factor.

Note

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

Example: `":CORR:TRAN:DEL"`

Characteristics: *RST value: -
                    SCPI: device-specific

Mode: R, A

This command is an event and therefore has no *RST value.

[SENSe<1|2>:]CORRection:TRANsducer:VIEW   ON | OFF

This command switches on the display of the active transducer factor or set.

Note

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

Example: `"CORR:TRAN:VIEW ON"`

Characteristics: *RST value: OFF
                    SCPI: device-specific

Mode: R, A

[SENSe<1|2>:]CORRection:TRANsducer:ADJust:RLEVel[:STATe]   ON | OFF

This command switches the automatic adjustment of the reference level to the selected transducer factor on or off.

Note

The command SENS:CORR:TRAN:SEL must have been sent prior to this command.

Example: "CORR:TRAN:ADJ:RLEV ON"

Characteristics: *RST-Wert: OFF
                    SCPI: device-specific

Mode: R, A

[SENSe<1|2>:]CORRection:TSET:SELect   <name>

This command selects the transducer set designated by <name>. If <name> does not exist yet, a new set is created.

Parameter: <name>::= name of the transducer set in string data form with a maximum of 8 characters.

Example: "CORR:TSET:SEL 'SET1'"

Characteristics: *RST value: -
                    SCPI: device-specific

Mode: R, A

This command must be sent prior to the subsequent commands for changing/activating the transducer sets.

[SENSe<1|2>:]CORRection:TSET:UNIT   <string>

This command defines the unit of the selected transducer sets. When assigning transducer factors to the set, only factors which are compatible to the selected unit, i.e. factors with the same unit or the unit dB, are allowed.

Parameter: <string>::= 'DB' | 'DBM' | 'DBUV' | 'DBUV/M' | 'DBUA' | 'DBUA/M" | DBPW' | 'DBPT'

Example: "CORR:TSET:UNIT 'DBUV'"

Characteristics: *RST value: 'DB'
                    SCPI: device-specific

Mode: R, A

Prior to this command, the command SENS:CORR:TSET:SEL must be sent.

[SENSe<1|2>:]CORRection:TSET:BREak   ON | OFF

This command defines if the sweep is to be stopped on changeover from range to another.

Example: "`CORR:TSET:BRE ON`"

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R, A

Prior to the above command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe<1|2>:]CORRection:TSET:COMMent   <string>

This command defines the comment for the selected transducer set.

Example: "`:CORR:TSET:COMM 'SET FOR ANTENNA'`"

Characteristics: *RST value: " (empty comment)
SCPI: device specific

Mode: R, A

Prior to this command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe<1|2>:]CORRection:TSET:RANGe<1 to 10>   <freq>,<freq>,<name>..

This command defines a partial range of the selected transducer set. The partial range is determined by its start and stop frequencies plus a list of names of the assigned transducer factors. The ranges 1 to 10 must be sent in ascending order.

Parameter: <freq>,<freq>::= start frequency, stop frequency of the range
<name>...::= list of names for the assigned transducer factors.
The individual names must be characterized by single quotation marks (') and separated by commas.

Example: "`CORR:TRAN:TSET:RANG 1MHZ,2MHZ,'FACTOR1,'FACTOR2'`"

Characteristics: *RST value: -
SCPI: device-specific

Mode: R, A

Prior to this command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe<1|2>:]CORRection:TSET[:STATe]   ON | OFF

This command switches the selected transducer set on or off.

Example: "`CORR:TSET ON`"

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R, A

Prior to this command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe<1|2>:]CORRection:TSET:DELete

This command deletes the selected transducer set.

Example: `"CORR:TSET:DEL"`

Characteristics: *RST value: -
                     SCPI: device-specific

Mode: R, A

This command is an event and therefore has no *RST value.
Prior to this command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe<1|2>:]CORRection:YIG:TEMPerature:AUTO   ON | OFF

This command switches on or off the automatic correction of the YIG filter frequency drift.

When correction is switched on, it is checked once per minute whether the temperature on the YIG filter has changed by more than 5K relative to the last instance of correction. If this is the case, the frequency of the YIG filter is – at the end of the next measurement – adjusted as required for the new temperature. For time-critical applications, the correction function can be switched off after an operating period of $\geq$ 30 minutes.

Example: `"CORR:YIG:TEMP OFF"`
                     'Switches off automatic correction of the YIG filter frequency drift.

Characteristics: *RST value: ON
                     SCPI: device-specific

Mode: all

SENSe:DEMod Subsystem

The SENSe:DEMod subsystem controls the analog demodulation of the video signal.

[SENSe<1|2>:]DEMod   OFF | AM | FM

This command selects the type of analog demodulation.

Example: `"DEM FM"`

Characteristics: *RST value: OFF
                 SCPI: device-specific

Mode: R

SENSe:DETector Subsystem

The SENSe:DETector subsystem controls the acquisition of measurement data via the selection of the detector for the corresponding trace. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]DETector<1..3>[:FUNCtion]   APEak | NEGative | POSitive | SAMPle | RMS | AVERage | QPEak | CAVerage | CRMS

This command sets the detector for recording measured values for the selected trace in the specified measurement window.

- The "APEak" (AutoPeak) detector displays the positive as well as the negative peak value for noise. Only the positive peak value is displayed if a signal is detected.

- The "POSitive" or "NEGative" detector displays only the positive or negative peak value, respectively.

- With the "Sample" detector, the instantaneous value is displayed at the time point when the measured value is recorded, while with the "RMS" detector the RMS value of the power measured at every measurement point is displayed.

- The "AVERage" detector displays the average value of the power at every measurement point.

- The detectors "QPEak" for quasipeak, "CAVerage" for CISPR average and "CRMS" for CISPR-RMS perform standard-compliant signal evaluations for the EMC test equipment.

If QPEak is selected, the video filter is automatically switched off. In addition, the couplings between the span and RBW as well as between RBW and the sweep time are switched off. They are not restored until another detector is selected. Accordingly, the sweep time should be set to a value that is large enough so that the quasipeak detector can settle in completely at each measurement point.

CISPR average "CAVerage and CISPR-RMS "CRMS" are available only in the analyzer operating mode and zerospan.

In the SCAN mode of the receiver, the detectors POSitive, NEGative, RMS, AVERage and QPEak are available.

The trace is indicated as a numerical suffix for DETector.

Example:	"DET POS"
	'Sets the detector in screen A to "positive peak".
Characteristics:	*RST value: APEak
	SCPI: conforming
Mode:	A, R

[SENSe<1|2>:]DETector<1 to 3>[:FUNCtion]:AUTO   ON | OFF

This command either couples the detector in the selected measurement window to the current trace setting or turns coupling off. The trace is selected by the numeric suffix at DETector.

Example:	"DET:AUTO OFF"
Characteristics:	*RST value: ON
	SCPI: conforming
Mode:	A

[SENSe<1|2>:]DETector:RECeiver[:FUNCtion]   POSitive | NEGative | RMS | AVERage | QPEak | CAVerage | CRMS

In the receiver mode, this command switches on the detectors for an individual measurement to record measured values.
The trace cannot be selected; three detectors can be switched on simultaneously.

Example: "DET:REC POS,AVER,QPE" 'Switches on the peak, average and quasipeak detectors.

Characteristics: *RST value: POS
SCPI: device-specific

Mode: R

[SENSe<1|2>:]DETector<1 to 3>:FMEasurement   NEGative | POSitive | RMS | AVERage | QPEak | CAVerage | CRMS

This command selects the detector for the final measurement which is performed subsequent to the overview measurement.

Example: "DET:FME POS"

Characteristics: *RST value: Trace 1 QPEak
Trace 2 AVERage
Trace 3 RMS
SCPI: device-specific

Mode: R

SENSe:FMEasurement Subsystem

This subsystem control the parameters of final measurement in the receiver.

[SENSe<1|2>:]FMEasurement:THReshold[:STATe]   ON | OFF

This command switches the threshold scan function (direct final measurement during the scan) on and off.

Example:	`"FME:THR ON "`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R

[SENSe<1|2>:]FMEasurement:NBBB[:STATe] ON | OFF   <numeric_value>:

This command switches on automatic detection of narrowband and broadband interference signals. The detector for the final measurement is also automatically selected.

Example:	`"FME:NBBB ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: R

[SENSe<1|2>:]FMEasurement:NBBB:LEVel   <numeric_value>:

This command enters the decision threshold to be used by the analyzer to discriminate between broadband and narrowband interference.

Example:	`"FME:NBBB:LEV 6 DB "`

Characteristics: *RST value: 6 dB
SCPI: device-specific

Mode: R

[SENSe<1|2>:]FMEasurement:AUTO   ON | OFF

This command switches between automatic and interactive final measurement.

Example:	`"FME:AUTO ON"`

Characteristics: *RST value: ON
SCPI: device-specific

Mode: R

[SENSe<1|2>:]FMEasurement:LISN[:TYPE]   TWOPhase | FOURphase | ESH3Z5 | ESH2Z5 | ENV4200 | ENV216 | OFF

This command selects whether a V-network is driven automatically via the user port in the final measurement and, if yes, which one:

TWOPhase and ESH3Z5	R&S ESH3-Z5 (two phases and protective earth are controllable)
FOURphase and ESH2Z5	R&S ESH2-Z5 (four phases and protective earth are controllable)
ENV4200	R&S ENV 4200 (four phases are controllable)
ENV216	R&S ENV 216 (two phases and highpass are controllable)
OFF	Remote control deactivated

Example: `":FME:LISN:TWOP"`

Characteristics: *RST value: OFF
                      SCPI: device specific

Mode: R

[SENSe<1|2>:]FMEasurement:LISN:PHASe   L1 | L2 | L3 | N[[,L1 | L2 | L3 | N],…]

This command selects the phases of the V-network on which level measurements are consecutively performed in the final measurement. L2 and L3 are only available with four-line V-networks (`FMEasurement:LISN FOURphase | ENV4200`).

Example: `":FME:LISN:PHAS L1,N"`

Characteristics: *RST value: L1
                      SCPI: device specific

Mode: R

[SENSe<1|2>:]FMEasurement:LISN:PEARth   GROunded | FLOating[,GROunded | FLOating]

This command selects the ground settings on the V-network on which level measurements are consecutively performed in the final measurement. This command is available only for certain V-networks (FMEasurement:LISN FOURphase | TWOPhase | ESH3Z5 | ESH2Z5).

Example: `":FME:LISN:PEAR GRO,FLO"`

Characteristics: *RST value: GRO
                      SCPI: device specific

Mode: R

[SENSe<1|2>:]FMEasurement:LISN:FILTer:HPAS[:STATe]   ON | OFF

This command selects the setting for the high pass on the V-network with which the level measurement is performed in the final measurement. This command is available only for the R&S ENV 216 V-network (FMEasurement:LISN ENV216).

Example: `":FME:LISN:FILT:HPAS ON"`

Characteristics: *RST value: ON
                      SCPI: device-specific

Mode: R

[SENSe<1|2>:]FMEasurement:TIME   <numeric_value>

This command defines the measurement time in which the values indicated in the peak list (final measurement values) are re-checked.

Example: ":FME:TIME 0.01"

Characteristics: *RST value: 1 s
                      SCPI: device specific

Mode: R

SENSe:FREQuency Subsystem

The SENSe:FREQuency subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]FREQuency:CENTer   0 to f_{max}

This command defines the receiver frequency or the center frequency in analyzer mode.

Example:	"FREQ:CENT 100MHz"
Characteristics:	*RST value: f_{max} /2 with f_{max} = maximum frequency SCPI: conforming
Mode:	all

[SENSe<1|2>:]FREQuency:CENTer:STEP   0 to f_{max}

This command defines the step width of the center frequency.

Example:	"FREQ:CENT:STEP 120MHz"
Characteristics:	*RST value: - (AUTO 0.1 × SPAN is switched on) SCPI: conforming
Mode:	all

[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK   SPAN | RBW | OFF

This command couples the step width of the center frequency to span (span >0) or to the resolution bandwidth (span = 0) or cancels the couplings.

Parameter:	SPAN = Coupling to frequency display range (for span > 0)
	RBW = Coupling to resolution bandwidth (for span = 0)
	OFF = manual input, no coupling.
Example:	"FREQ:CENT:STEP:LINK SPAN"
Characteristics:	*RST value: SPAN SCPI: device-specific
Mode:	A

[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor   1 to 100 PCT

This command couples the step width of the center frequency with a factor to the span (span >0) or to the resolution bandwidth (span = 0).

Example:	"FREQ:CENT:STEP:LINK:FACT 20PCT"
Characteristics:	*RST value: - (AUTO 0.1 × SPAN is switched on) SCPI: device-specific
Mode:	A

[SENSe<1|2>:]FREQuency:SPAN   0 to f_{max}

This command defines the frequency span in the analyzer mode.

Example: "FREQ:SPAN 10MHz"

Characteristics: *RST value: f_{max} with f_{max} = maximum frequency
SCPI: conforming

Mode: A

[SENSe<1|2>:]FREQuency:SPAN:FULL

This command sets the frequency span in the analyzer mode to its maximum.

Example: "FREQ:SPAN:FULL"

Characteristics: *RST value: -
SCPI: conforming

Mode: A

This command is an event and therefore has no *RST value and no query.

[SENSe<1|2>:]FREQuency:STARt   0 to f_{max}

This command defines the start frequency of the overall scan in receiver mode. It defines the start frequency of the sweep in analyzer mode..

Example: "FREQ:STAR 20MHz"

Characteristics: *RST value: 0
SCPI: conforming

Mode: R, A-F

[SENSe<1|2>:]FREQuency:STOP   0 to f_{max}

This command defines the stop frequency of the overall scan in receiver mode. It defines the stop frequency of the sweep in analyzer mode..

Example: "FREQ:STOP 2000MHz"

Characteristics: *RST value: f_{max}
SCPI: conforming

Mode: R, A-F

[SENSe<1|2>:]FREQuency:MODE   CW | FIXed | SWEep | SCAN | TDOMain

This command switches in the analyzer mode between frequency domain (SWEep) and time domain (CW | FIXed).

In the receiver mode, this command switches between frequency scan (SCAN) and time domain scan (TDOMain).

For CW and FIXed, the frequency setting is made using the FREQuency:CENTer command. In SWEep mode, the setting is made using the FREQuency:STARt, STOP, CENTer and SPAN commands.

In SCAN mode, the frequency setting is made using the FREQuency:STARt and FREQuency:STOP commands in the SENSe:SCANsubsystem.

Example:	`"FREQ:MODE TDOM"`

Characteristics:	*RST value: TDOMain for the receiver mode and SWEep for the analyzer mode SCPI: device-specific

Mode:	A, R

This command is available in the receiver mode only with the option ESU-K53.

[SENSe<1|2>:]FREQuency:OFFSet   <numeric_value>

This command defines the frequency offset of the instrument.

Example:	`"FREQ:OFFS 1GHZ"`

Characteristics:	*RST value: 0 Hz SCPI: conforming

Mode:	A, FM

SENSe:LIST Subsystem

The commands of this subsystem are used for measuring the power at a list of frequency points with different device settings. The measurement is always performed in the time domain (span = 0 Hz).

A new trigger event is required for each test point (exception: Trigger FREE RUN).

The results are output as a list in the order of the entered frequency points. The number of results per test point depends on the number of concurrently active measurements (peak/RMS/average).

Selection of concurrently active measurements and setting of parameters that are constant for the whole measurement is via a configuration command (`SENSe:LIST:POWer:SET`). This also includes the setting for trigger and gate parameters.

The following setting parameters can be selected independently for each frequency point:

- Analyzer frequency
- Reference level
- RF attenuation
- Resolution filter
- Resolution bandwidth
- Video bandwidth
- Measurement time
- Detector

The number of frequencies is limited to 100 entries.

The commands of this subsystem can be used in two different ways:

1. Instrument setup, measurement and querying of the results in a single command:
   With this method, there is the least delay between the measurement and the result output. However, it requires the control computer to wait for the response from the instrument.

2. Instrument setup and querying of the result list at the end of the measurement:
   With this method, the control computer may be used for other activities while the measurement is being performed. However, more time is needed for synchronization via service request.

Note

Settings that are not directly included in commands of this subsystem can be configured by sending the corresponding commands prior to the SENSe:LIST-commands.

Please note that changes to the trigger level have to be executed in time domain (span = 0 Hz) in order to take effect for the SENSe:LIST commands.

[SENSe<1|2>:]LIST:POWer:RESult?

This command queries the result of a previous list measurement as configured and initiated with `SENSe:LIST:POWer[:SEQuence]`. The measured results are output in a list of floating point values separated by commas. The unit of the results depends on the setting made with the `CALC:UNIT` command.

This command may be used to obtain measurement results in an asynchronous way, using the service request mechanism for synchronization with the end of the measurement.

If no measurement results are available, the command will return a query error.

Example:

```
'Configuration of the status reporting system for the generation of an SRQ
on operation complete

*ESE 1

*SRE 32

'Configuring and starting the measurement

"SENSe:LIST:POWer    935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                     935.4MHz,-20dBm,10dB,OFF,NORM,30kHz,100kHz,434us,0,
                     935.6MHz,-20dBm,10dB,OFF,NORM,30kHz,100kHz,434us,0;
                     *OPC"

'Further actions of the control computer during measurement

...

'Response to service request

On SRQ:

SENSe:LIST:POWer:RESult?
```

Characteristics: *RST value: --
                   SCPI: device-specific

Mode: A-F, A-T

[SENSe<1|2>:]LIST:POWer[:SEQuence]   <analyzer freq>,<ref level>,<rf att>,OFF,
<filter type>,<rbw>,<vbw>, <meas time>,<trigger level>,...

This command configures the list of settings (max. 100 entries) for the multiple power measurement and starts a measurement sequence. When synchronizing the command with *OPC, a service request is generated as soon as all frequency points are processed and the defined number of individual measurements is reached.

To reduce the setting time, all indicated parameters are set up simultaneously at each test point.

The query form of the command processes the list and immediately returns the list of results. The number of results per test point depends on the setting of the "`SENSe:LIST:POWer:SET`" command.

Note

The following parameters are the settings for an individual frequency point. They are repeated for every other frequency point.

For reasons of compatibility with the FSP instrument family, input OFF is required after parameter <rf att>.

Parameter:

<analyzer freq>:	Receive frequency for the signal to be measured (= center frequency in manual operation)	
	Range of values:	0 Hz to max. frequency, depending on the instrument model.
<ref level>:	Reference level	
	Range of values:	+30 dBm to -75 dBm in 5 dB steps
<rf att>:	RF input attenuation	
	Range of values:	0 dB to 75 dB in 5 dB steps
OFF:	always OFF	
<filter type>:	NORMal:	normal resolution filter
	CFILter:	channel filter. These are especially steep-edged filters, which are used for example in Fast ACP measurement to ensure the band-limiting of a transmission channel in the time domain.
	RRC:	Root Raised Cosine filter. This special filter form is used to determine the channel power for some mobile radio standards.
<rbw>:	Resolution bandwidth	
	Range of values:	10 Hz to 10 MHz, in 1, 2, 3, 5, 10 steps for <filter type> = NORMal.
		See filter table for <filter type> = CFILter and <filter type> = RRC. Possible combinations of filter type and filter bandwidth see table "List of available channel filters" in chapter "Instrument Functions", section "Setting the Bandwidths and Sweep Time – BW" on page 4.123.
<vbw>:	Video bandwidth	
	Range of values:	1 Hz to 10 MHz in 1, 2, 3, 5, 10 steps.
	The value is ignored for <filter type> = CFILter or RRC	
<meas time>:	Measurement time	
	Range of values:	1us to 30s
<trigger level>:	Reserved. Must be set to 0.	

Return value:

The query command returns a list of comma-separated values (CSV) which contains the power measurement results in floating-point format. The unit depends on the setting with `CALC:UNIT`.

```
"SENSe:LIST:POWer?    935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                      935.4MHz,-20dBm,10dB,OFF,NORM,30kHz,100kHz,434us,0,
                      935.6MHz,-20dBm,10dB,OFF,NORM,30kHz,100kHz,434us,0"
```

thus returns the following list, for example:

-28.3,-30.6,-38.1

If the command sequence is extended to

```
"SENSe:LIST:POWer:SET ON,ON,ON,IMM,POS,0,0"
```

```
"SENSe:LIST:POWer?    935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                      935.4MHz,-20dBm,10dB,OFF,NORM,30kHz,100kHz,434us,0,
                      935.6MHz,-20dBm,10dB,OFF,NORM,30kHz,100kHz,434us,0"
```

the result list is extended to 3 results per frequency point (peak, RMS and average):

-28.3, -29.6, 1.5, -30.6, -31.9, 0.9, -38.1, -40.0, 2.3

Example:

```
"SENSe:LIST:POWer     935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                      935.4MHz,-20dBm,10dB,OFF,CFIL,30kHz,100kHz,434us,0,
                      935.6MHz,-20dBm,10dB,OFF,CFIL,30kHz,100kHz,434us,0"
```

performs a measurement sequence with the following settings:

```
"SENSe:LIST:POWer?    935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                      935.4MHz,-20dBm,10dB,OFF,CFIL,30kHz,100kHz,434us,0,
                      935.6MHz,-20dBm,10dB,OFF,CFIL,30kHz,100kHz,434us,0"
```

performs the same measurement and returns the result list immediately after the last frequency point.

Notes

- The measurement is performed in the time domain and therefore the span is set to 0 Hz. If the time domain is abandoned, the function is automatically switched off.

- The measurement is not compatible with other measurements, especially as far as marker, adjacent channel power measurement or statistics are concerned. The corresponding commands thus automatically deactivate the function.

- The function is only available in REMOTE operation. It is deactivated when switching the instrument back to LOCAL.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A-F, A-T

[SENSe<1|2>:]LIST:POWer:SET   <PEAK meas>,<RMS meas>,<AVG meas>,<trigger mode>,<trigger slope>,<trigger offset>, <gate length>

This command defines the constant settings for the list during multiple power measurement.

Parameters <PEAK meas>, <RMS meas> and <AVG meas> define, which measurements are to be performed at the same time at the frequency point. Correspondingly, one, two or three results per frequency point are returned for the `SENS:LIST:POW?` command. If all three parameters are set to OFF, the command generates an execution error.

Parameter:	<PEAK meas>: ON activates the measurement of the peak power (peak detector). OFF deactivates the measurement of the peak power.
	<RMS meas>: ON activates the measurement of the RMS power (RMS detector). OFF deactivates the measurement of the RMS power.
	<AVG meas>: ON activates the measurement of the average power (average detector). OFF deactivates the measurement of the average power.
	<trigger mode>: Selection of the trigger source used for the list measurement. Possible values: IMMediate | VIDeo | EXTernal | IFPower
	<trigger slope>: Used trigger slope. Possible values: POSitive | NEGative
	<trigger offset>: Offset between the detection of the trigger signal and the start of the measurement at the next frequency point. Range of values: 0 s, 125 ns to 100s
	<gate length>: Gate length with Gated Sweep. Range of values: 0 s, 125 ns to 100s

---

> **Note**
>
> • The value 0 s deactivates the use of GATED TRIGGER; other values activate the GATED TRIGGER function.
>
> • Values <> 0 s are only possible if <trigger mode> is different from IMMediate. Otherwise, an execution error is triggered.

Return value:	The query command returns a list of comma-separated values (CSV) of the settings, i.e.
	ON,ON,ON,IMM,POS,0,0
	if the configuration has been set with the command
	`"SENSe:LIST:POWer:SET ON,ON,ON,IMM,POS,0,0"`
Example:	`"SENSe:LIST:POWer:SET ON,OFF,OFF,EXT,POS,10US,434US"`
	`"SENSe:LIST:POWer:SET ON,ON,ON,VID,NEG,10US,0"`
Characteristics:	*RST values: ON,OFF,OFF,IMM,POS,0S,0S SCPI: device-specific
Mode:	A-F, A-T

[SENSe<1|2>:]LIST:POWer:SET:AVERage:TYPE   LINear | LOGarithmic

With this command the average type of the sense list measurement can be set either to linear (default) or logarithmic. In linear mode voltages are averaged in logarithmic mode levels.

Example: `"LIST:POW:SET:AVER LOG"`
                      'sets log averaging for list measurement.

Characteristics: *RST value: LIN
                      SCPI: device-specific

Mode: A-F, A-T

[SENSe<1|2>:]LIST:POWer:STATe   OFF

This command deactivates the list measurement.

Example: `"SENSe:LIST:POWer:STATe OFF"`

Characteristics: *RST value: --
                      SCPI: device-specific

Mode: A-F, A-T

[SENSe<1|2>:]LIST:RANGe<1…20>:BANDwidth[:RESolution]   <numeric_value>

This command selects the resolution bandwidth (RBW) of a range in the spurious measurement.

Example: `":LIST:RANG2:BAND 10E3"`
                      'sets the RBW to 10 KHz

Characteristics: *RST value: 10 kHz
                      SCPI: device-specific

Mode: A

[SENSe<1|2>:]LIST:RANGe<1…20>:BANDwidth:VIDeo   <numeric_value>

This command selects the video bandwidth (VBW) of a range in the spurious measurement.

Example: `":LIST:RANG2:BAND:VIDeo 40E3"`
                      'sets the VBW to 40 KHz

Characteristics: *RST value: 30 kHz
                      SCPI: device-specific

Mode: A

[SENSe<1|2>:]LIST:RANGe<1…20>:BREak   ON | OFF

This command determines whether a sweep is stopped in the spurious measurement when a range is changed.

Example: `":LIST:RANG2:BRE ON"`
                      'sweep stops if the range is changed from range 2 to 3

Characteristics: *RST value: OFF
                      SCPI: device-specific

Mode: A

[SENSe<1|2>:]LIST:RANGe<1…20>:COUNt?

This command indicates the number of defined ranges of the spurious measurement.

The numeric suffix <1 to 4> with RANGe is not relevant for this command.

Example:	`":LIST:RANG:COUN?"`
	'Indicates the number of ranges
Characteristics:	*RST value: OFF
	SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:DELete

This command deletes a range.

Example:	`":LIST:RANG2:DEL"`
	'deletes range 2
Characteristics:	*RST value: --
	SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:DETector   APEak | NEGative | POSitive | SAMPle | RMS | AVERage

This command sets the detector in the spurious measurement.

Example:	`":LIST:RANG2:DET APE"`
	'autopeak detector
Characteristics:	*RST value: POS
	SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:FILTer:TYPE   NORMal | CHANnel | RRC | P5

This command sets the filter in the spurious measurement.

Example:	`":LIST:RANG2:FILT:TYPE RRC"`
	'RRC filter
Characteristics:	*RST value: NORMal
	SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>[:FREQuency]:STARt   <numeric_value>

This command sets the start frequency of a range in the spurious measurement.

Example:	`":LIST:RANG2:STAR 1GHZ"`
	'start frequency of range 2 to 1 GHz
Characteristics:	*RST value: --
	SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>[:FREQuency]:STOP <numeric_value>

This command sets the stop frequency of a range in the spurious measurement.

Example:	`":LIST:RANG2:STOP 2GHZ"` 'stop frequency of range 2 to 2 GHz
Characteristics:	*RST value: -- SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:INPut:ATTenuation <numeric_value>

This command defines the RF attenuation of a range in the spurious measurement.

Example:	`":LIST:RANG2:INP:ATT 30db"` 'RF attenuation of range 2 to 30 dB
Characteristics:	*RST value: - SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:INPut:ATTenuation:AUTO ON | OFF

This command switches the autoranging of a range in the spurious measurement on or off.

Example:	`":LIST:RANG2:INP:ATT:AUTO ON"` 'activates autorange for range 2
Characteristics:	*RST value: ON SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:INPut:GAIN:STATe ON | OFF

This command switches the preamplifier of a range in the spurious measurement on or off.

Example:	`":LIST:RANG2:INP:GAIN:STAT ON"` 'activates the preamplifier for range 2
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:POINts <numeric_value>

This command defines the number of sweep points of a range in the spurious measurement.

Example:	`":LIST:RANG2:POIN 300"` 'sets 300 sweep points in range 2
Characteristics:	*RST value: 625 SCPI: device-specific
Mode:	A

[SENSe<1|2>:]LIST:RANGe<1…20>:RLEVel   <numeric_value>

This command defines the reference level of a range in the spurious measurement.

Example: ":LIST:RANG2:RLEV -30"
                   'sets the reference level in range 2 to -30 dBm

Characteristics: *RST value: -
                   SCPI: device-specific

Mode: A

[SENSe<1|2>:]LIST:RANGe<1…20>:SWEep:TIME   <numeric_value>

This command defines the sweep duration of a range in the spurious measurement.

Example: ":LIST:RANG2:SWE:TIME 1MS"
                   'sets the sweep time in range 2 to 1 ms

Characteristics: *RST value: --
                   SCPI: device-specific

Mode: A

[SENSe<1|2>:]LIST:RANGe<1…20>:SWEep:TIME:AUTO   ON | OFF

This command controls the automatic coupling of the sweep duration on the frequency span and the bandwidth settings in a spurious measurement range.

Example: ":LIST:RANG2:SWE:TIME:AUTO ON"
                   'activates the coupling of frequency range and bandwidths in range 2

Characteristics: *RST value: ON
                   SCPI: device-specific

Mode: A

[SENSe<1|2>:]LIST:RANGe<1…20>:TRANsducer   <string>

This command sets the transducer factor for a range in the spurious measurement.

Example: ":LIST:RANG2:TRAN ON 'fac_1'"
                   'sets the transducer factor fac_1 in range 2

Characteristics: *RST value: --
                   SCPI: device-specific

Mode: A

SENSe:MPOWer Subsystem

The commands of this subsystem are used to determine the mean burst power or peak burst power for a given number of signal bursts, and for outputting the results in a list. Since all the settings required for a measurement are combined in a single command, the measurement speed is considerably higher than when using individual commands.

For measuring the signal bursts, the GATED SWEEP function is used in the time domain. The gate is controlled either by an external trigger signal or by the video signal. An individual trigger event is required for each burst to be measured. If an external trigger signal is used, the threshold is fixed to TTL level, while with a video signal the threshold can be set as desired.

The following graphics shows the relation between trigger time, trigger offset (for delayed gate opening) and measurement time.
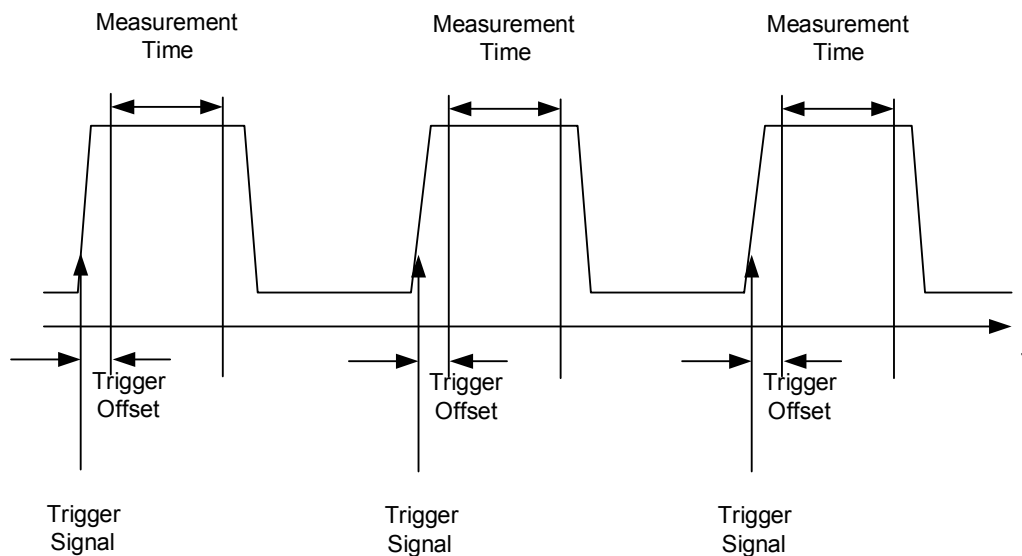
Depending on the settings made, the measurements are performed with the RMS detector for RMS power or the PEAK detector for peak power. For all these measurements, TRACE 1 of the selected system is used.

The setting parameters for this measurement are:

- analyzer frequency
- resolution bandwidth
- measurement time used for a single burst
- trigger source
- trigger level
- trigger offset
- type of power measurement (PEAK, MEAN)
- number of bursts to be measured

The commands of this subsystem can be used in two different ways:

1. Setting up the instrument and at the same time querying the result list:
   This method ensures the smallest delay between measurement and the output of the measured values, but requires the control computer to wait actively for the response of the instrument.

2. Setting up the instrument and querying the result list after synchronization to the end of measurement:
   With this method the control computer can be used for other activities while the instrument is performing the measurement at the cost of additional time needed for synchronization via service request.

[SENSe<1|2>:]MPOWer[:SEQuence]   <analyzer freq>,<rbw>,<meas time>,<trigger source>, <trigger level>,<trigger offset>,<type of meas>,<# of meas>

This command configures the instrument setup for multiple burst power measurement and starts a measurement sequence. When synchronizing the command with *OPC, a service request is generated as soon as the defined number of individual measurements (# of meas) is reached.

To reduce the setting time, the setup is performed simultaneously for all selected parameters.

The command in the form of a query makes the instrument settings, performs the defined number of measurements and outputs the measurement results list.

Parameter: <analyzer freq>: Receive frequency for the burst signals to be measured (= center frequency in manual operation)
Range: 0 Hz to max. frequency, depending on instrument model

<rbw>: resolution bandwidth for the measurement
Range: 10 Hz to 10 MHz in steps of 1, 3, 10

<meas time>: Time span during which measurement samples are sampled for RMS / peak measurement The type of measurement is selected by <type of meas>.
Range: 1us to 30s

<trigger source>: trigger signal source.
Possible settings: EXTernal =The trigger signal is fed from the "Ext. Trigger/Gate" input on the rear of the unit. VIDeo =The internal video signal is used as trigger signal.

<trigger level>: Signal level at which the trigger becomes active. For <trigger source> = VIDeo this is the level of the video signal as a percentage of the diagram height. If <trigger source> = EXTernal is selected, the value entered here is ignored, as in this case the trigger input uses TTL levels.
Range: 0 – 100PCT (<trigger source> = VIDeo)

<trigger offset>: Offset between the detection of the trigger signal and the start of the measurement.
Range: 125 ns to 100s

<type of meas>: Determines whether mean power (RMS) or peak power (PEAK) is to be measured. The detector is selected accordingly.
Possible values: MEAN, PEAK

<# of meas>: Number of individual bursts to be measured.
Range: 1 to 501

Return value: The query command returns a list separated by commas (comma separated values = CSV), which contains the power measurement results in floating-point format. The unit used for the return values is always dBm.

The command
`"SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20"`
may, for instance, cause the following list to be returned:

18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3, 18.6,18.1,18.0,17.9

Example: `"SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20"`
'performs a measurement sequence with the following settings:
'Frequency = 935.2 MHz,
'Resolution bandwidth = 1 MHz
'Measurement time = 434 µs
'Trigger source = VIDEO
'Trigger threshold = 50%
'Trigger offset = 5 µs
'Type of measurement = MEAN power
'No. of measurements = 20

`"SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20"`
'performs the same measurement and in addition returns the results list immediately after completion of the last measurement.

Note

The measurement function always uses trace 1 in the selected screen, and activates the selected screen.

Repeated use of the command without changes to its parameters (i.e. using the same settings again) will speed up the measurement since the previous hardware settings will be cached and therefore additional hardware settling times will be avoided. This also holds true if only part of the parameters (e.g. only the trigger delay) are changed, as in this case the rest of the parameters will be cached.

This measurement is not compatible with other measurements, especially as far as marker functions, adjacent-channel measurement or statistics are concerned. The corresponding functions are therefore automatically switched off. In return incompatible commands will automatically deactivate the multi burst power function.

The function is only available in the REMOTE operation. It is deactivated on switching back to LOCAL.

Characteristics: *RST value: --
                       SCPI: instrument-specific

Mode: A-F, A-T

SENSe:MPOWer:RESult[:LIST]?

This command queries the results of a multiple burst power measurement as configured and initiated with `SENSe:MPOWer[:SEQuence]`. The results are output in a comma-separated list of floating point values. The unit used for the return values is always dBm.

This command may be used to obtain measurement results in an asynchronous way using the service request mechanism for synchronization with the end of the measurement.

If no measurement results are available, the command will return a query error.

Example:	`*ESE 1`
	`*SRE 32`
	'Configuration of status reporting systems for the generation of an SRQ on operation complete
	`SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC`
	'Configuring and starting the measurement
	`...`
	'Further actions of the control computer during measurement
	`On SRQ:`
	'Response to service request
	`SENSe:MPOWer:RESult?`
Characteristics:	*RST value: --
	SCPI: instrument-specific
Mode:	A-F, A-T

SENSe:MPOWer:RESult:MIN?

This command queries the minimum power value in a multiple burst power measurement as configured and initiated with `SENSe:MPOWer[:SEQuence]`. The unit used for the return values is always dBm.

If no measurement result is available, the command will return a query error.

Example:	`*ESE 1`
	`*SRE 32`
	'Configuration of status reporting systems for the generation of an SRQ on operation complete
	`SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC`
	'Configuring and starting the measurement
	`...`
	'Further actions of the control computer during measurement
	`On SRQ:`
	'Response to service request
	`SENSe:MPOWer:RESult:MIN?`
Characteristics:	*RST value: --
	SCPI: instrument-specific
Mode:	A-F, A-T

SENSe:POWer Subsystem

This subsystem controls the setting of the instrument's channel and adjacent channel power measurements. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]POWer:ACHannel:SPACing:CHANnel<1...11>   100 Hz to 2000 MHz

This command defines the channel spacing of the carriers. At the same time the spacing of carriers with higher channel number are set to the same value. If the spacing is equal between all carriers it is sufficient to set the spacing between carrier 1 and 2 with the command `SENS:POW:ACP:SPAC:CHAN1` or `SENS:POW:ACP:SPAC:CHAN`. If the spacing are set in ascending order individual spacing of the carriers can be set.

The command is available only for measurements in the frequency domain (span > 0).

Example: `"POW:ACH:SPAC:CHAN 25kHz"`
'Sets the spacing between all carriers to 25 kHz

`"POW:ACH:SPAC:CHAN2 4.8MHz"`
'sets the spacing between TX carrier 2 and 3 to 4.8 MHz.

Characteristics: *RST value: 20 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:SPACing:ACHannel   100 Hz to 2000 MHz

This command defines the channel spacing of the adjacent channel to the TX channel. At the same time, the spacing of alternate adjacent channels 1 to 11 is set to the double or triple etc. of the entered value.

The command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:SPAC:ACH 33kHz"`
'Sets the spacing between the carrier signal and
'- the adjacent channel to 33 kHz
'- the alternate adjacent channel 1 to 66 kHz
'- the alternate adjacent channel 2 to 99 kHz

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1...11>   100 Hz to 2000 MHz

This command defines the spacing between the alternate adjacent channels and the TX channel. If the spacing to an alternate adjacent channel ALTernate<k> is modified, the spacing to all the following alternate adjacent channels ALTernate<n> is set to (<n> + 1) / (<k> + 1) times the entered value.

This command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:SPAC:ALT1 100kHz"`
'Sets the spacing between TX channel and alternate adjacent channel 1 to 100 kHz and between TX channel and alternate adjacent channel 2 to 150 kHz.

Characteristics:	*RST value:
	40 kHz (ALT1)
	60 kHz (ALT2)
	80 kHz (ALT3)
	100 kHz (ALT4)
	120 kHz (ALT5)
	140 kHz (ALT6)
	160 kHz (ALT7)
	180 kHz (ALT8)
	200 kHz (ALT9)
	220 kHz (ALT10)
	240 kHz (ALT11)
	SCPI: device-specific
Mode:	A-F

[SENSe<1|2>:]POWer:ACHannel:TXCHannel:COUNt   1...12

This command selects the number of carrier signals.

The command is available only for multi carrier channel and adjacent-channel power measurements (`CALC:MARK:FUNC:POW:SEL MCAC`) in the frequency domain (span > 0).

Example:	`"POW:ACH:TXCH:COUN 3"`
Characteristics:	*RST value: 4 SCPI: device-specific
Mode:	A-F

[SENSe<1|2>:]POWer:ACHannel:ACPairs   0...12

This command sets the number of adjacent channels (upper and lower channel in pairs). The figure 0 stands for pure channel power measurement.

The command is only available in the frequency domain (span > 0).

Example:	`"POW:ACH:ACP 3"` 'Sets the number of adjacent channels to 3, i.e. the adjacent channel and alternate adjacent channels 1 and 2 are switched on.
Characteristics:	*RST value: 1 SCPI: device-specific
Mode:	A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]   100 Hz to 1000 MHz

This command sets the channel bandwidth of the radio communication system. The bandwidths of adjacent channels are not influenced by this modification (in contrast to the FSE family).

With `SENS:POW:HSP  ON` the steep-edged channel filters from the table "List of available channel filters" in chapter "Instrument Functions", section "Setting the Bandwidths and Sweep Time – BW" on page 4.123 are available.

Example: `"POW:ACH:BWID 30kHz"`
'Sets the bandwidth of the TX channel to 30 kHz.

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel   100 Hz to 1000 MHz

This command defines the channel bandwidth of the adjacent channel of the radio transmission system. If the bandwidth of the adjacent channel is changed, the bandwidths of all alternate adjacent channels are automatically set to the same value.

With `SENS:POW:HSP ON` the steep-edged channel filters from the table "List of available channel filters" in chapter "Instrument Functions", section "Setting the Bandwidths and Sweep Time – BW" on page 4.123 are available.

Example: `"POW:ACH:BWID:ACH 30kHz"`
'Sets the bandwidth of all adjacent channels to 30 kHz.

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1...11>   100 Hz to 1000 MHz

This command defines the channel bandwidth of the alternate adjacent channels of the radio transmission system. If the channel bandwidth of an alternate adjacent channel (e.g. channel no. 1) is changed, the bandwidth of all the following alternate adjacent channels (e.g. channels no. 2 to 11) is automatically set to the same value.

With `SENS:POW:HSP ON` the steep-edged channel filters from the table "List of available channel filters" in chapter "Instrument Functions", section "Setting the Bandwidths and Sweep Time – BW" on page 4.123 are available.

Example: `"POW:ACH:BWID:ALT2 30kHz"`

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:MODE   ABSolute | RELative

This command toggles between absolute and relative adjacent channel measurement.

For the relative measurement the reference value is set to the currently measured channel power by command `SENSe:POWer:ACHannel:REFerence:AUTO ONCE`.

The command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:MODE REL"`

Characteristics: *RST value: ABSolute
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO   ONCE

This command sets the reference value for the relative measurement to the currently measured channel power.

The command is only available in the frequency domain (span > 0).

Example:	"POW:ACH:REF:AUTO ONCE"

Characteristics: *RST value: -
         SCPI: device-specific

Mode: A-F

This command is an event and therefore has no *RST value and no query.

[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:AUTO   MINimum | MAXimum | LHIGhest

This command activates the automatic selection of a transmission channel to be used as a reference channel in relative adjacent-channel power measurements.

The transmission channel with the highest power, the transmission channel with the lowest power, or the transmission channel nearest to the adjacent channels can be defined as a reference channel.

The command is available only for multi carrier channel and adjacent-channel power measurements (CALC:MARK:FUNC:POW:SEL MCAC) in the frequency domain (span > 0).

Parameter: MINimum: Transmission channel with the lowest power
          MAXimum: Transmission channel with the highest power
          LHIGhest: Lowermost transmission channel for the lower adjacent channels,
          uppermost transmission channel for the upper adjacent channels

Example: "POW:ACH:REF:TXCH:AUTO MAX"
          'The transmission channel with the highest power is used as a reference channel.

Characteristics: *RST value: -
         SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:MANual   1 | 2 | 3 | 4

This command selects a transmission channel to be used as a reference channel in relative adjacent-channel power measurements.

The command is available only for multi carrier channel and adjacent-channel power measurements (CALC:MARK:FUNC:POW:SEL MCAC) in the frequency domain (span > 0).

Example: "POW:ACH:REF:TXCH:MAN 3"
          'Transmission channel 3 is used as a reference channel.

Characteristics: *RST value: 1
         SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:PRESet   ACPower | CPOWer | MCACpower | OBANdwidth | OBWidth | CN | CN0

This command adjusts the frequency span, the measurement bandwidths and the detector as required for the number of channels, the channel bandwidths and the channel spacings selected in the active power measurement. If necessary, adjacent-channel power measurement is switched on prior to the adjustment.

To obtain valid results, a complete sweep with synchronization to the end of the sweep must be performed after the adjustment. Synchronization is possible only in the single-sweep mode.

The result is queried with the command `CALCulate:MARKer:FUNCtion:POWer:RESult?`.

The command is available only for measurements in the frequency domain (span > 0).

Example:　　　"`POW:ACH:PRES ACP`"
'Sets the frequency span, the measurement bandwidths and the detector as required for the ACP measurement in screen A.

"`INIT:CONT OFF`"
'Switches over to single-sweep mode.

"`INIT;*WAI`"
'Starts a sweep and waits for the end of the sweep.

"`CALC:MARK:FUNC:POW:RES? ACP`"
'Queries the result of the adjacent-channel power measurement.

Characteristics:　　*RST value: -
SCPI: device-specific

Mode:　　　　A-F

[SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel

This command adapts the reference level to the measured channel power and – if required - switches on previously the adjacent channel power measurement. This ensures that the signal path of the instrument is not overloaded. Since the measurement bandwidth is significantly smaller than the signal bandwidth in channel power measurements, the signal path can be overloaded although the trace is still significantly below the reference level. If the measured channel power equals the reference level, the signal path is not overloaded.

The command is only available in the frequency domain (span > 0).

Note

Subsequent commands have to be synchronized with *WAI, *OPC or *OPC? to the end of the auto range process which would otherwise be aborted.

Example:　　　"`POW:ACH:PRES:RLEV;*WAI`"
'Adapts the reference level to the measured channel power.

Characteristics:　　*RST value: -
SCPI: device-specific

Mode:　　　　A-F

[SENSe<1|2>:]POWer:BANDwidth|BWIDth   10 to 99.9PCT

This command defines the percentage of the power with respect to the total power. This value is the basis for the occupied bandwidth measurement (command: `POWer:ACHannel:PRESet OBW`).

The command is only available in the frequency domain (span > 0).

Example: `"POW:BWID 95PCT"`

Characteristics: *RST value: 99PCT
                   SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:HSPeed   ON | OFF

This command switches on or off the high-speed channel/adjacent channel power measurement. The measurement itself is performed in the time domain on the center frequencies of the individual channels. The command automatically switches to the time domain and back.

Depending on the selected mobile radio standard, weighting filters with √cos characteristic or very steep-sided channel filters are used for band limitation.

The command is only available in the frequency domain (span > 0).

Example: `"POW:HSP ON"`

Characteristics: *RST value: OFF
                   SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:NCORrection   ON | OFF

This command switches on or off the correction of the instrument inherent noise for channel power measurement. On activating this function, a reference measurement of the instrument inherent noise is performed. The measured noise power is then subtracted from the power in the examined channel.

The instrument inherent noise is then re-determined after any change of the center frequency, resolution bandwidth, sweep time and level setting by repeating the reference measurement in the new instrument setting.

Example: `"POW:NCOR ON"`

Characteristics: *RST value: OFF
                   SCPI: device-specific

Mode: A

[SENSe<1|2>:]POWer:TRACe   1 to 3

This command assigns the channel/adjacent channel power measurement to the indicated trace in the selected measurement window. The corresponding trace must be active, i.e. its state must be different from blank.

Note

The measurement of the occupied bandwidth (OBW) is performed on the trace on which marker 1 is positioned. To evaluate another trace, marker 1 must be positioned to another trace with `CALCulate:MARKer:TRACe`.

Example: "`POW:TRAC 2`"
'Assigns the measurement in screen A to trace 2.

"`SENS2:POW:TRAC 3`"
'Assigns the measurement in screen B to trace 3.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A

SENSe:ROSCillator Subsystem

This subsystem controls the reference oscillator. The numeric suffix in SENSe is irrelevant for the commands of this subsystem.

[SENSe<1|2>:]ROSCillator:SOURce   INTernal | EXTernal

This command controls selection of the reference oscillator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Example: "ROSC:SOUR EXT"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

*RST **is not** influencing this parameter.

[SENSe<1|2>:]ROSCillator:EXTernal:FREQuency   1MHz to 20MHz

This command informs the instrument on the frequency of the external reference oscillator. This frequency is used as starting point for the synchronization of the internal reference frequencies.

The value of the external reference frequency (1 MHz to 20 MHz) is rounded in steps of 1 Hz.

Example: "ROSC:EXT:FREQ 5MHz"

Characteristics: *RST value: -
SCPI: conforming

Mode: all

*RST **is not** influencing this parameter.

[SENSe<1|2>:]ROSCillator[:INTernal]:TUNe   0 to 4095

This command defines the value for the tuning of the internal reference oscillator.

The reference oscillator should be tuned only if an error has been detected in the frequency accuracy check. After rebooting the instrument, the factory-set reference frequency or the previously saved reference frequency is restored.

Note

This command is only available at service level 1.

Example: "ROSC:TUN 128"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

[SENSe<1|2>:]ROSCillator[:INTernal]:TUNe:SAVe

This command saves the new value for the tuning of the internal reference oscillator. The factory-set value in the EEPROM is overwritten.

> **Note**
>
> This command is only available at service level 1.

Example: `"ROSC:TUN:SAV"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

SENSe:SCAN Subsystem

This subsystem controls the parameters for the receiver scan data. The numeric suffix in [SENSe<1|2>]SCAN is not significant.

[SENSe<1|2>:]SCAN<1 to 10>:STARt f_{min} to f_{max}

This command defines the start frequency of the selected receiver scan range.

Example:	":SCAN1:STAR 50kHz"
	'Sets the start frequency of scan range 1 to 50 kHz

Characteristics:	*RST value: 150 kHz (range1)
	30 MHz (range2)
	SCPI: device-specific

Mode: R

[SENSe<1|2>:]SCAN<1 to 10>:STOP f_{min} to f_{max}

This command defines the stop frequency of the selected receiver scan range.

Example:	":SCAN1:STOP 200kHz"
	'Sets the stop frequency of scan range 1 to 200 kHz

Characteristics:	*RST value: 30 MHz (range1)
	1 GHz (range2)
	SCPI: device-specific

Mode: R

[SENSe<1|2>:]SCAN<1 to 10>:STEP f_{min} to f_{max}

This command defines the step size for the frequency of the selected receiver scan range.

Example:	":SCAN1:STEP 100Hz"
	'Sets the step size for the frequency of scan range 1 to 100 Hz

Characteristics:	*RST value: 4 kHz (range 1)
	40 kHz (range 2)
	SCPI: device-specific

Mode: R

[SENSe<1|2>:]SCAN<1 to 10>:BANDwidth:RESolution   10 Hz to 10 MHz

This command defines the bandwidth for the selected receiver scan range.

Example:	":SCAN1:BAND:RES 1MHz"
	'Sets the resolution bandwidth of scan range 1 to 1 MHz

Characteristics:	*RST value: 9 kHz (range 1)
	120 kHz (range 2)
	SCPI: device-specific

Mode: R

[SENSe<1|2>:]SCAN<1 to 10>:TIME   10 µs to 100 s

This command defines the measurement time of the receiver subscan.

Example:	":SCAN1:TIME 1 ms"
	'Sets the measurement time of scan range 1 to 1 ms
Characteristics:	*RST value: 1 ms (range 1)
	100 µs (range 2)
	SCPI: device-specific
Mode:	R

[SENSe<1|2>:]SCAN<1 to 10>:INPut:ATTenuation dB_{min} to dB_{max}

This command defines the RF attenuation for the selected receiver scan range.

Example:	":SCAN1:INP:ATT 30dB"
	'Sets the input attenuation of scan range 1 to 1 ms
Characteristics:	*RST value: 10 dB
	SCPI: device-specific
Mode:	R

[SENSe<1|2>:]SCAN<1 to 10>:INPut:ATTenuation:AUTO   ON | OFF

This command switches on or off the autoranging function in the selected receiver scan range.

Example:	":SCAN1:INP:ATT:AUTO ON"
	'Activates the auto ranging function for scan range 1
Characteristics:	*RST value: OFF
	SCPI: device-specific
Mode:	R

[SENSe<1|2>:]SCAN<1 to 10>:INPut:GAIN:STATE   ON | OFF

This command switches on or off the preamplifier in the selected receiver scan range.

Example:	":SCAN1:INP:GAIN:STAT ON"
	'Activates the preamplifier for scan range 1
Characteristics:	*RST value: OFF
	SCPI: device-specific
Mode:	R

[SENSe<1|2>:]SCAN<1 to 10>:INPut:GAIN:AUTO   ON | OFF

This command includes the preamplifier in the autoranging function of the selected receiver scan range.

Example:	":SCAN1:INP:GAIN:AUTO ON"
	'Includes the preamplifier in the autoranging function for scan range 1
Characteristics:	*RST value: OFF
	SCPI: device-specific
Mode:	R

[SENSe<1|2>:]SCAN:RANGes[:COUNt]   1 to 10

This command determines the number of ranges. With setting 0, the scan is performed using the current receiver settings and not the settings defined with commands `SENSe:SCAN:....`

Example: `"SCAN:RANG:COUN 3"`
                      'Sets the number of ranges to 3

Characteristics: *RST value: 0
                      SCPI: device-specific

Mode: R

SENSe:SWEep Subsystem

This subsystem controls the sweep parameters. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]SWEep:TIME   50µs to 100s (receiver) | 2,5ms to 16000s (frequency domain) | 1µs to 16000s (time domain)

This command defines the sweep time in analyzer mode or the measurement time for the bar graph in receiver mode.,

For receiver, the available time value range is 50 µs to 100 s with a 2-digit resolution. In analyzer mode, the available time values are different in the frequency domain (2.5 ms to 16000s with span > 0) and in the time domain (1 µs to 16000 s with span = 0).

If SWEep:TIME is directly programmed, automatic coupling to resolution bandwidth and video bandwidth is switched off.

Example:	"SWE:TIME 10s"
Characteristics:	*RST value: - (analyzer; AUTO is set to ON) 100 ms (receiver) SCPI: conforming
Mode:	R, A, FM

[SENSe<1|2>:]SWEep:TIME:AUTO   ON | OFF

This command controls the automatic coupling of the sweep time to the frequency span and bandwidth settings.

If SWEep:TIME is directly programmed, automatic coupling is switched off.

Example:	"SWE:TIME:AUTO ON" 'Switches on the coupling to frequency span and bandwidths.
Characteristics:	*RST value: ON SCPI: conforming
Mode:	A

[SENSe<1|2>:]SWEep:COUNt   0 to 32767

This command defines the number of scans started with single scan in receiver mode,

In analyzer mode, this command defines the number of sweeps started with single sweep, which are used for calculating the average or maximum value. In average mode, the value 0 defines a continuous averaging of measurement data over 10 sweeps.

Example:	"SWE:COUN 64" 'Sets the number of sweeps to 64. "INIT:CONT OFF" 'Switches to single-sweep mode. "INIT;*WAI" 'Starts a sweep and waits for its end.
Characteristics:	*RST value: 0 SCPI: conforming
Mode:	R, A, FM

[SENSe<1|2>:]SWEep:COUNt:CURRent?

Example: `"SWE:COUNt 64"`
'sets sweep count to 64

`"INIT:CONT OFF"`
'switches to single sweep mode

`"INIT"`
'starts a sweep (without waiting for the sweep end!)

`"SWE:COUN:CURR?"`
'queries the number of started sweeps

Characteristics: *RST value: 0
SCPI: conforming

Mode: R, A, FM

[SENSe<1|2>:]SWEep:EGATe   ON | OFF

This command switches on/off the sweep control by an external gate signal. If the external gate is selected the trigger source is automatically switched to EXTernal as well.

In case of measurement with external gate, the measured values are recorded as long as the gate is opened. There are two possibilities:

– The gate is edge-triggered (`"SWEep:EGATe:TYPE EDGE"`):
After detection of the set gate signal edge, the gate remains open until the gate delay (`SWEep:EGATe:HOLDoff`) has expired.

– The gate is level-triggered (`"SWEep:EGATe:TYPE LEVel"`):
After detection of the gate signal, the gate remains open until the gate signal disappears.

A delay between applying the gate signal and the start of recording measured values can be defined with `SWEep:EGATe:HOLDoff`.

During a sweep the gate can be opened and closed several times. The synchronization mechanisms with *OPC, *OPC? and *WAI remain completely unaffected.

The sweep end is detected when the required number of measurement points (625 in analyzer mode) has been recorded.

Example: `"SWE:EGAT ON"`
'Switches on the external gate mode.

`"SWE:EGAT:TYPE EDGE"`
'Switches on the edge-triggered mode.

`"SWE:EGAT:HOLD 100US"`
'Sets the gate delay to 100 µs.

`"SWE:EGAT:LEN 500US"`
'Sets the gate opening time to 500 µs.

`"INIT;*WAI"`
'Starts a sweep and waits for its end.

| **Characteristics:** | *RST value: OFF |
| | SCPI: device-specific |

| **Mode:** | A |

[SENSe<1|2>:]SWEep:EGATe:TYPE   LEVel | EDGE

This command sets the type of triggering (level or edge) by the external gate signal.

The gate opening time cannot be defined with the parameter `EGATe:LENGth` in case of level triggering. The gate is closed when the gate signal disappears.

| **Example:** | `"SWE:EGAT:TYPE EDGE"` |

| **Characteristics:** | *RST value: EDGE |
| | SCPI: device-specific |

| **Mode:** | A |

[SENSe<1|2>:]SWEep:EGATe:POLarity   POSitive | NEGative

This command determines the polarity of the external gate signal. The setting is valid both for the edge of an edge-triggered signal and the level of a level-triggered signal.

| **Example:** | `"SWE:EGAT:POL POS"` |

| **Characteristics:** | *RST value: POSitive |
| | SCPI: device-specific |

| **Mode:** | A |

[SENSe<1|2>:]SWEep:EGATe:HOLDoff   125 ns to 100 s

This command defines the delay time between the external gate signal and the continuation of the sweep.

| **Example:** | `"SWE:EGAT:HOLD 100us"` |

| **Characteristics:** | *RST value: 0s |
| | SCPI: device-specific |

| **Mode:** | A |

[SENSe<1|2>:]SWEep:EGATe:LENGth   0 to 100 s

In case of edge triggering, this command determines the time interval during which the instrument sweeps.

| **Example:** | `"SWE:EGAT:LENG 10ms"` |

| **Characteristics:** | *RST value: 0s |
| | SCPI: device-specific |

| **Mode:** | A |

[SENSe<1|2>:]SWEep:EGATe:SOURce   EXTernal | IFPower

This command toggles between external gate signal and IF power signal as a signal source for the gate mode. If an IF power signal is used, the gate is opened as soon as a signal at > -20 dBm is detected within the IF path bandwidth (10 MHz).

Example: `"SWE:EGAT:SOUR IFP"`
                       'Switches the gate source to IF power.

Characteristics: *RST value: IFPower
                       SCPI: device-specific

Mode: A

[SENSe<1|2>:]SWEep:POINts   155 to 30001

This command defines the number of measurement points for one sweep run.

Parameter: SENSe<1|2>]SWEep:POINts <numeric_value>

                       <numeric_value>::= 155, 313, 625, 1251, 1999, 2501, 5001, 10001, 20001, 30001

Example: `"SWE:POIN 313"`

Characteristics: *RST value: 625
                       SCPI: conforming

Mode: A

[SENSe<1|2>:]SWEep:SPACing   LINear | LOGarithmic | AUTO

This command toggles between linear and logarithmic step modes of the receiver. In analyzer mode, it toggles between linear and logarithmic sweep.

Example: `"SWE:SPAC LOG"`

Characteristics: *RST value: LIN
                       SCPI: conforming

Mode: R, A, VA

The frequency axis is set to linear or logarithmic scaling accordingly.

SOURce Subsystem

The SOURce subsystem controls the output signals of the instrument if the options tracking generator (B9) or External Generator Control (B10) are installed. The measurement window is selected by SOURce1 (screen A) and SOURce2 (screen B).

SOURce<1|2>:AM:STATe   ON | OFF

This command switches on or off the external amplitude modulation of the tracking generator in the selected measurement window.

External I/Q modulation is switched off, if active. This command is only valid in conjunction with the tracking generator option B9.

Example:	`"SOUR:AM:STAT ON"`
	'Switches on the external amplitude modulation of the tracking generator for screen A.
Characteristics:	*RST value: OFF
	SCPI: conforming
Mode:	all

SOURce<1|2>:DM:STATe   ON | OFF

This command switches on or off the external I/Q modulation of the tracking generator in the selected measurement window.

External AM and external FM are switched off, if active. This command is only valid in conjunction with the tracking generator option B9.

Example:	`"SOUR2:DM:STAT ON"`
	'Switches on the external I/Q modulation of the tracking generator for screen B.
Characteristics:	*RST value: OFF
	SCPI: conforming
Mode:	all

SOURce<1|2>:FM:STATe   ON | OFF

This command switches on or off the external frequency modulation of the tracking generator in the selected measurement window.

External I/Q modulation is switched off, if active. This command is only valid in conjunction with the tracking generator option B9.

Example:	`"SOUR:FM:STAT ON"`
	'Switches on the external frequency modulation of the tracking generator for screen A.
Characteristics:	*RST value: OFF
	SCPI: conforming
Mode:	all

SOURce<1|2>:FM:DEViation   100Hz to 10MHz

This command defines the maximum frequency deviation at 1 V input voltage at the FM input of the tracking generator.

The possible value range is 100 Hz to 10 MHz in steps of one decade.

This command is only available in connection with the Tracking Generator Option B9.

Example:	`"SOUR:FM:DEV 1MHz"` 'Sets the maximum frequency deviation of the tracking generator for screen A to 1 MHz.
Characteristics:	*RST value: 100 Hz SCPI: conforming
Mode:	all

SOURce<1|2>:FREQuency:OFFSet   -150MHz to 150MHz

This command defines a frequency offset of the tracking generator for the indicated measurement window. Frequency-converting DUTs can be measured with this setting.

The possible value range is -150 MHz to 150 MHz. It should be noted that the terms (start frequency - tracking frequency offset) and (stop frequency - tracking frequency offset) are both > 1 kHz or both < -1 kHz.

External I/Q modulation is switched off, if active. This command is only valid in conjunction with the tracking generator option B9.

Example:	`"SOUR:FREQ:OFFS 10MHz"` 'Switches on the frequency offset of the tracking generator for screen A to 10 MHz.
Characteristics:	*RST value: 0 Hz SCPI: conforming
Mode:	all

SOURce<1|2>:POWer[:LEVel][:IMMediate][:AMPLitude]   <numeric_value>

This command defines the output level of the tracking generator in the current measurement window.

This command is only valid in conjunction with the tracking generator option B9.

Parameter:	<numeric value>::= -30 dBm to 0 dBm
Example:	`"SOUR:POW -20dBm"` 'Sets the tracking generator level in screen A to -20 dBm.
Characteristics:	*RST value: -20 dBm SCPI: conforming
Mode:	all

SOURce<1|2>:POWer[:LEVel][:IMMediate]:OFFSet   -200dB to +200dB

This command defines a level offset for the tracking generator level. Thus, for example, attenuators or amplifiers at the output of the tracking generator can be taken into account for the setting.

This command is only valid in conjunction with the tracking generator option B9.

Example: `"SOUR:POW:OFFS -10dB"`
                      'Sets the level offset of the tracking generator in screen A to - 20 dBm.

Characteristics: *RST value: 0dB
                      SCPI: conforming

Mode: all

SOURce<1|2>:POWer:MODE   FIXed | SWEep

This command activates or deactivates the power sweep. If the power sweep is ON the enhancement label TGPWR is shown and the analyzer is set in zero span mode (span = 0Hz). During the sweep time of the zero span the power at the internal tracking generator is changed linear from start power to stop power. The start and stop power values are shown on the right side below the diagram

Example: `"SOUR:POW:MODE SWE"`
                      "switches on the level sweep in screen A.

Characteristics: *RST value: FIX
                      SCPI: conforming

Mode: all

SOURce<1|2>:POWer:STARt   -30 dBm to 0 dBm

This command defines the start power of the power sweep. start power can be set between -30 dBm and +5 dBm for the R&S ESU. With the option FSU-B12 the power can be set between -100 and + 5 dBm.

Example: `"SOUR:POW:STAR -20dBm"`
                      'sets the start level to –20 dBm in screen A.

Characteristics: *RST value: - 30 dBm
                      SCPI: conforming

Mode: A

SOURce<1|2>:POWer:STOP   -30 dBm to 0 dBm

This command defines the stop power of the power sweep.The stop power can be set between -30 dBm and +5 dBm for the R&S ESU. With the option FSU-B12 the power can be set between -100 and + 5 dBm. The stop value can be smaller than the start value.

Example: `"SOUR:POW:STOP 0dBm"`
                      'sets the end level to 0 dBm in screen A.

Characteristics: *RST value: 0 dBm
                      SCPI: conforming

Mode: A

SOURce:EXTernal Subsystem

The SOURce:EXTernal subsystem controls the operation of the unit with option Ext. Generator Control (B10). The commands are only valid for the selected window, with SOURce1 changing the setting in screen A and SOURce2 the setting in screen B.

The selection of the external generator 1 or 2 is via EXTernal<1|2>.

Note

The commands of the SOURce:EXTernal subsystem assume that the addressed generator was correctly configured with the commands of subsystem `SYSTem: COMMunicate:GPIB:RDEVice:GENerator`.

If no external generator is selected, if the IEC bus address is not correct or the generator is not ready for operation, an execution error will be generated.

SOURce<1|2>:EXTernal<1|2>[:STATe]   ON | OFF

This command activates or deactivates the external generator selected with `SOUR:EXT<1|2>:FREQ: SWE ON` in the selected window.

The suffix behind EXTernal is irrelevant for this command.

This command is only available in connection with option Ext. Generator Control B10.

Example:	`"SYST:COMM:RDEV:GEN1:TYPE 'SMP02'"` 'Selects SMP02 as generator 1.
	`"SYST:COMM:RDEV:GEN1:LINK TTL"` 'Selects IECBUS + TTL link as interface.
	`"SYST:COMM:RDEV:GEN1:ADDR 28"` 'Sets the generator address to 28.
	`"SOUR:EXT1:FREQ:SWE ON"` 'Activates the frequency sweep for generator 1.
	`"SOUR:EXT ON"` 'Activates the external generator
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	all

SOURce<1|2>:EXTernal<1|2>:FREQuency[:FACTor]:DENominator   <numeric_value>

This command defines the denominator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator 1 or 2 in the selected window.

Note

Select the multiplication factor in a way that the frequency range of the generator is not exceeded by the following formula:

$$F_{Generator} = F_{Analyzer} * Numerator/Denominator + F_{Offset}$$

if applied to the start and stop frequency of the analyzer.

This command is only valid in combination with option Ext. Generator Control B10.

Example: `"SOUR:EXT:FREQ:NUM 4"`
                        `"SOUR:EXT:FREQ:DEN 3"`
                        'Sets a multiplication factor of 4/3, i.e. the transmit frequency of the generator is 4/3 times the analyzer frequency.

Characteristics: *RST value: 1
                              SCPI: device-specific

Mode: all

SOURce<1|2>:EXTernal<1|2>:FREQuency[:FACTor]:NUMerator   <numeric_value>

This command defines the numerator of the factor with which the analyzer frequency is multiplied to obtain the transmit frequency of the selected generator 1 or 2 in the selected window.

Note

Select the multiplication factor in a way that the frequency range of the generator is not exceeded by the following formula:

$$F_{Generator} = F_{Analyzer} * Numerator/Denominator + F_{Offset}$$

if applied to the start and stop frequency of the analyzer.

This command is only valid in combination with option Ext. Generator Control B10.

Example: `"SOUR:EXT:FREQ:NUM 4"`
                        `"SOUR:EXT:FREQ:DEN 3"`
                        'Sets a multiplication factor of 4/3, i.e. the transmit frequency of the generator is 4/3 times the analyzer frequency.

Characteristics: *RST value: 1
                              SCPI: device-specific

Mode: all

SOURce<1|2>:EXTernal<1|2>:FREQuency:OFFSet   <numeric_value>

This command defines the frequency offset of the selected generator 1 or 2 with reference to the receive frequency in the selected window.

Note

Select the multiplication factor in a way that the frequency range of the generator is not exceeded by the following formula:

$$F_{Generator} = F_{Analyzer} * Numerator/Denominator + F_{Offset}$$

if applied to the start and stop frequency of the analyzer.

This command is only valid in combination with option Ext. Generator Control B10.

Example: "`SOUR:EXT:FREQ:OFFS 1GHZ`"
'Sets a frequency offset of the generator transmit frequency compared to the analyzer receive frequency of 1 GHz.

Characteristics: *RST value: 0 Hz
SCPI: device-specific

Mode: all

SOURce<1|2>:EXTernal<1|2>:FREQuency:SWEep[:STATe]   ON | OFF

This command activates or deactivates the frequency sweep for generator 1 or 2 in the selected window.

This command is only valid in combination with option Ext. Generator Control B10.

Example: "`SOUR:EXT1:FREQ:SWE ON`"
'Activates the frequency sweep for ext. generator 1.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

SOURce<1|2>:EXTernal<1|2>:POWer[:LEVel]   <numeric_value>

This command sets the output power of the selected generator 1 or 2 in the selected window.

This command is only valid in combination with option Ext. Generator Control B10.

Example: "`SOUR:EXT:POW –30dBm`"
'Sets the generator level to –30 dBm

Characteristics: *RST value: -20 dBm
SCPI: device-specific

Mode: all

SOURce<1|2>:EXTernal<1|2>:ROSCillator[:SOURce]　　INTernal | EXTernal

This command switches between external and internal reference oscillator for the frequency processing of external generator 1 and 2.

The command always works on both generators. Therefore, the numeric suffix in EXTernal<1|2> is not significant.

This command is only valid in combination with option Ext. Generator Control B10.

Example:　　　　　`"SOUR:EXT:ROSC EXT"`
　　　　　　　　　　　'switches to external reference oscillator

Characteristics:　*RST value: INT
　　　　　　　　　　　SCPI: device-specific

Mode:　　　　　　all

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (see chapter "Remote Control – Basics", section "Status Reporting System" on page 5.21). *RST does not influence the status registers.

STATus:OPERation[:EVENt]?

This command queries the contents of the EVENt section of the STATus:OPERation register. The contents of the EVENt section are deleted after readout.

Example: `"STAT:OPER?"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:CONDition?

This command queries the CONDition section of the STATus:OPERation register. Readout does not delete the contents of the CONDition section. The value returned reflects the current hardware status.

Example: `"STAT:OPER:COND?"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:OPERation register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit in the status byte.

Example: `"STAT:OPER:ENAB 65535"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:OPERation register from 0 to 1 for the transitions of the CONDition bit.

Example: `"STAT:OPER:PTR 65535"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:OPER:NTR 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:PRESet

This command resets the edge detectors and ENABle parts of all registers to a defined value. All PTRansition parts are set to FFFFh, i.e. all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e. a transition from 1 to 0 in a CONDition bit is not detected. The ENABle part of the STATus:OPERation and STATus:QUEStionable registers are set to 0, i.e. all events in these registers are not passed on.

Example: "STAT:PRES"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable register. The contents of the EVENt section are deleted after the readout.

Example: "STAT:QUES?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:CONDition?

This command queries the CONDition section of the STATus:QUEStionable register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:COND?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus-QUEStionable register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit in the status byte.

Example: `"STAT:QUES:ENAB 65535"`

Characteristics: *RST value: –
                        SCPI: conforming

Mode: all

STATus:QUEStionable:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable register from 0 to 1 for the transitions of the CONDition bit.

Example: `"STAT:QUES:PTR 65535"`

Characteristics: *RST value: –
                        SCPI: conforming

Mode: all

STATus:QUEStionable:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Example: `"STAT:QUES:NTR 65535"`

Characteristics: *RST value: –
                        SCPI: conforming

Mode: all

STATus:QUEStionable:POWer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:POWer register. Readout deletes the contents of the EVENt section.

Example: `"STAT:QUES?"`

Characteristics: *RST value: –
                        SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:POWer register. Readout does not delete the contents of the CONDition section.

Example: `"STAT:QUES:COND?"`

Characteristics: *RST value: –
                        SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:ENAB 65535"

Characteristics: *RST value: –
                      SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:PTR 65535"

Characteristics: *RST value: –
                      SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:NTR 65535"

Characteristics: *RST value: –
                      SCPI: conforming

Mode: all

STATus:QUEStionable:LIMit<1|2> [:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LIMit register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES?"

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register.

Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:LIM:COND?"

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: `"STAT:QUES:ENAB 65535"`

Characteristics: *RST value: –
                SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 0 to 1 for the transitions of the CONDition bit.

Example: `"STAT:QUES:PTR 65535"`

Characteristics: *RST value: –
                SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 1 to 0 for the transitions of the CONDition bit.

Example: `"STAT:QUES:NTR 65535"`

Characteristics: *RST value: –
                SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2> [:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LMARgin register. Readout deletes the contents of the EVENt section.

Example: `"STAT:QUES:LMAR?"`

Characteristics: *RST value: –
                SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LMARgin register. Readout does not delete the contents of the CONDition section.

Example: `"STAT:QUES:LMAR:COND?"`

Characteristics: *RST value: –
                SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:LMARgin register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:LMAR:ENAB 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LMARgin register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:LMAR:PTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LMARgin register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:LMAR:NTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:ACPLimit register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES:ACPL?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:ACPLimit register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:ACPL:COND?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:ACPLimit register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:ACPL:ENAB 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:ACPLimit register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:ACPL:PTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:ACPLimit register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:ACPL:NTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:FREQuency register.

Example: "STAT:QUES:FREQ?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:FREQuency:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable: FREQuency register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:FREQ:COND?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:FREQuency register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: `"STAT:QUES:FREQ:ENAB 65535"`

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 0 to 1 for the transitions of the CONDition bit.

Example: `"STAT:QUES:FREQ:PTR 65535"`

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 1 to 0 for the transitions of the CONDition bit.

Example: `"STAT:QUES:FREQ:NTR 65535"`

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: all

STATus:QUEStionable:TRANsducer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:TRANsducer register. Readout deletes the contents of the EVENt section.

Example: `"STAT:QUES:TRAN?"`

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: all

STATus:QUEStionable:TRANsducer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable: FREQuency register. Readout does not delete the contents of the CONDition section.

Example: `"STAT:QUES:TRAN:COND?"`

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: all

STATus:QUEStionable:TRANsducer:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:TRANsducer register. The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

Example: "STAT:QUES:TRAN:ENAB 65535"

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: all

STATus:QUEStionable:TRANsducer:PTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:TRANsducer register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:TRAN:PTR 65535"

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: all

STATus:QUEStionable:TRANsducer:NTRansition   0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:TRANsducer register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:TRAN:NTR 65535"

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: all

STATus:QUEue[:NEXT]?

This command returns the earliest entry to the error queue and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI (cf. chapter "Error Messages"). If the error queue is empty, the error number 0, "no error", is returned. This command is identical with the command SYSTem:ERRor.

Example: "STAT:QUE?"

Characteristics: *RST value: –
                      SCPI: conforming

Mode: all

SYSTem Subsystem

This subsystem contains a series of commands for general functions.

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess   0 to 30

This command changes the IEC/IEEE-bus address of the unit.

Example:	`"SYST:COMM:GPIB:ADDR 18"`
Characteristics:	*RST value: - (no influence on this parameter, factory default 20) SCPI: conforming
Mode:	all

SYSTem:COMMunicate:GPIB[:SELF]:RTERminator   LFEOI | EOI

This command changes the GPIB receive terminator.

According to the standard the terminator in ASCII is <LF> and/or <EOI>. For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code (0AH) used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by changing the receive terminator to EOI.

Output of binary data from the instrument to the control computer does not require such a terminator change.

Example:	`"SYST:COMM:GPIB:RTER EOI"`
Characteristics:	*RST value: -- (no influence on this parameter, factory default LFEOI) SCPI: device-specific
Mode:	all

SYSTem:COMMunicate:GPIB:RDEVice:GENerator<1|2>:ADDRess   0 to 30

This command changes the IEC/IEEE-bus address of the device selected as external generator 1 or 2.

Note

If two generators are connected at the same time to IECBUS 2 their addresses must be different.

The command is only available with option Ext. Generator Control B10.

Example:	`"SYST:COMM:GPIB:RDEV:GEN1:ADDR 19"` ' Changes the IECBUS address of generator 1 to 19
Characteristics:	*RST value: 28 SCPI: device-specific
Mode:	all

SYSTem:COMMunicate:RDEVice:GENerator<1|2>:LINK   GPIB | TTL

This command selects the interface type of the external generator 1 or 2.
The following types are available

- IECBUS alone (= GPIB, for all the generators of other manufacturers and some Rohde & Schwarz units)

- IECBUS and TTL interface for synchronization (= TTL, for most of the Rohde & Schwarz generators, see table in command `SYSTem:COMMunicate:RDEVice:GENerator:TYPE`).

The difference between the two operating modes is the execution speed. While, during IECBUS operation, each settable frequency is transmitted separately to the generator, a whole frequency list can be programmed in one go if the TTL interface is also used. Frequency switching can then be performed per TTL handshake which results in considerable speed advantages.

Note

Only one of the two generators can be operated via the TTL interface at a time. The other generator must be configured for IECBUS (GPIB).

The command is only available with option Ext. Generator Control B10.

Example: `"SYST:COMM:RDEV:GEN:LINK TTL"`
                       'Selects IECBUS + TTL interface for generator operation

Characteristics: *RST value: GPIB
                      SCPI: device-specific

Mode: all

SYSTem:COMMunicate:RDEVice:GENerator<1|2>:TYPE   <name>

This command selects the type of external generator 1 or 2. The following table shows the available generator types including the associated interface:

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
SME02	TTL	5 kHz	1.5 GHz	-144	+16
SME03	TTL	5 kHz	3.0 GHz	-144	+16
SME06	TTL	5 kHz	6.0 GHz	-144	+16
SMG	GPIB	100 kHz	1.0 GHz	-137	+13
SMGL	GPIB	9 kHz	1.0 GHz	-118	+30
SMGU	GPIB	100 kHz	2.16 GHz	-140	+13
SMH	GPIB	100 kHz	2.0 GHz	-140	+13
SMHU	GPIB	100 kHz	4.32 GHz	-140	+13
SMIQ02B	TTL	300 kHz	2.2 GHz	-144	+13
SMIQ02E	GPIB	300 kHz	2.2 GHz	-144	+13
SMIQ03B	TTL	300 kHz	3.3 GHz	-144	+13

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
SMIQ03E	GPIB	300 kHz	3.3 GHz	-144	+13
SMIQ04B	TTL	300 kHz	4.4 GHz	-144	+10
SMIQ06B	TTL	300 kHz	6.4 GHz	-144	+10
SML01	GPIB	9 kHz	1.1 GHz	-140	+13
SML02	GPIB	9 kHz	2.2 GHz	-140	+13
SML03	GPIB	9 kHz	3.3 GHz	-140	+13
SMR20	TTL	1 GHz	20 GHz	-130 [2]	+11 [2]
SMR20B11 [1]	TTL	10 MHz	20 GHz	-130 [2]	+13 [2]
SMR27	TTL	1 GHz	27 GHz	-130 [2]	+11 [2]
SMR27B11 [1]	TTL	10 MHz	27 GHz	-130 [2]	+12 [2]
SMR30	TTL	1 GHz	30 GHz	-130 [2]	+11 [2]
SMR30B11 [1]	TTL	10 MHz	30 GHz	-130 [2]	+12 [2]
SMR40	TTL	1 GHz	40 GHz	-130 [2]	+9 [2]
SMR40B11 [1]	TTL	10 MHz	40 GHz	-130 [2]	+12 [2]
SMR50	TTL	1 GHz	50 GHz	-130 [2]	+9 [2]
SMR50B11 [1]	TTL	10 MHz	50 GHz	-130 [2]	+12 [2]
SMR60	TTL	1 GHz	60 GHz	-130 [2]	+9 [2]
SMR60B11 [1]	TTL	10 MHz	60 GHz	-130 [2]	+12 [2]
SMP02	TTL	10 MHz	20 GHz	-130 [3]	+17 [3]
SMP03	TTL	10 MHz	27 GHz	-130 [3]	+13 [3]
SMP04	TTL	10 MHz	40 GHz	-130 [3]	+12 [3]
SMP22	TTL	10 MHz	20 GHz	-130 [3]	+20 [3]
SMT02	GPIB	5.0 kHz	1.5 GHz	-144	+13
SMT03	GPIB	5.0 kHz	3.0 GHz	-144	+13
SMT06	GPIB	5.0 kHz	6.0 GHz	-144	+13
SMU200A	TTL	100 kHz	6.0 GHz	-145	+19
SMV03	GPIB	9 kHz	3.3 GHz	-140	+13
SMX	GPIB	100 kHz	1.0 GHz	-137	+13
SMY01	GPIB	9 kHz	1.04 GHz	-140	+13
SMY02	GPIB	9 kHz	2.08 GHz	-140	+13
HP8340A	GPIB	10 MHz	26.5 GHz	-110	10
HP8648	GPIB	9 kHz	4 GHz	-136	10
HP ESG-A Series 1000A, 2000A, 3000A, 4000A	GPIB	250 kHz	4 GHz	-136	20

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
HP ESG-D SERIES E4432B	GPIB	250 kHz	3 GHz	-136	+10

[1]) Requires mounting of option SMR-B11.

[2]) Maximum/Minimum Power depends on the presence of option SMR-B15/-B17 and of the selected frequency range.
For details please consult the SMR data sheet.

[3]) Maximum/Minimum Power depends on the presence of option SMP-B15/-B17 and of the selected frequency range.
For details please consult the SMP decathlete.

Notes

Generators with TTL interface can also be operated via IECBUS (= GPIB) alone.

With NONE selected, the corresponding generator 1 or 2 is deactivated.

The command is only available with option Ext. Generator Control B10.

Example: `"SYST:COMM:RDEV:GEN2:TYPE 'SME02'"`
'Selects SME02 as generator 2.

Characteristics: *RST value: NONE
SCPI: device-specific

Mode: all

SYSTem:COMMunicate:SERial:CONTrol:DTR   IBFull | OFF

SYSTem:COMMunicate:SERial:CONTrol:RTS   IBFull | OFF

These commands switch the hardware handshake procedure for the serial interface off (OFF) or on (IBFull).

The two commands are equivalent.

Example: `"SYST:COMM:SER:CONT:DTR OFF"`

`"SYST:COMM:SER:CONT:RTS IBF"`

Characteristics: *RST value: -- (no influence on this parameter, factory default OFF)
SCPI: conforming

Mode: all

SYSTem:COMMunicate:SERial[:RECeive]:BAUD   110 | 300 | 600 | 1200 | 2400 | 9600 | 19200

This command sets the transmission speed for the serial interface (COM).

Example:	`"SYST:COMM:SER:BAUD 2400"`
Characteristics:	*RST value: -- (no influence on this parameter, factory default 9600) SCPI: conforming
Mode:	all

SYSTem:COMMunicate:SERial[:RECeive]:BITS   7 | 8

This command defines the number of data bits per data word for the serial interface (COM).

Example:	`"SYST:COMM:SER:BITS 7"`
Characteristics:	*RST value: -- (no influence on this parameter, factory default 8) SCPI: conforming
Mode:	all

SYSTem:COMMunicate:SERial[:RECeive]:PARity[:TYPE]   EVEN | ODD | NONE

This command defines the parity check for the serial interface (COM).

Parameter:	EVEN: even parity ODD: odd parity NONE: no parity check.
Example:	`"SYST:COMM:SER:PAR EVEN"`
Characteristics:	*RST value: -- (no influence on this parameter, factory default NONE) SCPI: conforming
Mode:	all

SYSTem:COMMunicate:SERial[:RECeive]:SBITs   1|2

This command defines the number of stop bits per data word for the serial interface (COM).

Example:	`"SYST:COMM:SER:SBITs 2"`
Characteristics:	*RST value: -- (no influence on this parameter, factory default 1) SCPI: conforming
Mode:	all

SYSTem:COMMunicate:SERial[:RECeive]:PACE   XON | NONE

This command switches on or off the software handshake for the serial interface.

Example:	`"SYST:COMM:SER:PACE XON"`
Characteristics:	*RST value: -- (no influence on this parameter, factory default NONE) SCPI: conforming
Mode:	all

SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?

This command queries the name of the first printer (in the list of printers) available under Windows NT.

The names of other installed printers can be queried with command `SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?.`

If no printer is configured an empty string is output.

Example: `"SYST:COMM:PRIN:ENUM:FIRS?"`

Characteristics: *RST value: NONE
                        SCPI: device-specific

Mode: all

SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?

This command queries the name of the next printer installed under Windows NT.

The command `SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` should be sent previously to return to the beginning of the printer list and query the name of the first printer.

The names of other printers can then be queried with NEXT?. After all available printer names have been output, an empty string enclosed by quotation marks (") is output for the next query. Further queries are answered by a Query Error.

Example: `"SYST:COMM:PRIN:ENUM:NEXT?"`

Characteristics: *RST value: NONE
                        SCPI: device-specific

Mode: all

SYSTem:COMMunicate:PRINter:SELect <1|2>   \<printer_name\>

This command selects one of the printers configured under Windows NT including the associated output destination.

The specified printer name must be a string as returned by the commands
`SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` or
`SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?`

Note

Command `HCOPy:DESTination` is used to select an output medium other than the default one.

Example: `"SYST:COMM:PRIN:SEL 'LASER on LPT1'"`

Characteristics: *RST value: NONE
                        SCPI: device-specific

Mode: all

SYSTem:DATE   1980 to 2099, 1 to 12, 1 to 31

This command is used to enter the date for the internal calendar.

The sequence of entry is year, month, day.

Example: `"SYST:DATE 2000,6,1"`

Characteristics: *RST value: –
                     SCPI: conforming

Mode: all

SYSTem:DISPlay:FPANel   ON | OFF

This command activates or deactivates the display of the front panel keys on the screen.

With the display activated, the instrument can be operated on the screen using the mouse by pressing the corresponding buttons. This may be useful if the instrument is operated in a detached station by means of a remote program such as PCANYWHERE.

Notes

With the display of the front panel keys activated, the screen resolution of the unit is set to 1024x768. Thus, only a section of the whole screen is visible on the internal LCD display, which will be moved by mouse moves.

For a full display of the user interface, an external monitor has to be connected to the rear panel.

When the front panel display is deactivated, the original screen resolution is restored.

Example: `"SYST:DISP:FPAN ON"`

Characteristics: *RST value: OFF
                     SCPI: device-specific

Mode: all

SYSTem:DISPlay:UPDate   ON | OFF

This command switches on or off the update of all display elements during remote control.

Note

The best performance is obtained when the display output is switched off during remote control.

Example: `"SYST:DISP:UPD ON"`

Characteristics: *RST value: OFF
                     SCPI: device specific

Mode: all

SYSTem:ERRor?

This command queries the earliest entry in the error queue, and deletes it after the readout.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI (cf. chapter "Error Messages"). If the error queue is empty, the error number 0, "no error", is returned. This command is identical with the command STATus:QUEue:NEXT?. This command is a query and therefore has no *RST value.

Example: "SYST:ERR?"

Characteristics: *RST value: –
                      SCPI: conforming

Mode: all

SYSTem:ERRor:LIST?

This command reads all system messages and returns a list of comma separated strings. Each string corresponds to an entry in the table SYSTEM MESSAGES.

If the error list is empty, an empty string "" will be returned.

This command is a query and therefore has no *RST value.

Example: "SYST:ERR:LIST?"

Characteristics: *RST value: –
                      SCPI: device specific

Mode: all

SYSTem:ERRor:CLEar:ALL

This command deletes all entries in the table SYSTEM MESSAGES.

This command is an event and therefore has no query and no *RST value.

Example: "SYST:ERR:CLE:ALL?"

Characteristics: *RST value: –
                      SCPI: device specific

Mode: all

SYSTem:FIRMware:UPDate   <path>

This command starts a firmware update using the data set in the selected directory. Beforehand, the update files have to be stored in the following subdirectories using command MMEM:DATA:

Directory	Contents
DISK1	disk1.bin
DISK2	data3.cab
DISK3	data4.cab
DISK4	data5.cab
DISK5	data6.cab
DISK6	data7.cab
DISK7	data8.cab

Directory	Contents
DISK8	data9.cab
DISK9	data10.cab
DISK10	data11.cab
DISK11	data12.cab
DISK12	data13.cab

Example: `"SYST:FIRM:UPD 'D:\USER\FWUPDATE'"`
'Starts the firmware update from directory D:\USER\FWUPDATE using the files of subdirectories DISK1 to DISK5

Characteristics: *RST value: –
SCPI: device specific

Mode: all

This command is an 'event' and therefore has no query and no *RST value.

SYSTem:LANGuage   'SCPI' | '8566A' | '8566B' | '8568A' | '8568B' | '8591E' | '8594E' | '71100C' | '71200C' | '71209A'

This command activates the emulation of various analyzers. The analyzer default command set is SCPI.

The following remote-control languages are available:

- SCPI
- 8566A
- 8566B
- 8568A
- 8568B
- 8591E
- 8594E
- 71100C
- 71200C
- 71209A

Note

- When SCPI is selected, the 8566B/8568B/8594E command set is available in addition.
- When 8566A, 8566B, 8568A or 8568B is selected, both command sets A and B are available, as far as they are supported.
- The HP model 8591E is compatible to HP model 8594E,
  the HP models 71100C, 71200C, and 71209A are compatible to HP models 8566A/B.

On switching between remote-control languages, the following settings or changes will be made:

- **SCPI:** The instrument will perform a PRESET.

- **8566A/B, 8568A/B, 8594E:** The instrument will perform a PRESET.

The following instrument settings will then be changed:

Model	# of Trace Points	Start Freq.	Stop Freq.	Input Coupling
8566A/B	1001	2 GHz	22 GHz	DC (FSU) AC (FSP)
8568A/B	1001	0 Hz	1.5 GHz	AC
8594E	625 (FSU) 501 (FSP)	0 Hz	3 GHz	AC

Notes regarding switch over to 8566A/B and 8568A/B:

Commands IP and KST, too, will perform the settings for the "# of Trace Points", "Start Freq.", "Stop Freq." and "Input Coupling".

Switch over of the "# of Trace Points" will not take place until the instrument is switched to the REMOTE mode. For manual operation (selected with LOCAL softkey), the number of sweep points (trace points) will always be set to 1251.

In the remote mode, the screen area for the measurement will be reduced. The LOCAL softkey (lowermost softkey) will be shifted slightly towards the center of the screen.

Example: `"SYST:LANG 'SCPI'"`

Characteristics: *RST value: 'SCPI'
SCPI: conforming

Mode: all

There is no query for this command.

SYSTem:PASSword[:CENable] 'password'

This command enables access to the service functions by means of the password.

Example: `"SYST:PASS 'XXXX'"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

This command is an event and therefore has no *RST value and no query.

SYSTem:PRESet

This command initiates an instrument reset.

The effect of this command corresponds to that of the *PRESET* key with manual control or to the *RST command.

Example: `"SYST:PRES"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem:PRESet:COMPatible   FSP | OFF

This command determines if the settings of the receiver after a reset are compatible to the settings of the R&S FSP (selection FSP). If OFF is selected, the receiver specific settings are active after a reset.

Example: `"SYST:PRES:COMP FSP"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

SYSTem:SPEaker:VOLume   0 to 1

This command sets the volume of the built-in loudspeaker for demodulated signals. Minimum volume is set by 0 and maximum volume by 1.

The value 0 is the lowest volume, the value 1 the highest volume.

Example: `"SYST:SPE:VOL   0.5"`

Characteristics: *RST value: 0
SCPI: device-specific

Mode: all

SYSTem:TIME   0 to 23, 0 to 59, 0 to 59

This command sets the internal clock. The sequence of entry is hour, minute, second.

Example: `"SYST:TIME 12,30,30"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem:VERSion?

This command queries the number of the SCPI version, which is relevant for the instrument.

Example: `"SYST:VERS?"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

This command is a query and therefore has no *RST value.

TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

General Trace Commands

TRACe[:DATA]   TRACE1| TRACE2| TRACE3| SINGle | SCAN| STATus | FINAL1 | FINAL1 | FINAL2 | FINAL3 | ABITstream | PWCDp, <block> | <numeric_value>

This command transfers trace data from the control computer to the instrument, the query reads trace data out of the instrument. The associated measurement window is selected with the numeric suffix of TRACe<1|2>.

> **Note**
>
> If the FM demodulator (option FS-K7) is active, only the displayed trace data is read out and recalled. A portion of the measurement data that can be called by means of a marker, however, is calculated from the raw measurement data. These results are no longer available after recalling a trace; the associated queries generate a query error.

SPURIous reads the peak list in the spurious measurement. As results a list of frequency, level and delta to limit line values is returned. A delta limit of +200dB indicates no limit check is active

Example:	`"TRAC TRACE1,"+A$` (A$: data list in the current format) `"TRAC? TRACE1"`
Characteristics:	*RST value: - SCPI: conforming
Mode:	all
Return value:	The returned values are scaled in the current level unit. Returned FM-modulated measurement values (activated option FS-K7) are scaled in Hz.

ASCII format (FORMat ASCII):

In ASCII format, a list of values separated by commas is returned (Comma Separated Values = CSV).

The number of measurement points is 625.

Binary format (FORMat REAL,32):

If the transmission takes place using the binary format (REAL,32), the data are transferred in block format (Definite Length Block Data according to IEEE 488.2). They are arranged in succeeding lists of I and Q data of 32 Bit IEEE 754 floating point numbers. General structure of return string:

#42500<meas value 1><meas value value2>...<meas value 625>

with

– #4: digits of the subsequent number of data bytes (4 in the example)

– 2500: Number of subsequent data bytes (2500 in the example))

– <meas value x>: 4 byte floating point measurement values

Saving and recalling:

Saving and recalling trace data together with the device settings to/from the device-internal hard disk or to/from a memory stick is controlled via the commands `MMEMory:STORe:STATe` and `MMEMory:LOAD:STATe` respectively. Trace data are selected with "`MMEMory:SELect[:ITEM]:ALL`" or "`MMEMory:SELect[:ITEM]:TRACe`". Trace data in ASCII format (ASCII FILE EXPORT) are exported with the command "`MMEM:STORe:TRACe`".

The commands for final measurement data are "`MMEMory:SELect[:ITEM]:FINal`" and "`MMEM:STORe:FINal`".

Transfer format:

The trace data are transferred in the current format (corresponding to the command FORMat ASCii|REAL). The device-internal trace memory is addressed using the trace names 'TRACE1' to 'FINAL3'.

The transfer of trace data from the control computer to the instrument takes place by indicating the trace name and then the data to be transferred. In ASCII format, these data are values separated by commas. If the transfer takes place using the format real (REAL,32), the data are transferred in block format.

The parameter of the query is the trace name TRACE1 to FINAL3, it indicates which trace memory will be read out.

The command "`MMEMory:STORe:STATe`" or "`MMEMory:LOAD:STATe`" controls the storage or loading of measured data, including the device settings, on or from the internal hard disk or memory stick. The trace data is selected via "`MMEMory:SELect[:ITEM]:ALL`" or "`MMEMory:SELect[:ITEM]:TRACe`". The trace data in ASCII format (ASCII FILE EXPORT) is exported via the "`MMEM:STORe:TRACe`" command.

Number and Format of the Measurement Values for the Different Operating Modes

The number of measurement values depends on the instrument setting:

SPECTRUM mode (span > 0 and zero span):

625 results are output in the unit selected for display.

Note

With AUTO PEAK detector, only positive peak values can be read out.
Trace data can be written into the instrument with logarithmic display only in dBm,
with linear display only in volts.

FORMat REAL,32 is to be used as format for binary transmission, and FORMat ASCii for ASCII transmission.

Receiver

Note

For reasons of compatibility with the ESI test receiver, the data structure of the status information is designed for 4 traces. However, only 3 traces can be activated and transferred.

SINGle is possible only as a query for single measurements in the receiver mode. The values of all activated detectors are transferred separated by commas in the following order: POS, NEG, QPE, AVER, RMS. For inactive detectors, the value and the comma are omitted at the position(s) in question.

SCAN is only possible in form of a query during scan measurements. The number of transmitted measurement results depends on the scan settings.

FORMAT REAL,32 is to be used as format setting for binary transmission.

Structure of transmitted data:

– 4 byte: trace status: bit 0 to 9 subscan; bit 10: last block of subscan; Bit 11: last block of last subscan of scan; Bit 12: last of all blocks (for multiple scans after the last scan)

– 4 bytes:number n of the transmitted measurement results of a trace

– 4 byte:trace1 active (0/1)

– 4 byte:trace2 active (0/1)

– 4 byte:trace3 active (0/1)

– n*4 bytes:measurement results of trace 1 if trace 1 is active

– n*4 bytes:measurement results of trace 2 if trace 2 is active

– n*4 bytes:measurement results of trace 3 if trace 3 is active

– n*1 byte:status information per measurement result:
   bit 0: underrange trace1;
   bit 1: underrange trace2;
   bit 2: underrange trace3;
   bit 3: overrange trace1 to trace4

STATus is only possible in form of a query during scan measurements. 1 byte status information per measurement result is transmitted:

   bit 0: underrange trace1;
   bit 1: underrange trace2;
   bit 2: underrange trace3;
   bit 3: overrange trace1 to trace3

FINAL1, FINAL2 and FINAL3 are only possible in form of a query. The final measurement values are transmitted.

TRACe<1|2>:COPY   TRACe:COPY TRACE1| TRACE2| TRACE3|,
TRACE1| TRACE2| TRACE3|

This command copies data from one trace to another. The second operand describes the source, the first operand the destination of the data to be copied. The associated measurement window is selected with the numeric suffix of TRACe<1|2>.

Example: `"TRAC:COPY TRACE1,TRACE2"`

Characteristics: *RST value:
               SCPI: conforming

Mode: A

TRACe<1|2>:IMMediate:LEVel?

This query returns the current Y results of the sweep. During a sweep the last measured value is read out.

Example: `"INIT:CONT OFF"`
               'switches to single sweep mode

               `"INIT"`
               'starts a sweep (without waiting for the sweep end!)

               `"TRAC1:IMM:LEV?"`
               'queries the level of the last measured measurement point

Characteristics: *RST value:
               SCPI: conforming

Mode: A

TRACe<1|2>:IMMediate:RESult?

This query returns the current X and Y results of the sweep. During a sweep the last measured values are read out.

Example: `"INIT:CONT OFF"`
'switches to single sweep mode

                     `"INIT"`
'starts a sweep (without waiting for the sweep end!)

                     `"TRAC:IMM:RES?"`
'queries the X and Y values of the last measured measurement point

Characteristics: *RST value:
SCPI: conforming

Mode: A

TRACe:IQ Subsystem

The commands of this subsystem are used for collection and output of measured IQ measured data. A special memory is therefore available in the instrument with 16M words for the I and Q data. The measurement is always performed in the time domain (span = 0 Hz) at the selected center frequency. The number of samples to be collected can be set. The sampling rate can be set in the range from 10 kHz to 81.6 MHz; when channel filters are used, the sampling rate depends on the filter involved and can be determined via a special command depending on the setting used. Prior to being stored in memory or output via GPIB, the measured data is corrected by an equalizer filter in terms of frequency response.

Note

The commands of this subsystem are not available during GSM measurements.

Depending on the sample rate, the following maximum bandwidths can be obtained during the measurement.

Sample rate (from)	Sample rate (to)	Max. bandwidth	Notes
81.6 MHz	40.8 MHz	30 MHz	Half-band filter at half the sample rate (81.6 MHz)
40.8 MHz	20.4 MHz	0.68 sample rate	
20.4 MHz	10.2 MHz	0.8 sample rate	
10.2 MHz	5.1 MHz	0.8 sample rate	
5.1 MHz	2.55 MHz	0.8 sample rate	
2.55 MHz	1.275 MHz	0.8 sample rate	
1.275 MHz	0.6375 MHz	0.8 sample rate	
0.6375 MHz	318.75 kHz	0.8 sample rate	
318.75 kHz	159.375 kHz	0.8 sample rate	
159.375 kHz	79.6875 kHz	0.8 sample rate	
79.6875 kHz	39.84375 kHz	0.8 sample rate	
39.84375 kHz	19.921875 kHz	0.8 sample rate	
19.921875 kHz	10 kHz	0.8 sample rate	

The block diagram below shows the analyzer hardware from the IF section to the processor. The IF filter is the resolution filter of the signal analyzer with bandwidths selectable from 300 kHz to 50 MHz. The A/D converter samples the IF signal (20.4 MHz) at a rate of 81.6 MHz.

The digital signal is down-converted to the complex baseband, lowpass-filtered, and the sampling rate is reduced, i.e. the output sampling rate is set between 10.0 kHz and 81.6 MHz in steps of 0.1 Hz. This avoids unnecessary oversampling at narrower bandwidths, which saves processing time and increases the maximum recording time. Since the sample rate can be programmed quasi-continuously, even sampling rates, which cannot be derived by direct division of the 81.6 MHz, can be set.

The I/Q data are written to a memory of 16M words. The memory is hardware-triggered.
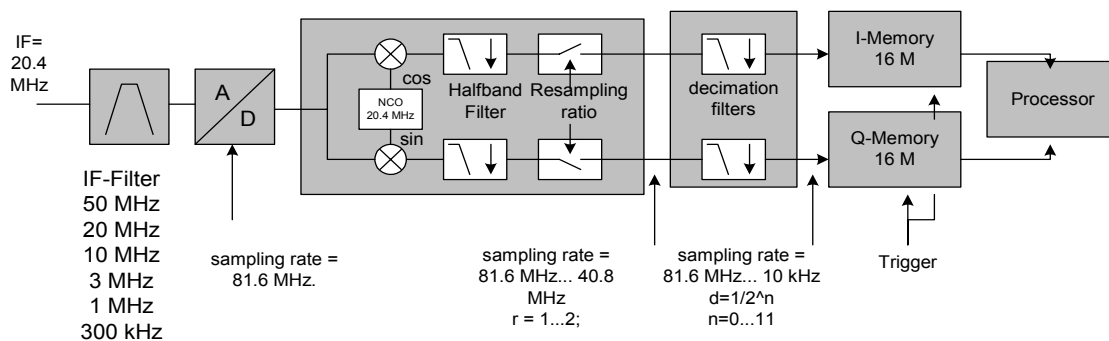
Fig. 6-1   Block diagram illustrating signal processing in analyzer

All trigger sources except for VIDeo can be used for triggering. The number of test points to be recorded prior to the trigger time can be selected for all of the available trigger sources except for FREE RUN, where this parameter is always to be assigned the value 0). Measurement results are output in the form of a list, with the Q values following immediately after the list of I values in the output buffer. The FORMAT command can be used to select between binary output (32 bit IEEE 754 floating-point values) and output in ASCII format.

The commands of this subsystem can be used in two ways:

1. Measurement and result query with one command:

   This method causes the least delay between measurement and output of the result data, but it requires the control computer to wait actively for the response data.

2. Setting up the instrument, start of the measurement via "INIT" and query of the result list at the end of the measurement:

   With this method the control computer can be used for other activities during the measurement. In this case the additional time needed for synchronization via service request must be taken into account.

TRACe<1|2>:IQ:DATA?

This command starts a measurement with the settings defined via `TRACe:IQ:SET` and returns the list of measurement results immediately after they are corrected in terms of frequency response. The number of measurement results depends on the settings defined with `TRACe:IQ:SET`, the output format depends on the settings of the `FORMat` – subsystem.

Note

The command requires that all response data are read out completely before the instrument accepts further commands.

Parameter: none

Example: `"TRAC:IQ:STAT ON"`
'Enables acquisition of I/Q data

`"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096"`
'Measurement configuration:
'Filter type: Normal
'RBW: 10 MHz
'Sample Rate: 32 MHz
'Trigger Source: External
'Trigger Slope: Positive
'Pretrigger Samples: 0
'# of Samples: 4096

`"FORMat REAL,32"`
'Selects format of response data

`"TRAC:IQ:DATA?"`
'Starts measurement and reads results

Return value: The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument.

ASCII Format (FORMat ASCII):

In this case the command returns a comma separated list of the measured voltage values in floating point format (Comma Separated Values = CSV). The number of values returned is 2 * number of samples, the first half being the I-values, the second half the Q-values.

Note

With >512 k ≡ 524288 samples, the data is transmitted in logical blocks of 512k values. See below.

Binary Format (FORMat REAL,32):

In this case the command returns binary data (Definite Length Block Data according to IEEE 488.2), with the lists of I- and Q-data being arranged one after the other in 32 Bit IEEE 754 floating point data. The scheme of the response string is as follows:

#44096<I-value1><I-value2>...<I-value512><Q-value1><Q-value2>...<Q-value512>

with

– #4: digits of the subsequent number of data bytes (4 in the example)

– 4096: number of subsequent data bytes (*# of DataBytes*, 4096 in the example)

– <I-value x>: 4-Byte-Floating Point I-value; max. 512k

– <Q-value y>: 4-Byte-Floating Point Q-value; max. 512k

The number of I- and Q-data can be calculated as follows:

# of I-data = # of Q-data = (# of DataBytes) / 8

The offset of Q-data in the output buffer can be calculated as follows:

Q-data offset = (# of DataBytes) / 2 + LengthIndicatiorDigit

with LengthIndicatorDigits being the number of digits of the length indicator including the '#'. In the example above (#44096...) this results in a value of 6 for LengthIndicatorDigits and the offset for the Q-data will result in 2048 + 6 = 2054.

Blockwise transmission with data volumes exceeding 512k words:

With > 512 k ≡ 524288 samples, the data is transmitted in logical blocks of 512k values. All transmitted blocks, except the block last transmitted, have a data length of exactly 512k words.

The following example shows the data structure for 1058816 I data samples and 1058816 Q data the samples. Since the block length is limited to 512k, 3 blocks are required for data transmission:

　　512k (=524288) Samples of I data of **Block 1**
　　512k (=524288) Samples of Q data of **Block 1**
　　512k (=524288) Samples of I data of **Block 2**
　　512k (=524288) Samples of Q data of **Block 2**
　　10k (=10240) Samples of I data of **Block 3**
　　10k (=10240) Samples of Q data of **Block 3**

Block transfer structure for 1034k samples = 1058816 samples
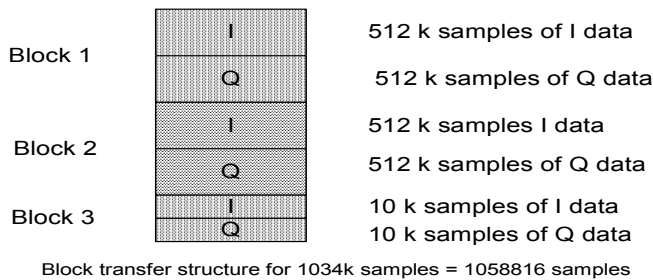
Characteristics:　　*RST value: --

Note

Using the command with the *RST values for command TRAC:IQ:SET the following minimum buffer sizes for the response data are recommended:
ASCII format: 10 kBytes
Binary format: 2 kBytes

SCPI: device specific

Mode:　　　　A-T

TRACe<1|2>:IQ:DATA:FORMat   COMPatible | IQBLock | IQPair

This command sets the data output formatting (using the TRAC:IQ:DATA? command):

Parameter: COMPatible: 512k I data and 512k Q data is alternately transferred
IQBLock: First, all I and then all Q data is transferred
IQPair: I/Q data is transferred in pairs

Example: `"TRAC:IQ:DATA:FORM IQP"`

Characteristics: *RST value: COMP
SCPI: device-specific

Mode: A

TRACe<1|2>:IQ:DATA:MEMory[:RF]?   <offset samples>,<# of samples>

This command allows you to read baseband IQ data from the memory that was previously sampled (and frequency-response-corrected) if you indicate the offset at the beginning of the sampling and the number of measurement values.

A data set once sampled can thus be read in smaller portions. The maximum number of measurement results depends on the `TRACe:IQ:SET` command specifications, the output format on the presetting via the `FORMat` subsystem.

Note

The command requires that all requested measurement data be completely retrieved before the device accepts any further commands.

If no baseband IQ data is available in the memory because the associated measurement has not yet been started, the command generates a query error.

Parameter: <offset samples>: Offset of the values to be output, referenced to the start of the sampled data.
Value range: 0 ... <# of samples> - 1, where <# of samples> is the value specified with the TRACe:IQ:SET command

<# of samples>: Value range: 1 ... <# of samples> - <offset samples> where <# of samples> is the value specified with the TRACe:IQ:SET command.

Example: "TRAC:IQ:STAT ON"
'activates the I/Q data sampling

"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,100,4096"
'configures the measurement:
'Filter type: Normal
'RBW: 10 MHz
'Sample Rate: 32 MHz
'Trigger Source: External
'Trigger Slope: Positive
'Pretrigger Samples: 100
'# of Samples: 4096

"INIT;*WAI"
'starts the measurement and waits for its end

"FORMat REAL,32"
'specifies the format of the response data

'Reading the results:

"TRAC:IQ:DATA:MEM? 0,2048"
'reads in 2048 I/Q values starting with the beginning of the sampling

"TRAC:IQ:DATA:MEM? 2048,1024"
'reads in 2048 I/Q values starting with the beginning of the sampling

"TRAC:IQ:DATA:MEM? 100,512"
'reads in 512 I/Q values starting with the trigger time (<Pretrigger Samples> was 100)

Return value: Irrespective of the output format selected, the data is scaled linearly with 'V' as the unit and corresponds to the voltage at the RF input of the device.

The return buffer is similarly configured to the return buffer with the TRACe:IQ: DATA? command where all I data has the value 0.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A-T

TRACe<1|2>:IQ:DATA:MEMory:AIQ?   <offset samples>,<# of samples>

This command allows you to read baseband Q data from the memory that was previously sampled (and frequency-response-corrected) if you indicate the offset at the beginning of the sampling and the number of measurement values. A data set once sampled can thus be read in smaller portions. The maximum number of measurement results depends on the TRACe:IQ:SET command specifications, the output format on the presetting via the FORMat subsystem.

Note

The command requires that all requested measurement data be completely retrieved before the device accepts any further commands.

If no baseband Q data is available in the memory because the associated measurement has not yet been started, the command generates a query error.

Parameter: \<offset samples\>:
Offset of the values to be output, referenced to the start of the sampled data.
Value range: 0 ... \<# of samples\> - 1, where \<# of samples\> is the value specified with the TRACe:IQ:SET command.

\<# of samples\>:
Number of measurement values to be output.
Value range: 1 ... \<# of samples\> - \<offset samples\>, where \<# of samples\> is the value specified with the TRACe:IQ:SET command.

Example: `"TRAC:IQ:STAT ON"`
'activates the I/Q data sampling

`"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,100,4096"`
'configures the measurement:
'Filter type: Normal
'RBW: 10 MHz
'Sample Rate: 32 MHz
'Trigger Source: External
'Trigger Slope: Positive
'Pretrigger Samples: 100
'# of Samples: 4096

`"INIT;*WAI"`
'starts the measurement and waits for its end

`"FORMat REAL,32"`
'specifies the format of the response data

'Reading the results:

`"TRAC:IQ:DATA:MEM:AIQ? 0,2048"`
'reads in 2048 I/Q values starting with the beginning of the sampling

`"TRAC:IQ:DATA:MEM:AIQ? 2048,1024"`
'reads in 1024 I/Q values starting at half the sampled data

`"TRAC:IQ:DATA:MEM:AIQ? 100,512"`
'reads in 512 I/Q values starting with the trigger time (\<Pretrigger Samples\> was 100)

Return value: Irrespective of the output format selected, the data is scaled linearly with 'V' as the unit and corresponds to the voltage at the RF input of the device.

The return buffer is similarly configured to the return buffer with the TRACe:IQ: DATA? command where all I data has the value 0.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

TRACe\<1|2\>:IQ:SET   \<filter type\>,\<rbw\>,\<sample rate\>,\<trigger source\>,\<trigger slope\>, \<pretrigger samples\>,\<# of samples\>

This command defines the settings of the analyzer hardware for the measurement of I/Q data.
This allows setting the bandwidth of the analog filters in front of the A/D converter as well as setting the sample rate, trigger conditions and the record length.

Note

If this command is omitted, the current analyzer settings will be used for the corresponding parameters.

Parameter: <filter type>: NORMAL
Selects the analog analyzer resolution filters as filter type. This is currently the only available filter type.

<rbw>: Bandwidth of the analog filters in front of the A/D converter.

Value range: 300 kHz – 10 MHz in steps of 1, 3, 10 and 20 MHz and 50 MHz for <filter type> = NORMal

<sample rate>: Sampling rate for the data acquisition.

Value range: 10 kHz to 81,6 MHz for <filter type> = NORMal

<trigger mode>: Selection of the trigger source used for the measurement.

Values: IMMediate | EXTernal | IFPower

Note

After selecting IFPower, the trigger threshold can be set with command TRIG:LEV: IFP.

<trigger slope>: Used trigger slope.

Values: POSitive (currently the only value supported)

<pretrigger samples>: Number of measurement values to be recorded before the trigger point.

Range: -16744447 (= -(2^{24}-1-512k)) to 65023 (= 64*1024 – 512 - 1)
(Negative values correspond to a trigger delay.)

Note

For <trigger mode> = IMMediate the value must be 0.

<# of samples>: Number of measurement values to record.

Value range: 1 to 16776704 (=16*1024*1024 - 512)

Example: `"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,2048"`
'Reads 2048 I/Q-values starting at the trigger point.
'Filtertype: NORMAL (analog)
'RBW: 10 MHz
'Sample Rate: 32 MHz
'Trigger: External
'Slope: Positive

                 `"TRAC:IQ:SET NORM,1MHz,4MHz,EXT,POS,1024,512"`
'Reads 512 I/Q-values from 1024 measurement points before the trigger point.
'Filter type: NORMAL (analog)
'RBW: 1 MHz
'Sample Rate: 4 MHz
'Trigger: External
'Slope: Positive

Characteristics: *RST values: `NORM,3MHz,32MHz,IMM,POS,0,128`

Note

For using these default settings with command `TRAC:IQ:DATA?` the following minimum buffer sizes for the response data are recommended:
ASCII format: 10 kBytes
Binary format: 2 kBytes

       SCPI: device specific

Mode: A-T

TRACe<1|2>:IQ:SRATe   10.0kHz to 81.6MHz

This command sets the sampling rate for the I/Q data acquisition. Thus the sample rate can be modified without affecting the other settings.

Return value: 10.0 kHz to 81.6 MHz
                sampling rates require a bandwidth of 50 MHz, set with the TRAC:IQ:SET command.

Note

If <filter type> = CFILter, the sample rate is determined by the selected filter bandwidth. In this case, the currently set sample rate can be determined using the query command. Entering a value causes an execution error if <filter type> = CFILter.

Example: `TRAC:IQ:SRAT 4MHZ`

Characteristics: *RST value: 32 MHz
                       SCPI: device specific

Mode: A-T

TRACe<1|2>:IQ[:STATe]   ON | OFF

This command switches the I/Q data acquisition on or off.

> **Note**
>
> The I/Q data acquisition is not compatible with other measurement functions. Therefore all other measurement functions will be switched off as soon as the I/Q measurement function is switched on. Additionally a trace display is not possible in this operating mode. Therefore all traces are set to "BLANK". Finally split screen operation will automatically be stopped.

Example: `TRAC:IQ ON`
'Switches on I/Q data acquisition

`TRAC:IQ:ONL ON`
'Switches the online output of the I/Q data on.

`INIT:CONT ON`
'Selects continuous measurement data output.

Characteristics: *RST value: OFF
SCPI: device specific

Mode: A-T

TRIGger Subsystem

The TRIGger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep. An external trigger signal can be applied to the connector at the rear panel of the instrument. A distinction is made between TRIGger1 (screen A) and TRIGger2 (screen B).

TRIGger<1|2>[:SEQuence]:SOURce   IMMediate | EXTernal | VIDeo | IFPower | AF | FM | AM | PM

This command selects the trigger source for the start of a sweep.

Note

The trigger source selection has to be done with the command `TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust`.

The selection AF, AM FM and PM is only available with option FS-K7 (FM Demodulator).

Parameter:

IMMediate	automatic triggering the next measurement at the end of the previous one. The value IMMediate corresponds to the FREE RUN setting.
EXTernal	the next measurement is triggered by the signal at the external trigger input.
VIDeo	the next measurement is triggered by the detection of a signal at the video filter output (not available for FM DEMOD mode).
IFPower	the next measurement is triggered by the detection of a signal at the instrument IF (10 MHz bandwidth)
AF | FM	the next measurement is triggered by the detection of a FM modulated signal (AF is synonymous with FM)
AM	the next measurement is triggered by the detection of a audio signal after AM demodulation
PM	the next measurement is triggered by the detection of a audio signal after PM demodulation

---

Note

To ensure successful triggering with trigger sources AF, AM, FM, and PM the measurement time should include at least 5 periods of the audio signal.

Example: `"TRIG:SOUR EXT"`
'Selects the external trigger input as source of the trigger signal

Characteristics: *RST value: IMMediate
SCPI: conforming

Mode: R, A, FM

TRIGger<1|2>[:SEQuence]:LEVel:IFPower -30 to –10DBM

This command sets the level of the IF power trigger source.

Example: `"TRIG:LEV:IFP –20DBM"`

Characteristics: *RST value: -20 DBM
SCPI: device-specific

Mode: all, except for FM

TRIGger<1|2>[:SEQuence]:HOLDoff -100 to 100s

This command defines the length of the trigger delay.

A negative delay time (pretrigger) can be set in the time domain (span < 0 Hz) only.

Example: `"TRIG:HOLD 500us"`

Characteristics: *RST value: 0s
SCPI: conforming

Mode: all

TRIGger<1|2>[:SEQuence]:HOLDoff:ADJust:AUTO ON|OFF

This command defines whether the group delay of the bandwidth filters for the external trigger is compensated (ON) or not (OFF). If a burst signal is analyzed in the time domain mode, the rising edge will remain at the same time position if compensation is on and the bandwidth changes.

Example: `"TRIG:HOLD:ADJ:AUTO ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

TRIGger<1|2>[:SEQuence]:SLOPe POSitive | NEGative

This command selects the slope of the trigger signal. The selected trigger slope applies to all trigger signal sources.

Example: `"TRIG:SLOP NEG"`

Characteristics: *RST value: POSitive
SCPI: conforming

Mode: all

UNIT Subsystem

The UNIT subsystem is used to switch the basic unit of setting parameters. A distinction is made between UNIT1 (screen A) and UNIT2 (screen B).

UNIT<1|2>:POWer   DBM | V | A | W | DB | PCT | UNITLESS | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DBPT | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ

This command selects the unit for power for the selected measurement window*.*
DBxx_MHZ indicates the units dBxx/MHz and DBxx_MMHZ indicates the units dBxx/mMHz (the measured level is referenced to a 1 MHz bandwidth).

Example: `"UNIT:POW DBM"`
                  'Sets the power unit for screen A to dBm.

Characteristics: *RST value: DBM
                       SCPI: conforming

Mode: A

IEC/IEEE-Bus Commands of HP Models 856xE, 8566A/B, 8568A/B and 8594E

Introduction

The FSP analyzer family supports a subset of the IEC/IEEE-bus commands of HP models 8560E, 8561E, 8562E, 8563E, 8564E, 8565E, 8566A, 8566B, 8568A, 8568B and 8594E.

Despite the differences in system architecture and device features, the supported commands have been implemented in a way to ensure a sufficiently high degree of correspondence with the original.

This includes the support of syntax rules for not only newer device families (B and E models) but for the previous A family as well.

In many cases the selection of commands supported by the R&S ESU is sufficient to run an existing IEC/IEEE bus program without adaptation.

The device model to be emulated is selected manually by means of the key sequence *SETUP - GENERAL SETUP - GPIB - GPIB LANGUAGE* via the IEC/IEEE bus using the *SYSTem:LANGuage* command.

To make it possible to also emulate device models that are not part of the selection list of the GPIB LANGUAGE softkey, the identification string received in response to the ID command can be modified (key sequence *SETUP - GENERAL SETUP - GPIB - ID STRING USER*). This allows any device model to be emulated whose command set is compatible with one of the supported device models.

Command Set of Models 8560E, 8561E, 8562E, 8563E, 8564E, 8565E, 8566A/B, 8568A/B and 8594E

As with the original units, the R&S ESU includes the command set of the A models in the command set of the B models.

Note

The HP model 8591 is compatible to HP model 8594E, the HP models 71100, 71200C, and 71209A are compatible to HP models 8566A/B.

Command	Supported subset	Function	Corresponding HP-Models	Status
A1	A1	Clear/Write A	HP 8566A/ HP 8568A	available
A2	A2	Max Hold A	HP 8566A/ HP 8568A	available
A3	A3	View A	HP 8566A/ HP 8568A	available
A4	A4	Blank A	HP 8566A/ HP 8568A	available
ABORT [1]	ABORT	Stop previous function	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
ADJALL	ADJALL	Adjust all	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
ADJCRT [2]	ADJCRT	Adjust CRT	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
ADJIF [2]	ADJIF	Auto adjust IF	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
AMB	AMB ON|OFF AMB 1|0 AMB?	Trace A - B -> Trace A	HP 856xE / HP 8594E	available in V3.3x and above
AMBPL	AMBPL ON|OFF AMBPL 1|0 AMBPL?		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
ANNOT	ANNOT ON|OFF ANNOT 1|0 ANNOT?	Annotation	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available

Command	Supported subset	Function	Corresponding HP-Models	Status
APB	APB	Trace A + B -> Trace A	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
AT	AT <numeric_value> DB | DM AT DN AT UP AT AUTO AT?	Attenuation	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
AUNITS	AUNITS DBM | DBMV | DBUV | AUNITS?	Amplitude Units	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
AUTOCPL	AUTOCPL	Coupling default	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
AXB	AXB	Exchange trace A and B	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
B1	B1	Clear/Write B	HP 8566A/ HP 8568A	available
B2	B2	Max Hold B	HP 8566A/ HP 8568A	available
B3	B3	View B	HP 8566A/ HP 8568A	available
B4	B4	Blank B	HP 8566A/ HP 8568A	available
BL	BL	Trace B - Display Line -> Trace B	HP 8566A/ HP 8568A	available in V3.3x and above
BML	BML	Trace B - Display Line -> Trace B	HP 856xE/ HP8594E	available in V3.3x and above
BTC	BTC	Transfer Trace B -> C	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
BXC	BXC	Exchange Trace B and C	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
BLANK	BLANK TRA|TRB|TRC	Blank Trace	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
C1	C1	A-B off	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresponding HP-Models	Status
C2	C2	A-B -> A	HP 8566A/ HP 8568A	available
CA	CA	Couple Attenuation	HP 8566A/ HP 8568A	available
CAL [1]	CAL ALL CAL ON CAL OFF	Start analyzer self alignment	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
CF	CF <numeric_value> HZ|KHZ|MHZ|GHZ CF UP CF DN CF?	Center Frequency	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
CHANPWR	CHANPWR TRA|TRB, <numeric_value>,?	Channel Power Measurement	HP 856xE / HP 8594E	available in V3.4x and above
CHPWRBW	CHPWRBW <numeric_value> HZ|KHZ|MHZ|GHZ	Channel Power Bandwidth	HP 856xE / HP 8594E	available in V3.4x and above
CLRW	CLRW TRA|TRB|TRC	Clear/Write Trace	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
CLS [1]	CLS	Clear all status bits	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
CONTS	CONTS		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
COUPLE	COUPLE AC|DC	Input coupling	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
CR	CR	Couple RBW	HP 8566A/ HP 8568A	available
CS	CS	Couple Step Size	HP 8566A/ HP 8568A	available
CT	CT	Couple SWT	HP 8566A/ HP 8568A	available
CV	CV	Couple VBW	HP 8566A/ HP 8568A	available
D1 [2]	D1	Display Size normal	HP 8566A/ HP 8568A	available in V3.3x and above
DEMOD [1]	DEMOD ON|OFF|AM|FM	AF Demodulator	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available

Command	Supported subset	Function	Corresponding HP-Models	Status
DEMODAGC 2)	DEMODAGC ON|OFF|1|0 DEMODAGC?	Demodulation AGC	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
DEMODT	DEMODT <numeric_value> S|MS|US|SC DEMODT UP|DN DEMODT?	Demodulation time	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
DET	DET POS|SMP|NEG DET?	Detector	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
DL	DL <numeric_value> DB|DM DL DN DL UP DL ON DL OFF DL?	Display Line	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
DLE	DLE ON|OFF	Display Line enable	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
DONE	DONE DONE?	Done query	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
E1	E1	Peak Search	HP 8566A/ HP 8568A	available
E2	E2	Marker to Center Freq.	HP 8566A/ HP 8568A	available
E3	E3	Deltamarker Step Size	HP 8566A/ HP 8568A	available
E4	E4	Marker to Ref. Level	available	available
ERR	ERR 250 cal level error ERR 300 LO unlock ERR 472 cal error digital filter ERR 473 cal error analog filter ERR 552 cal error log amp ERR 902 unscale tracking generator ERR 906 oven cold ERR117 numeric unit error ERR112 Unrecognized Command	Now some FSx errors are mapped to HP errors.	HP8568A HP856xE	Available in V3.7x and above
ERR?	ERR?	Error queue query	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
EX	EX	Exchange trace A and B	HP 8566A / HP 8568A	available in V3.2x and above

Command	Supported subset	Function	Corresponding HP-Models	Status
FA	FA <numeric_value> HZ|KHZ|MHZ|GHZ FA UP FA DN FA?	Start Frequency	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
FB	FB <numeric_value> HZ|KHZ|MHZ|GHZ FB UP FB DN FB?	Stop Frequency	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
FOFFSET[1]	FOFFSET <numeric_value> HZ|KHZ|MHZ|GHZ FOFFSET?	Frequency Offset	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
FREF	FREF INT|EXT	Reference Frequency	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
FS	FS	Full Span	HP 8566A/ HP 8568A	available
FUNCDEF		Define Function Function must be in one line between delimiters @	HP 8594E / HP 856xE / HP 8566B	available in V3.7x and above
GATE [1]	GATE ON|OFF GATE 1|0		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
GATECTL [1]	GATECTL EDGE|LEVEL GATECTL?		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
GD [1]	GD <numeric_value> US|MS|SC GD DN GD UP GD?		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
GL [1]	GL <numeric_value> US|MS|SC GL DN GL UP GL?		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
GP [1]	GP POS|NEG GP?		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
GRAT [2]	GRAT ON|OFF	Graticule	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
I1	I1		HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresponding HP-Models	Status
I2	I2		HP 8566A/ HP 8568A	available
ID	ID ID?	Identify	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
INZ 1)	INZ 75 INZ 50 INZ?	Input Impedance	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
IP	IP	Instrument preset	HP 8566A/ HP 8568A	available
KEYDEF	KEYDEF	Key definition	HP 8566B/ HP 856xE / HP 859xE	available in V3.7x and above
KEYEXEC	KEYEXEC	Key execute	HP 8566B	available in V3.7x and above
KS=	KS= <numeric_value> HZ|KHZ|MHZ|GHZ KS= DN KS= UP KS=?	Marker Frequency Counter Resolution	HP 8566A/ HP 8568A	available
KS/	KS/	Manual Peaking	HP 8566A/ HP 8568A	available in V3.2x and above
KS(	KS(	Lock register	HP 8566A/ HP 8568A	available in V3.4x and above
KS)	KS)	Unlock register	HP 8566A/ HP 8568A	available in V3.4x and above
KS91	KS91	Read Amplitude Error	HP 8566A/ HP 8568A	available in V3.4x and above
KSA	KSA	Amplitude Units in dBm	HP 8566A/ HP 8568A	available
KSB	KSB	Amplitude Units in dBmV	HP 8566A/ HP 8568A	available
KSC	KSC	Amplitude Units in dBuV	HP 8566A/ HP 8568A	available
KSD	KSD	Amplitude Units in V	HP 8566A/ HP 8568A	available
KSE	KSE <numeric_value>|<char data>@	Title mode	HP 8566A/ HP 8568A	available
KSG	KSG KSG ON KSG <numeric_value>	Video Averaging on	HP 8566A/ HP 8568A	available
KSH	KSH	Video Averaging Off	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresponding HP-Models	Status
KSK		Marker to Next Peak	HP 8566A/ HP 8568A	available
KSL		Marker Noise off	HP 8566A/ HP 8568A	available
KSM		Marker Noise on	HP 8566A/ HP 8568A	available
KSO	KSO	Deltamarker to span	HP 8566A/ HP 8568A	available in V3.2x and above
KSP	KSP <numeric_value>	HPIB address	HP 8566A/ HP 8568A	available
KSQ 2)	KSQ	Band lock off	HP 8566A/ HP 8568A	available in V3.2x and above
KST	KST	Fast Preset	HP 8566A/ HP 8568A	available
KSV	KSV <numeric_value> HZ|KHZ|MHZ|GHZ KSV?	Frequency Offset	HP 8566A/ HP 8568A	available
KSW	KSW	Error Correction Routine	HP 8566A/ HP 8568A	available
KSX	KSX	Correction Values On	HP 8566A/ HP 8568A	available
KSY	KSY	Correction Values Off	HP 8566A/ HP 8568A	available
KSZ	KSZ <numeric_value> DB KSZ?	Reference Value Offset	HP 8566A/ HP 8568A	available
KSa	KSa	Normal Detection	HP 8566A/ HP 8568A	available
KSb	KSb	Pos Peak Detection	HP 8566A/ HP 8568A	available
KSd	KSd	Neg Peak Detection	HP 8566A/ HP 8568A	available
KSe	KSe	Sample Detection	HP 8566A/ HP 8568A	available
KSj	KSj	View Trace C	HP 8566A/ HP 8568A	available
KSk	KSk	Blank Trace C	HP 8566A/ HP 8568A	available
KSl	KSl	Transfer B to C	HP 8566A/ HP 8568A	available
KSm	KSm	Graticule off	HP 8566A/ HP 8568A	available
KSn	KSn	Grid on	HP 8566A/ HP 8568A	available in V3.2x and above
KSo	KSn	Character display off	HP 8566A/ HP 8568A	available in V3.2x and above

Command	Supported subset	Function	Corresponding HP-Models	Status
KSp	KSp	Character display on	HP 8566A/ HP 8568A	available in V3.2x and above
KSr	KSr	Create service request	HP 8566A/ HP 8568A	available in V3.2x and above
KSt [2]	KSt	Band lock on	HP 8566A/ HP 8568A	available in V3.2x and above
KSv [2]	KSv	Signal ident on	HP 8566A/ HP 8568A	available in V3.2x and above
L0	L0	Display line off	HP 8566A/ HP 8568A	available in V3.2x and above
LB	LB <numeric_value>|<char data>@	Label	HP 8566A/ HP 8568A	available in V3.2x and above
LF	LF	Low frequency band preset	HP 8566A/ HP 8568A	available in V3.2x and above
LG	LG <numeric_value> DB | DM LG?	Amplitude Scale Log	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
LL [2]	LL	Plot command	HP 8566A/ HP 8568A	available in V3.2x and above
LN	LN	Amplitude Scale Lin	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
M1	M1	Marker Off	HP 8566A/ HP 8568A	available
M2	M2 M2 <numeric_value> HZ|KHZ|MHZ|GHZ M2 DN M2 UP M2?	Marker Normal	HP 8566A/ HP 8568A	available
M3	M3 M3 <numeric_value> HZ|KHZ|MHZ|GHZ M3 DN M3 UP M3?	Delta Marker	HP 8566A/ HP 8568A	available
M4	M4 <numeric_value> HZ|KHZ|MHZ|GHZ	Marker Zoom	HP 8566A/ HP 8568A	available
MA	MA	Marker Amplitude	HP 8566A/ HP 8568A	available
MC0	MC0	Marker Count off	HP 8566A/ HP 8568A	available
MC1	MC1	Marker Count on	HP 8566A/ HP 8568A	available
MDS	MDS	Measurement data size	HP 8566B	available in V3.7x and above

Command	Supported subset	Function	Corresponding HP-Models	Status
MF	MF MF?	Marker Frequency	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MINH[1]	MINH TRC	Minimum Hold	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKA	MKA <numeric_value> MKA?	Marker Amplitude	HP 856xE / HP 8566B / HP 8568B / HP 8594E	MKA <numeric_value> available in V3.4x and above query always available
MKACT	MKACT 1 MKACT?	Select the active marker	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKBW [1]	MKBW <numeric_value> MKBW ON MKBW OFF	N dB Down	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKD	MKD MKD <numeric_value> HZ|KHZ|MHZ|GHZ MKD DN MKD UP MKD ON MKD OFF MKD?	Delta Marker	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKDR	MKDR <numeric_value> HZ|KHZ|MHZ|GHZ|S|SC|MS|MSEC|USMKDR?	Delta Marker reverse	HP 856xE / HP 8566B / HP 8568B / HP 8594E	query available in V3.2x and above, completely available in V3.3x and above
MKF	MKF <numeric_value> HZ|KHZ|MHZ|GHZ MKF?	Set Marker Frequency	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
		Marker On		hidden
MKFC	MKFC ON|OFF	Frequency Counter on/off	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
MKFCR [1]	MKFCR <numeric_value> HZ|KHZ| MHZ|GHZ MKFCR DN MKFCR UP MKFCR?	Frequency Counter Resolution	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKMIN	MKMIN	Marker -> Min	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available

Command	Supported subset	Function	Corresponding HP-Models	Status
MKN	MKN MKN <numeric_value> HZ|KHZ|MHZ|GHZ MKN DN MKN UP MKN ON MKN OFF MKN?	Normal Marker	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKNOISE	MKNOISE ON|OFF MKNOISE 1|0 MKNOISE?	Noise Measurement	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKOFF	MKOFF MKOFF ALL	Marker off	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKP	MKP <numeric_value> MKP?	Marker position	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.4x and above
MKPK	MKPK MKPK HI MKPK NH MKPK NR MKPK NL	Marker Search	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKPT	MKPT MKPT HI MKPT NH MKPT NR MKPT NL	Marker Peak Threshold	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKPX	MKPX <numeric_value> DB MKPX DN MKPX UP MKPX?	Peak Excursion	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKRL	MKRL	Ref Level = Marker Level	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKSP	MKSP	Deltamarker to span	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
MKSS	MKSS	CF Stepsize = Marker Freq	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKT	MKT <numeric_value> S|MS|US|SC MKT?	MKF = fstart + MKT/ SWT*Span	HP 856xE / HP 8594E	available in V3.3x and above
MKTRACE	MKTRACE TRA|TRB|TRC	Marker to Trace	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available

Command	Supported subset	Function	Corresponding HP-Models	Status
MKTRACK	MKTRACK ON|OFF MKTRACK 1|0 MKTRACK?	Signal Track	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MKTYPE	MKTYPE AMP MKTYPE?	Marker type	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.4x and above
MOV	MOV TRA|TRB|TRC,TRA|TRB|TRC	Move Trace Contents	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
MT0	MT0	Marker Track Off	HP 8566A/ HP 8568A	available
MT1	MT1	Marker Track On	HP 8566A/ HP 8568A	available
MXMH	MXMH TRA|TRB	Maximum Hold	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
NORMALIZE	NORMALIZE	Normalize trace	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
NRL [1]	NRL <numeric_value> DB | DM NRL?	Normalized Reference Level	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
NRPOS	NRPOS <numeric_value> NRL?	Normalize position	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
O1	O1	Format ASCII, Values 0 to 4095	HP 8566A/ HP 8568A	available
O2	O2	Format Binary, Values 0 to 4095	HP 8566A/ HP 8568A	available in V3.3x and above
O3	O3	Format ASCII	HP 8566A/ HP 8568A	available
OA	OA	Output All	HP 8566A/ HP 8568A	available
OL	OL <80 characters> OL?	Output Learn String	HP 8566A/ HP 8568A	available
OT	OT	Output Trace Annotations	HP 8566A/ HP 8568A	available
PA [2]	PA <numeric_value>, <numeric_value	Plot command	HP 8566A/ HP 8568A	available in V3.2x and above
PD [2]	PD <numeric_value>, <numeric_value	Plot command	HP 8566A/ HP 8568A	available in V3.2x and above

Command	Supported subset	Function	Corresponding HP-Models	Status
PLOTORG [2]	PLOTORG DSP|GRT	Plot command	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
PLOTSRC [2]	PLOTSRC ANNT|GRT|TRB| TRA|ALLDSP|GRT	Plot command	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
PP	PP	Preselector Peaking	HP 8566A/ HP 8568A	available
PRINT [1]	PRINT PRINT 1|0	Hardcopy	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
PSDAC [2]	PSDAC <numeric_value> PSDAC UP|DN	Preselector DAC value	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
PSTATE [2]	PSTATE ON|OFF|1|0	Protect State	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
PU [2]	PU	Pen Up	HP 8566A/ HP 8568A	available in V3.3x and above
PWRBW	PWRBW	Power Bandwidth	HP 8566B/ HP 859x/ HP 856xE	available in V3.7x and above
R1	R1	Set Status Bit Enable	HP 8566A/ HP 8568A	available
R2	R2	Set Status Bit Enable	HP 8566A/ HP 8568A	available
R3	R3	Set Status Bit Enable	HP 8566A/ HP 8568A	available
R4	R4	Set Status Bit Enable	HP 8566A/ HP 8568A	available
RB	RB <numeric_value> HZ|KHZ|MHZ|GHZ RB DN RB UP RB AUTO RB?	Resolution Bandwidth	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
RBR	RBR <numeric_value> RBR DN RBR UP RBR?	Resolution Bandwidth Ratio	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
RC1...6	RC1...6	Recall Last State	HP 8566A/ HP 8568A	available
RCLS	RCLS <numeric_value>	Recall State Register	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available

Command	Supported subset	Function	Corresponding HP-Models	Status
RCLT	RCLT TRA|TRB,<number>	Recall Trace	HP856xE / HP8594E	available in V3.3x and above
RESET	RESET	Instrument preset	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
REV	REV REV?	Firmware revision	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
RL	RL <numeric_value> DB|DM RL DN RL UP RL?	Reference Level	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
RLCAL	RLCAL <numeric_value> RL?	Reference Level Calibration	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
RCLOSCAL	RCLOSCAL	Recall Open/ Short Average	HP 856xE / HP 8594E	available in V3.3x and above
RCLTHRU	RCLTHRU	Recall Thru	HP 856xE / HP 8594E	available in V3.3x and above
RLPOS [1]	RLPOS <numeric_value> RLPOS DN RLPOS UP RLPOS?	Reference Level Position	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
ROFFSET	ROFFSET <numeric_value> DB | DM ROFFSET?	Reference Level Offset	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
RQS	RQS	Service Request Bit mask	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
S1	S1	Continuous Sweep	HP 8566A/ HP 8568A	available
S2	S2	Single Sweep	HP 8566A/ HP 8568A	available
SAVES	SAVES <numeric_value>	Save State Register	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
SAVET	SAVET TRA|TRB,<number>	Save Trace	HP856xE / HP8594E	avalable in V3.3x and above
SMOOTH	SMOOTH TRA|TRB|TRC, <number of points>	Smooth Trace	HP 856xE / HP 8566B / HP 8568B / HP 8594E	avalable in V3.4x and above

Command	Supported subset	Function	Corresponding HP-Models	Status
SNGLS	SNGLS	Single Sweep	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
SQUELCH 2)	SQUELCH <numeric_value> DM | DB SQUELCH UP|DN SQUELCH ON|OFF	Squelch	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
SP	SP <numeric_value> HZ|KHZ|MHZ|GHZ SP DN SP UP SP?	Span	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
SRCNORM 1)	SRCNORM ON|OFF SRCNORM 1|0	Source Normalization	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
SRCPOFS 1)	SRCPOFS <numeric_value> DB | DM SRCPOFS DN SRCPOFS UP SRCPOFS?	Source Power Offset	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
SRCPWR 1)	SRCPWR <numeric_value> DB | DM SRCPWR DN SRCPWR UP SRCPWR ON SRCPWR OFF SRCPWR?	Source Power	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
SS	SS <numeric_value> HZ|KHZ|MHZ|GHZ SS DN SS UP SS AUTO SS?	CF Step Size	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
ST	ST <numeric_value> US|MS|SC ST DN ST UP ST AUTO ST?	Sweep Time	HP 8566A/ HP 8568A/ HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
STB	STB	Status byte query	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
STOREOPEN	STOREOPEN	Store Open	HP 856xE / HP 8594E	available in V3.3x and above
STORESHORT	STORESHORT	Store Short	HP 856xE / HP 8594E	available in V3.3x and above
STORETHRU	STORETHRU	Store Thru	HP 856xE / HP 8594E	available in V3.3x and above
SV1...6	SV1...6	Save State	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresponding HP-Models	Status
SWPCPL [2]	SWPCPL SA | SR SWPCPL?	Sweep Couple	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
SWPOUT [2]	SWPOUT FAV|FAVA|RAMP SWPOUT?	Sweep Output	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.2x and above
T0	T0	Threshold off	HP 8566A/ HP 8568A	available
T1	T1	Free Run Trigger	HP 8566A/ HP 8568A	available
T2 [2]	T2	Line Trigger	HP 8566A/ HP 8568A	available
T3	T3	External Trigger	HP 8566A/ HP 8568A	available
T4	T4	Video Trigger	HP 8566A/ HP 8568A	available
TA	TA	Transfer A	HP 8566A/ HP 8568A	available
TACL	TACL?	Returns instantaneous measurement results. See TRACe<trace #>:IMMediate:LEVel? for full description.		available in V3.7x and above
TBCL	, TBCL?			
TCCL	TCCR?			
TACR	TACR?	Returns instantaneous measurement results. See TRACe<trace #>:IMMediate:RESult? for full description.		available in V3.7x and above
TBCR	, TBCR?			
TCCR	TCCL?			
TB	TB	Transfer B	HP 8566A/ HP 8568A	available
TDF	TDF P TDF?	Trace Data Format	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
TH	TH <numeric_value> DB|DM TH DN TH UP TH ON TH OFF TH AUTO TH?	Threshold	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available

Command	Supported subset	Function	Corresponding HP-Models	Status
THE	THE ON| OFF	Threshold Line enable	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
TIMEDSP [1]	TIMEDSP ON|OFF TIMEDSP 1|0 TIMEDSP?	Time Display	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
TM	TM FREE|VID|EXT|LINE[2] TM?	Trigger Mode	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
TM LINE [2]	TM LINE	Trigger Line	HP 8566B	available in V3.7x and above
TRA	TRA?	Transfer A	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
TRB	TRB?	Transfer B	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
TRSTAT	TRSTAT?	Trace State Query	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available in V3.3x and above
TS	TS	Take Sweep	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
UR [2]	UR	Plot Command	HP 8566A/ HP 8568A	available in V3.2x and above
VARDEF	VARDEF	Variable definition, Command ignored	HP 8566B / HP 859xE / HP 856xE	available in V3.7x and above
VAVG	VAVG VAVG TRA|TRB|TRC	Video Averaging	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
VB	VB <numeric_value> HZ|KHZ|MHZ|GHZ VB DN VB UP VB AUTO VB?	Video Bandwidth	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
VBR [1]	VBR <numeric_value> VBR DN VBR UP VBR?	Video Bandwidth Ratio	HP 856xE / HP 8566B / HP 8568B / HP 8594E	available

Command	Supported subset	Function	Corresponding HP-Models	Status
VIEW	VIEW TRA|TRB|TRC		HP 856xE / HP 8566B / HP 8568B / HP 8594E	available
VTL	VTL <numeric_value> DB|DM VTL DN VTL UP VTL?	Video Trigger Level	HP 856xE / HP 8594E	available in V3.3x and above

1) HP 8594E only

2) Command will be accepted without error message, but will be ignored

Special Features of the Syntax Parsing Algorithms for 8566A and 8568A Models

The command syntax is very different for models A and B. Different names are assigned to identical instrument functions, and the command structure likewise differs considerably between models A and models B.

The command structure for models A is as follows:

<command> ::=
<command code>[<SPC>][<data>|<step>][<SPC>][<delimiter>][<command code>]...<delimiter>

<data> ::= <value>[<SPC>][<units code>][<SPC>][<delimiter>][<SPC>][<data>]...

<step> ::= UP|DN

where

<command code> = see Table "Supported Commands"

<value> = integer or floating-point numerical value

<units code> = DM | -DM | DB | HZ | KZ | MZ | GZ | MV | UV | SC | MS | US

<delimiter> = <CR> | <LF> | <,> | <;> | <ETX>

<SPC> = 32_{10}

<ETX> = 3_{10}

Command sections given in [ ] are optional.

The R&S ESU IEC/IEEE-bus hardware differs from that used in the HP analyzers. Therefore, the following constraint exists:

<LF>| <EOI> are still used as delimiters since the IEC/IEEE-bus hardware is able to identify them. The other delimiters are identified and evaluated during syntax analysis.

Special Behavior of Commands

Command	Known Differences
ABORT	Does not automatically set the command complete bit (bit 4) in the status byte. An additional DONE is required for that purpose.
ANNOT	Only frequency axis annotation is affected.
AT	AT DN/UP: Step size
CAL	The CAL commands do not automatically set the command complete bit (bit 4) in the status byte. An additional DONE command is required for that purpose.
CF	Default value, range, step size
CR	Default ratio Span / RBW
CT	Formula for coupled sweeptime
CV	Default ratio RBW / VBW
DEMOD	on FSP: requires option FSP-B3
DET	DET? returns SAMP instead of SMP on the R&S ESU. DET not automatically set the command complete bit (bit 4) in the status byte. An additional DONE is required for that purpose.
ERR?	Deletes the error bit in the status register but always returns a '0' in response.
FA	Default value, range, step size
FB	Default value, range, step size
ID	Query of instrument type. The instrument type entered with *SETUP - GENERAL SETUP - GPIB - ID STRING USER* will be returned.
M2	Default value, range, step size
M3	Default value, range, step size
MKACT	Only marker 1 is supported as the active marker.
MKBW	Default value
MKPT	Step size
MKPX	Step size
OL?	Storage of instrument settings: 80 characters are returned as information on the instrument settings. The contents of the 80 characters returned does not correspond to the original data contents of the 8566A / 8568A family.
OL	Readout of instrument settings: The 80 characters read by means of OL? are accepted as information on the corresponding instrument settings. The contents of the 80 characters read does not correspond to the original data contents of the 8566A / 8568A family.
RB	Default value, range, step size
RL	Default value, step size
RLPOS	Adapts the position of the reference level even if the tracking generator normalization is not active.

Command	Known Differences
RQS	Supported bits: 1 (Units key pressed) 2 (End of Sweep) 3 (Device error) 4 (Command complete) 5 (Illegal command)
SRCNORM	
SRCPWR	
SP	Default value, range, step size
SS	Default value, range, step size
ST	Default value, range, step size
STB	The status bits are mapped as described with command RQS. **Note** Bit 2 and 4 are always set in parallel if "Command Complete" or "End of Sweep" are recognized. The R&S ESU cannot distinguish between these conditions. Additionally these bits are not suitable for synchronization on the end of sweep in continuous sweep operation.
TA	Output of 1001 trace points of trace A in O1 or O3 format.
TB	Output of 1001 trace points of trace B in O1 or O3 format.
TH	Default value
VB	Range
VBR	Default value

Model-Dependent Default Settings

When the IEC/IEEE-bus language is switched over to an 85xx model, the IEC/IEEE-bus address will automatically be switched over to 18 provided that the default address of the R&S ESU (20) is still set. If a different value is set, this value will be maintained. Upon return to SCPI, this address will remain unchanged.

The following table shows the default settings obtained after a change of the IEC/IEEE-bus language and for the commands IP, KST and RESET:

Model	# of Trace Points	Start Freq.	Stop Freq.	Ref Level	Input Coupling
8566A/B	1001	2 GHz	22 GHz	0 dBm	"DC (FSU)
AC (FSP)"					
8568A/B	1001	0 Hz	1.5 GHz	0 dBm	AC
8560E	601	0 Hz	2.9 GHz	0 dBm	AC
8561E	601	0 Hz	6.5 GHz	0 dBm	AC
8562E	601	0 Hz	13.2 GHz	0 dBm	AC
8563E	601	0 Hz	26.5 GHz	0 dBm	AC
8564E	601	0 Hz	40 GHz	0 dBm	AC
8565E	601	0 Hz	50 GHz	0 dBm	AC
8594E	401	0 Hz	3 GHz	0 dBm	AC

Notes regarding the set stop frequency:

The stop frequency given in the table may be limited to the corresponding frequency range of the R&S ESU.

Command LF sets the stop frequency for 8566A/B to a maximum value of 2 GHz.

Note regarding the number of test points (trace points):

The # of trace points is switched over only upon transition to the REMOTE state.

Data Output Formats

In the case of the SCPI and IEEE488.2 standards, the output formats for numerical data are flexible to a large extent. The output format for the HP units, by contrast, is accurately defined with respect to the number of digits. The memory areas for reading instrument data have therefore been adapted accordingly in the remote-control programs for instruments of this series.

Therefore, in response to a query, the R&S ESU returns data of the same structure as that used by the original instruments; this applies in particular to the number of characters returned.

Two formats are currently supported when trace data is output: Display Units (command O1) and physical values (command O2, O3 or TDF P). As to the "Display Units" format, the level data of the R&S ESU is converted to match the value range and the resolution of the 8566/8568 series. Upon transition to the *REMOTE* state, the R&S ESU is reconfigured such that the number of test points (trace points) corresponds to that of the 85xx families (1001 for 8566A/B and 8568A/B, 601 for 8560E to 8565E, 401 for 8594E).

Trace Data Output Formats

All formats are supported for trace data output: display units (command O1), display units in two byte binary data (command O2 or TDF B and MDS W), display units in one byte binary data (command O4 or TDF B and MDS B) and physical values (commands O3 or TDF P). With format "display units" the level data will be converted into value range and resolution of the 8566/8568 models. On transition to REMOTE state the number of trace points will be reconfigured in order to be conforming to the selected instrument model (1001 for 8566A/B and 8568 A/B, 601 for 8560E to 8565E, 401 for 8594E).

Trace Data Input Formats

Trace data input is only supported for binary date (TDF B, TDF A, TDF I, MDS W, MDS B).

IEC/IEEE-Bus Status Reporting

The STB command and the serial poll respond with an 8-bit value having the following assignment:

Bit enabled by RQS	
0	not used (value 0)
1	Units key pressed
2	End of Sweep
3	Device Error
4	Command Complete
5	Illegal Command
6	Service Request
7	not used (value 0)

Bits 0 and 7 are not used and always have the value 0.

Please note that the R&S ESU reports any key pressed on the front panel rather than only the unit keys if bit 1 was enabled.

Another difference is the behavior of bit 6 when using the STB? query. On the HP analyzers this bit monitors the state of the SRQ line on the bus. On the R&S ESU this is not possible. Therefore this bit is set, as soon as one of the bits 1 to 5 is set. It won't be reset by performing a serial poll.

Differences in GPIB Behavior between the FSP and the FSE Families of Instruments

The following list of commands contains the differences in syntax and behavior between the GPIB command set of the FSP and the FSE families of instruments. Firmware options are not described in this operating manual as the related commands are not available in the basic instrument. FSE alone in column "Devices" denotes the instrument families FSE, FSIQ, FSET and ESIB, unless otherwise noted in column "Notes".

Devices		Command *(Sheet 1 of 41)*	Parameter	Notes
ESU	FSE	*CAL?		ESU: executes total calibration FSE: executes short calibration
ESU	FSE	*CLS		
ESU	FSE	*ESE		
ESU	FSE	*ESR?		
ESU	FSE	*IDN?		model indicator and version index is different for ESU and FSE
ESU	FSE	*IST?		
ESU	FSE	*OPC?		
ESU	FSE	*OPT?		list of available options is slightly different for ESU and FSE, but equally available options have equal names
ESU	FSE	*PCB		
ESU	FSE	*PRE		
ESU	FSE	*PSC		
ESU	FSE	*RST		instrument settings are slightly different for ESU and FSE due to different instrument specs
ESU	FSE	*SRE		
ESU	FSE	*STB?		
ESU	FSE	*TRG		ESU starts measurement in active screen FSE: starts measurement in both screens (split screen mode)
ESU	FSE	*TST?		
ESU	FSE	*WAI		
ESU	FSE	ABORt		

Devices		Command *(Sheet 2 of 41)*	Parameter	Notes
ESU		CALCulate:STATistics:APD[:STATe]	ON | OFF	new function for ESU
ESU		CALCulate:STATistics:CCDF[:STATe]	ON | OFF	new function for ESU
ESU		CALCulate:STATistics:NSAMples	100 to 1E9	new function for ESU
ESU		CALCulate:STATistics:PRESet		new function for ESU
ESU		CALCulate:STATistics:Result<1...3>?	MEAN | PEAK | CFACtor | ALL	new function for ESU
ESU		CALCulate:STATistics:SCALe:AUTO	ONCE	new function for ESU
ESU		CALCulate:STATistics:X:RANGe	-10dB to 200dB	new function for ESU
ESU		CALCulate:STATistics:X:RLEVel	-130dBm to 30dBm	new function for ESU
ESU		CALCulate:STATistics:Y:LOWer	-1E-9 to 0.1	new function for ESU
ESU		CALCulate:STATistics:Y:UPPer	-1E-8 to 1.0	new function for ESU
	FSE	CALCulate<1|2>:CTHReshold	MIN to MAX	not available in ESU
	FSE	CALCulate<1|2>:CTHReshold:STATe	ON | OFF	not available in ESU
ESU		CALCulate<1|2>:DELTamarker<1...4>:AOFF		markers 2...4 are either normal or delta markers; marker 1 always serves as the reference marker for all deltamarkers
	FSE	CALCulate<1|2>:DELTamarker<1...4>:AOFF		there are 4markers and 4 deltamarkers; the most recently used marker serves as the reference marker for all deltamarkers
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion: FIXed:RPOint:X	<numeric_value>	ESU: marker 1 can be moved independently from the reference point FSE: the marker and the reference point are linked to each other
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion: FIXed:RPOint:Y	<numeric_value>	ESU: marker 1 can be moved independently from the reference point; FSE: the marker and the reference point are linked to each other
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion: FIXed:RPOint:Y: OFFSet	<numeric_value>	
ESU		CALCulate<1|2>:DELTamarker<1...4>:FUNCtion: FIXed:RPOint:MAX: PEAK		new function for ESU
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion: FIXed[:STATe]	ON | OFF	
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion: PNOise:RESult?		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion: PNOise[:STATe]	ON | OFF	

Devices		Command *(Sheet 3 of 41)*	Parameter	Notes
	FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum: APEak		not available for ESU
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum: LEFT		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum: NEXT		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum: RIGHt		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>: MAXimum[:PEAK]		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum: LEFT		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum: NEXT		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum: RIGHt		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum[: PEAK]		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:MODE	ABSolute | RELative	
	FSE	CALCulate<1|2>:DELTamarker<1...4>:STEP: AUTO	ON | OFF	not available for ESU
	FSE	CALCulate<1|2>:DELTamarker<1...4>:STEP[: INCRement]	<numeric_value>	not available for ESU
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:TRACe	1 to 3	ESU: 3 traces are available per screen; FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:X	0 to MAX (frequency | sweep time)	unit 'SYM' is not available for ESU
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:X:RELative		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>:Y?		
ESU	FSE	CALCulate<1|2>:DELTamarker<1...4>[:STATe]	ON | OFF	
ESU	FSE	CALCulate<1|2>:DLINe<1|2>	MIN to MAX	
ESU	FSE	CALCulate<1|2>:DLINe<1|2>:STATe	ON | OFF	
	FSE	CALCulate<1|2>:FEED	'XTIM:DDEM:MEAS' | 'XTIM:DDEM:REF' | 'XTIM:DDEM:ERR:MPH' | 'XTIM:DDEM:ERR: VECT' | 'XTIM:DDEM: SYMB' | 'XTIM:AM' | 'XTIM:FM' | 'XTIM:PM' | 'XTIM:AMSummary' | 'XTIM:FMSummary' |'XTIM:PMSummary' | 'TCAP'	not available for ESU

Devices		Command *(Sheet 4 of 41)*	Parameter	Notes
	FSET	CALCulate<1|2>:FEED	'XTIM:DDEM:MEAS' | 'XTIM:DDEM:REF' | 'XTIM:DDEM:ERR:MPH' | 'XTIM:DDEM:ERR: VECT' | 'XTIM:DDEM: SYMB' | 'TCAP'	not available for ESU
ESU	FSE	CALCulate<1|2>:FLINe<1|2>	0 to f_{max}	
ESU	FSE	CALCulate<1|2>:FLINe<1|2>:STATe	ON | OFF	
	FSE	CALCulate<1|2>:FORMat	MAGNitude | PHASe | UPHase | RIMag | FREQuency | IEYE | QEYE | TEYE | FEYE | COMP | CONS	not available for ESU
	FSE	CALCulate<1|2>:FSK:DEViation:REFerence	<numeric value>	not available for ESU
	FSE	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ACHannel [:RELative] of ESU not available for FSET
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ACHannel:ABSolute	-200 to 200 DBM, -200 to 200 DBM	new function for ESU
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ACHannel:ABSolute:STATe	ON | OFF	new function for ESU
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:ACPower: ACHannel:RESult?		
	FSE	CALCulate<1|2>:LIMit<1...8>:ACPower: ACHannel:STATe	ON | OFF	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ACHannel[:RELative]: STATe of ESU not available for FSET
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ACHannel[:RELative]	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ACHannel of FSE
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ACHannel[:RELative]:STATe	ON | OFF	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ACHannel:STATe of FSE
	FSE	CALCulate<1|2>:LIMit<1...8>:ACPower: ALTernate<1|2>	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ALTernate<1|2> [:RELative] of ESU not available for FSET
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ALTernate<1|2>:ABSolute	-200 to 200 DBM, -200 to 200 DBM	new function for ESU
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ALTernate<1|2>:ABSolute:STATe	ON | OFF	new function for ESU

Devices		Command *(Sheet 5 of 41)*	Parameter	Notes
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:ACPower: ALTernate<1|2>:RESult?		
	FSE	CALCulate<1|2>:LIMit<1...8>:ACPower: ALTernate<1|2>:STATe	ON | OFF	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ALTernate<1|2> [:RELative]:STATe of ESU not available for FSET
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ALTernate<1|2>[:RELative]	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ALTernate<1|2> of FSE
ESU		CALCulate<1|2>:LIMit<1...8>:ACPower: ALTernate<1|2>[:RELative]:STATe	ON | OFF	compatible to CALCulate<1|2>: LIMit<1...8>:ACPower: ALTernate<1|2>: STATe of FSE
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe]	ON | OFF	
	FSE	CALCulate<1|2>:LIMit<1...8>:BURSt:POWer?		not available for ESU, FSET and ESI
	FSE	CALCulate<1|2>:LIMit<1...8>:BURSt:PTEMplate?		not available for ESU, FSET and ESI
	FSE	CALCulate:LIMit:CATalog?		not available in ESU
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:CLEar[:IMMediate]		
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:COMMent	<string>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain	FREQuency | TIME	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE	RELative | ABSolute	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFset	<numeric value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt	<numeric_value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:SPACing	LINear | LOGarithmic	
	FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:UNIT[: TIME]	S | SYM	not available for ESU
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA]	<numeric value>, <numeric value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:COPY	1 to 8|<name>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:DELete		
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:FAIL?		
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin	<numeric value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:MODE	RELative | ABSolute	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:OFFset	<numeric value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt	<numeric_value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:SPACing	LINear | LOGarithmic	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:STATe	ON | OFF	

Devices		Command *(Sheet 6 of 41)*	Parameter	Notes
		CALCulate<1|2>:LIMit<1...8>:LOWer:THReshold	<numeric value>	new function for ESU
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA]	<numeric value>	
	FSE	CALCulate<1|2>:LIMit<1...8>:MARGin	0 to 100DB	not available for ESU, FSET and ESI
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:NAME	1 to 8|<string>	
	FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum: MODulation:EXCeptions?	ARFCn | TXBand | RXBand| COMBined | DCSRx1800	not available for ESU, FSET and ESI
	FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum: MODulation:FAILs?	ARFCn | TXBand | RXBand| COMBined | DCSRx1800	not available for ESU, FSET and ESI
	FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum: MODulation?	ARFCn | TXBand | RXBand| COMBined | DCSRx1800	not available for ESU, FSET and ESI
	FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum: SWITching:FAILs?		not available for ESU, FSET and ESI
	FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum: SWITching?		not available for ESU, FSET and ESI
	FSE	CALCulate<1|2>:LIMit<1...8>:SPURious:FAILs?	TXBand | OTXBand| RXBand | IDLeband	not available for ESU, FSET and ESI
	FSE	CALCulate<1|2>:LIMit<1...8>:SPURious?	TXBand | OTXBand| RXBand | IDLeband	not available for ESU, FSET and ESI
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:STATe	ON | OFF	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:TRACe	1 to 3	ESU: 3 traces are available per screen. FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode
ESU		CALCulate<1|2>:LIMit<1...8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS	Available units are compatible to the FSE
	FSE/ FSIQ	CALCulate<1|2>:LIMit<1...8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ ||DBUV_M | DBUA_M | DBUV_MHZ | DBUA_MHZ | DEG | RAD | S | HZ | PCT | UNITLESS	only the following units are available for the ESU:DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS

Devices		Command *(Sheet 7 of 41)*	Parameter	Notes
	FSET/ ESI	CALCulate<1|2>:LIMit<1...8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | |DBUV_M | DBUA_M | DBUV_MHZ | DBUA_MHZ | DEG | RAD | S | HZ | PCT | UNITLESS	only the following units are available for the ESU:DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin	<numeric value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:MODE	RELative | ABSolute	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:OFFset	<numeric value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt	<numeric_value>	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:SPACing	LINear | LOGarithmic	
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:STATe	ON | OFF	
ESU		CALCulate<1|2>:LIMit<1...8>:UPPer:THReshold	<numeric value>	new function for ESU
ESU	FSE	CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA]	<numeric value>	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:AOFF		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:COUNt	ON | OFF	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:COUNt: FREQuency?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:COUNt: RESolution	0.1 | 1 | 10 | 100 | 1000 | 10000 Hz	
	FSE	CALCulate<1|2>:MARKer<1...4>: COUPled[STATe]	ON | OFF	not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:AFRequency[:RESult]?		not available for ESU and FSET
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:AM[:RESult]?	PPEak | MPEak | MIDDle | RMS	not available for ESU and FSET
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:CARRier[:RESult]?		not available for ESU and FSET
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:FERRor[:RESult]?		not available for ESU and FSET
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:FM[:RESult]?	PPEak | MPEak | MIDDle | RMS | RDEV	not available for ESU and FSET
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:PM[:RESult]?	PPEak | MPEak | MIDDle | RMS	not available for ESU and FSET
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:SINad:RESult?		not available for ESU and FSET
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ADEMod:SINad[:STATe]	ON | OFF	not available for ESU and FSET
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: CENTer		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: CSTep		

Devices		Command *(Sheet 8 of 41)*	Parameter	Notes
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: DDEMod:RESult?	MERM | MEPK | MEPS | PERM PEPK | PEPS | EVRM | EVPK | EVPS IQOF | IQIM |ADR | FERR | FEPK | RHO | DEV | FSRM | ESUK | ESUS | DTTS	not available for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: DEModulation: CONTinuous		new function for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: DEModulation:HOLDoff	10ms to 1000s	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: DEModulation:SELect	AM | FM	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: DEModulation[:STATe]	ON | OFF	
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: FPEaks[:IMMediate]	<numeric value>	new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: FPEaks:COUNt?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: FPEaks:X?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: FPEaks:Y?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: FPEaks:SORT	X | Y	new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: MDEPth:RESult?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: MDEPth[:STATe]		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: MSUMmary?	<numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	new function for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: MSTep		not available for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: NDBDown	<numeric_value>	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: NDBDown:FREQuency?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: NDBDown:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: NDBDown:STATe	ON | OFF	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: NOISe:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: NOISe:STATe	ON | OFF	

Devices		Command *(Sheet 9 of 41)*	Parameter	Notes
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:CFILter	ON | OFF	not available for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:PRESet	NADC | TETRA | PDC | PHS | CDPD | FWCDma | RWCDma | F8CDma | R8CDma | F19Cdma | R19Cdma | FW3Gppcdma| RW3Gppcdma | D2CDma | S2CDma | M2CDma | NONE	available standards are compatible to the FSE
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult:PHZ	ON | OFF	new function for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult?	ACPower | CPOWer | OBANdwidth | OBWidth | MCACpower	MCACpower is not available on the FSE MCACpower, ACPower and CPOWer are not available on the FSET
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect?	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0 | MCACpower	MCACpower is not available on the FSE MCACpower, ACPower and CPOWer are not available on the FSET
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe]	OFF	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence		
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor	(60dB/3dB) | (60dB/6dB)	not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:FREQuency?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:STATe	ON | OFF	not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STARt		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STOP		not available for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack: BANDwidth|BWIDth	10 Hz to MAX(span)	new function for ESU. Replaces DISP:FLINE of the FSE.
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:THReshold	-330 to +30 dBm	new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:TRACe	1 to 3	new function for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack[:STATe]	ON | OFF	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AOFF		

Devices		Command *(Sheet 10 of 41)*	Parameter	Notes
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:AVERage	ON | OFF	
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MAXimum: AVERage:RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MAXimum: PHOLd:RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MAXimum: RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MAXimum [:STATe]	ON | OFF	not available for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MEAN: AVERage:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MEAN:PHOLd:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MEAN:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MEAN[:STATe]	ON | OFF	
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MIDDle: AVERage:RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MIDDle: PHOLd:RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MIDDle: RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MIDDle [:STATe]	ON | OFF	not available for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MODE	ABSolute | RELative	new function for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MPEak: AVERage:RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MPEak: PHOLd:RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MPEak: RESult?		not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:MPEak [:STATe]	ON | OFF	not available for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:PHOLd	ON | OFF	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:PPEak: AVERage:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:PPEak:PHOLd:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:PPEak:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:PPEak[:STATe]	ON | OFF	

Devices		Command *(Sheet 11 of 41)*	Parameter	Notes
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:REFerence: AUTO	ONCE	new function for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:RMS:AVERage:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:RMS:PHOLd: RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:RMS:RESult?		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:RMS[:STATe]	ON | OFF	
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:SDEViation: RESult?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMarySDEViation: AVERage:RESult?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:SDEViation: PHOLd:RESult?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary:SDEViation [:STATe]	ON | OFF	new function for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: SUMMary[:STATe]	ON | OFF	
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI: RESult?		new function for ESU
ESU		CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI[: STATe]	ON | OFF	new function for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion: ZOOM	<numeric_value>	ESU: function uses always marker 1 as its reference marker; FSE: all available markers can be used as a reference marker
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:LOEXclude	ON | OFF	
	FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum: APEak		not available for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum: NEXT		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum: RIGHt		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum[: PEAK]		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:MINimum[: PEAK]		
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:PEXCursion	<numeric_value>	

Devices		Command *(Sheet 12 of 41)*	Parameter	Notes
	FSE	CALCulate<1|2>:MARKer<1...4>:READout	MPHase | RIMaginary	not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>: SCOupled[STATe]	ON | OFF	not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:STEP:AUTO	ON | OFF	not available for ESU
	FSE	CALCulate<1|2>:MARKer<1...4>:STEP[: INCRement]	<numeric_value>	not available for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:TRACe	1 to 3	ESU: 3 traces are available per screen FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:X	0 to MAX (frequency | sweep time)	additional unit SYM is available for FSE
ESU		CALCulate<1|2>:MARKer<1...4>:X:SLIMits:LEFT	0 to MAX (frequency | sweep time)	new function for ESU. Replaces DISP:FLIN and DISP:TLIN commands of the FSE
ESU		CALCulate<1|2>:MARKer<1...4>:X:SLIMits:RIGHt	0 to MAX (frequency|sweep time)	new function forESU. Replaces DISP:FLIN and DISP:TLIN commands of the FSE
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:X:SLIMits[: STATe]	ON | OFF	
ESU	FSE	CALCulate<1|2>:MARKer<1...4>:Y?		
ESU		CALCulate<1|2>:MARKer<1...4>:Y:PERCent	<numeric_value>	new function for ESU
ESU	FSE	CALCulate<1|2>:MARKer<1...4>[:STATe]	ON | OFF	
ESU		CALCulate<1|2>:MATH:MODE	LINear | LOGarithmic	affects all traces on the ESU; therefore the numeric suffix : MATH<1...4> is not allowed for the ESU
	FSE	CALCulate<1|2>:MATH<1...4>:MODE	LINear | LOGarithmic	for FSE, only the trace indicated by a numeric suffix is affected
ESU		CALCulate<1|2>:MATH:POS	-100PCT to 200PCT	new function for ESU; replacement for CALC: RLINe of the FSE
ESU	FSE	CALCulate<1|2>:MATH:STATe	ON | OFF	for ESU, traces can only be subtracted from trace 1; therefore there is no numeric suffix behind : MATH

Devices		Command *(Sheet 13 of 41)*	Parameter	Notes
ESU	FSE	CALCulate<1|2>:MATH[:EXPRession][:DEFine]	<expr>	for ESU, traces can only be subtracted from trace 1; therefore there is no numeric suffix behind : MATH and <expr> may only consist of (TRACE1-TRACE2) or (TRACE1-TRACE3)
	FSE	CALCulate<1|2>:RLINe	MIN to MAX	not available for ESU (replaced by CALC: MATH:POS)
	FSE	CALCulate<1	2>:RLINe:STATe	ON	OFF	not available for ESU (replaced by CALC: MATH:POS)
ESU	FSE	CALCulate<1|2>:THReshold	MIN to MAX	
ESU	FSE	CALCulate<1	2>:THReshold:STATe	ON	OFF	
	FSE	CALCulate<1|2>:TLINe<1|2>	0 to 1000s	not available on the ESU; replaced by CALC: SLIMits:LEFT and CALC:SLIMits:RIGHt
	FSE	CALCulate<1	2>:TLINe<1	2>:STATe	ON	OFF	not available on the ESU; replaced by CALC: SLIMits:LEFT and CALC:SLIMits:RIGHt
	FSE	CALCulate<1	2>:UNIT:ANGLe	DEG	RAD	not available for ESU
ESU		CALCulate<1	2>:UNIT:POWer	DBM	V	A	W	DBPW	WATT	DBUV	DBMV	VOLT	DBUA	AMPere	available units are compatible to the FSE
	FSET/ ESI	CALCulate<1|2>:UNIT:POWer	DBM	V	W	DB	PCT	UNITLESS	DBPW	WATT	DBUV	DBMV	VOLT	DBUA	AMPere	DBPT	DBUV_MHZ	DBMV_MHZ	DBUA_MHZ	DBUV_M	DBUA_M	DBUV_MMHZ	DBUA_MMHZ	the ESU supports the following units:DBM	V| A| W	DBPW	WATT	DBUV	DBMV	VOLT	DBUA	AMPere
	FSE/ FSIQ	CALCulate<1|2>:UNIT:POWer	DBM	V	W	DB	PCT	UNITLESS	DBPW	WATT	DBUV	DBMV	VOLT	DBUA	AMPere	DBUV_MHZ	DBMV_MHZ	DBUA_MHZ	DBUV_M	DBUA_M	DBUV_MMHZ	DBUA_MMHZ	the ESU supports the following units:DBM	V| A| W	DBPW	WATT	DBUV	DBMV	VOLT	DBUA	AMPere
	FSE	CALCulate<1	2>:X:UNIT:TIME	S	SYM	not available for ESU
ESU		CALibration:ABORt		new function for ESU
	FSE	CALibration:BANDwidth	BWIDth[:RESolution]?		not available for ESU
	FSE	CALibration:IQ?		not available for ESU

Devices		Command *(Sheet 14 of 41)*	Parameter	Notes
	FSE	CALibration:LDETector?		not available for ESU
	FSE	CALibration:LOSuppression?		not available for ESU
	FSE	CALibration:PPEak?		not available for ESU
	ESI	CALibration:PRESelector?		not available for ESU
		CALibration:RESult?		new function for ESU
	FSE	CALibration:SHORt?		not available for ESU
ESU	FSE	CALibration:STATe	ON | OFF	
ESU	FSE	CALibration[:ALL]?		
	FSE	CONFigure:BURSt:PFERror:COUNt	1 to 1000	not available for ESU and FSET
	FSE	CONFigure:BURSt:PFERror[IMMediate]		not available for ESU and FSET
	FSE	CONFigure:BURSt:POWer:CONDition	NORMal | EXTReme	not available for ESU and FSET
	FSE	CONFigure:BURSt:POWer:COUNt	1 to 1000	not available for ESU and FSET
	FSE	CONFigure:BURSt:POWer[IMMediate]		not available for ESU and FSET
	FSE	CONFigure:BURSt:PTEMplate:[IMMediate]		not available for ESU and FSET
	FSE	CONFigure:BURSt:PTEMplate:COUNt	1 to 1000	not available for ESU and FSET
	FSE	CONFigure:BURSt:PTEMplate:SELect	FULL | TOP | RISing | FALLing	not available for ESU and FSET
	FSE	CONFigure:BURst:REFerence:AUTO	ON | OFF	not available for ESU and FSET
	FSE	CONFigure:SPECtrum:MODulation:COUNt	1 to 1000	not available for ESU and FSET
	FSE	CONFigure:SPECtrum:MODulation:RANGe	ARFCn | TXBand | RXBand | COMBined | DCSRx1800	not available for ESU and FSET
	FSE	CONFigure:SPECtrum:MODulation:TGATe	ON | OFF	not available for ESU and FSET
	FSE	CONFigure:SPECtrum:MODulation[:IMMediate]		not available for ESU and FSET
	FSE	CONFigure:SPECtrum:SWITching:COUNt	1 to 1000	not available for ESU and FSET
	FSE	CONFigure:SPECtrum:SWITching[:IMMediate]		not available for ESU and FSET
	FSE	CONFigure:SPURious:ANTenna	CONDucted | RADiated	not available for ESU and FSET
	FSE	CONFigure:SPURious:COUN:RXBandt	1 to 1000	not available for ESU and FSET

Devices		Command *(Sheet 15 of 41)*	Parameter	Notes
	FSE	CONFigure:SPURious:COUNt	1 to 1000	not available for ESU and FSET
	FSE	CONFigure:SPURious:RANGe	TXBand | OTXBand | RXBand | IDLeband | COMBined	not available for ESU and FSET
	FSE	CONFigure:SPURious:STEP:COUNt?		not available for ESU and FSET
	FSE	CONFigure:SPURious:STEP<1..26>	ON | OFF	not available for ESU and FSET
	FSE	CONFigure:SPURious[:IMMediate]		not available for ESU and FSET
	FSE	CONFigure[:BTS]:ARFCn	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:BTS]:ARFCn:AUTO	ONCE	not available for ESU and FSET
	FSE	CONFigure[:BTS]:CHANnel:SFH	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:BTS]:CHANnel:SLOT	0 to 7	not available for ESU and FSET
	FSE	CONFigure[:BTS]:CHANnel:SLOT:AUTO	ONCE	not available for ESU and FSET
	FSE	CONFigure[:BTS]:CHANnel:TSC	0 to 7	not available for ESU and FSET
	FSE	CONFigure[:BTS]:CHANnel:TSC:AUTO	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:BTS]:COSiting	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:BTS]:LIMIt:FREQency	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:BTS]:LIMIt:PPEak	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:BTS]:LIMIt:PRMS	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:BTS]:LIMit:STANdard	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:BTS]:NETWork:PHASe	1|2[,PLUS]	not available for ESU and FSET
	FSE	CONFigure[:BTS]:NETWork[:TYPE]	PGSM |PGSM900 | EGSM |EGSM900 | DCS |GSM1800 | PCS | GSM1900 | RGSM | RGSM900	not available for ESU and FSET
	FSE	CONFigure[:BTS]:POWer:CLASs	1 to 8 | 1 to 4 | M1 | M2 | M3	not available for ESU and FSET
	FSE	CONFigure[:BTS]:POWer:COUPled	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:BTS]:POWer:DYNamic	0 to 15	not available for ESU and FSET

Devices		Command *(Sheet 16 of 41)*	Parameter	Notes
	FSE	CONFigure[:BTS]:POWer:EXPected	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:BTS]:POWer:LIMit	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:BTS]:POWer:SINGle:CLEar		not available for ESU and FSET
	FSE	CONFigure[:BTS]:POWer:SINGle[:STATe]	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:BTS]:POWer:STATic	0 to 6	not available for ESU and FSET
	FSE	CONFigure[:BTS]:PRESet		not available for ESU and FSET
	FSE	CONFigure[:BTS]:SWEeptime	STANdard | AUTO	not available for ESU and FSET
	FSE	CONFigure[:BTS]:TXSupp	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:BTS]MEASurement?		not available for ESU and FSET
	FSE	CONFigure[:MS]:ARFCn	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:MS]:ARFCn:AUTO	ONCE	not available for ESU and FSET
	FSE	CONFigure[:MS]:CHANnel:SFH	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:MS]:CHANnel:TSC	0 to 7	not available for ESU and FSET
	FSE	CONFigure[:MS]:LIMIt:FREQuency	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:MS]:LIMIt:PPEak	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:MS]:LIMIt:PRMS	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:MS]:LIMit:STANdard	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:MS]:NETWork:PHASe	1|2[,PLUS]	not available for ESU and FSET
	FSE	CONFigure[:MS]:NETWork[:TYPE]	PGSM |PGSM900 | EGSM |EGSM900|DCS |GSM1800 | PCS | GSM1900 | RGSM | RGSM900	not available for ESU and FSET
	FSE	CONFigure[:MS]:POWer:CLASs	<numeric_value>	not available for ESU and FSET
	FSE	CONFigure[:MS]:POWer:COUPled	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:MS]:POWer:EXPected	<numeric_value>	not available for ESU and FSET

Devices		Command *(Sheet 17 of 41)*	Parameter	Notes
	FSE	CONFigure[:MS]:POWer:LEVel	0 to 31	not available for ESU and FSET
	FSE	CONFigure[:MS]:POWer:LIMit	\<numeric_value\>	not available for ESU and FSET
	FSE	CONFigure[:MS]:POWer:SINGle:CLEar		not available for ESU and FSET
	FSE	CONFigure[:MS]:POWer:SINGle[:STATe]	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:MS]:POWer:SMALl	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:MS]:PRESet		not available for ESU and FSET
	FSE	CONFigure[:MS]:SWEeptime	STANdard | AUTO	not available for ESU and FSET
	FSE	CONFigure[:MS]:TXSupp	ON | OFF	not available for ESU and FSET
	FSE	CONFigure[:MS]MEASurement?		not available for ESU and FSET
	FSET	DIAGnostic:INFO:CCOunt:ATTenuation?		not available for ESU
	FSE	DIAGnostic:INFO:CCOunt:ATTenuation<1 | 10>?		not available for ESU
	FSIQ	DIAGnostic:INFO:CCOunt:ATTenuation<1 | 2 | 3>?		not available for ESU
	ESI	DIAGnostic:INFO:CCOunt:ATTenuation<1|2|4>?		not available for ESU
	FSE	DIAGnostic:INFO:CCOunt:PRESelector<1..6>?		not available for ESU
ESU		DIAGnostic:SERVice:CSOurce[:POWer]	\<numeric_value\>	new function for ESU
	FSE	DIAGnostic:SERVice:FUNCtion	\<numeric_value\>, \<numeric_value\> to	not available for ESU. Replaced by DIAG: SERV:SFUNction
	FSET	DIAGnostic:SERVice:HGENerator	OFF | 10 kHz | 100 kHz | BALanced	not available for ESU
ESU		DIAGnostic:SERVice:HWINfo?		new function for ESU
ESU	FSE	DIAGnostic:SERVice:INPut[:SELect]	CALibration | RF	
ESU		DIAGnostic:SERVice:INPut:PULSed[:STATe]	ON | OFF	new command for ESU
ESU		DIAGnostic:SERVice:INPut:PULSed:PRATe	\<numeric_value\>	new command for ESU
ESU	FSE	DIAGnostic:SERVice:NSOurce	ON | OFF	
ESU		DIAGnostic:SERVice:SFUNction	\<string\> to	replacement for DIAG: SERV:FUNC of ESU; necessary due to different parameter formats needed on the ESU
ESU		DIAGnostic:SERVice:STESt:RESult?		new function for ESU
ESU	FSE	DISPlay:ANNotation:FREQuency	ON | OFF	
		DISPlay:BARGraph:LEVel:LOWer		not available for ESU

Devices		Command *(Sheet 18 of 41)*	Parameter	Notes
		DISPlay:BARGraph:LEVel:UPPer		not available for ESU
ESU	FSE	DISPlay:CMAP<1...26>:DEFault<1|2>		larger selection of independently configurable items (1 to 26)
ESU	FSE	DISPlay:CMAP<1...26>:HSL	0 to 1,0 to 1,0 to 1	larger selection of independently configurable items (1 to 26)
ESU	FSE	DISPlay:CMAP<1...26>:PDEFined	<color>	larger selection of independently configurable items (1 to 26)
ESU	FSE	DISPlay:FORmat	SINGle | SPLit	
ESU	FSE	DISPlay:LOGO	ON | OFF	
FSE	FSE	DISPlay:PROGram[:MODE]	ON | OFF	not available for ESU
ESU	FSE	DISPlay:PSAVe:HOLDoff	0 to 60	
ESU	FSE	DISPlay:PSAVe[:STATe]	ON | OFF	
	FSE	DISPlay[:WINDow<1|2>]:FEED	'AF' | 'VIDeo'	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:MINFo	ON | OFF	not available for ESU
ESU		DISPlay[:WINDow<1|2>]:SELect		new function for ESU
ESU		DISPlay[:WINDow<1|2>]:SIZE	LARGe | SMALl	new function for ESU
ESU	FSE	DISPlay[:WINDow<1|2>]:TEXT:STATe	ON | OFF	
ESU	FSE	DISPlay[:WINDow<1|2>]:TEXT[:DATA]	<string>	
ESU	FSE	DISPlay[:WINDow<1|2>]:TIME	ON | OFF	
ESU	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE	WRITe | VIEW | AVERage | MAXHold | MINHold	ESU: 3 traces are available per screen. FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:EYE:COUNt	1 to Result Length	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:ANALog	ON | OFF	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:CWRite	ON | OFF	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:HCONtinuous	ON | OFF	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:SYMBol	DOTS | BARS | OFF	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X:SPACing	LINear | LOGarithmic	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:RVALue	<numeric_value>	not available for ESU

Devices		Command *(Sheet 19 of 41)*	Parameter	Notes
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM	ON | OFF	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM[:FREQuency]:CENTer	<numeric_value>	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM[:FREQuency]:STARt	<numeric_value>	not available for ESU
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM[:FREQuency]:STOP	<numeric_value>	not available for ESU
ESU		DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing	LINear | LOGarithmic | LDB	ESU: TRACe<1...3> LDB is not available for FSE
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SPACing	LINear | LOGarithmic | PERCent	PERCent is not available for ESU FSE: TRACE<1...4>
ESU	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]	10dB to 200dB	ESU: TRACe<1...3> FSE: TRACE<1...4>
	FSET/ ESI	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:BOTTom	<numeric_value>	not available for ESU
ESU	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:MODE	ABSolute | RELative	ESU: TRACe<1...3> FSE: TRACE<1...4>
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:PDIVision		not available for ESU
ESU	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel	-130dBm to 30dBm	ESU: TRACe<1...3> FSE: TRACE<1...4>
ESU	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet	-200dB to 200dB	ESU: TRACe<1...3> FSE: TRACE<1...4>
ESU	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RPOSition	0 to 100 PCT	ESU: TRACe<1...3> FSE: TRACE<1...4>
ESU	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RVALue	<numeric_value>	ESU: TRACe<1...3> FSE: TRACE<1...4>
	FSE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue:AUTO	ON | OFF	not available for ESU
	FSET/ ESI	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:TOP	<numeric_value>	not available for ESU
ESU		DISPlay[:WINDow<1|2>]:TRACe<1...3>[:STATe]	ON | OFF	ESU: TRACe<1...3> FSE: TRACE<1...4>
	FSE	FETCh:BURSt:FERRor:AVERage?		not available for ESU and FSET
	FSE	FETCh:BURSt:FERRor:MAXimum?		not available for ESU and FSET
	FSE	FETCh:BURSt:FERRor:STATus?		not available for ESU and FSET

Devices		Command *(Sheet 20 of 41)*	Parameter	Notes
	FSE	FETCh:BURSt:PERRor:PEAK:AVERage?		not available for ESU and FSET
	FSE	FETCh:BURSt:PERRor:PEAK:MAXimum?		not available for ESU and FSET
	FSE	FETCh:BURSt:PERRor:PEAK:STATus?		not available for ESU and FSET
	FSE	FETCh:BURSt:PERRor:RMS:AVERage?		not available for ESU and FSET
	FSE	FETCh:BURSt:PERRor:RMS:MAXimum?		not available for ESU and FSET
	FSE	FETCh:BURSt:PERRor:RMS:STATus?		not available for ESU and FSET
	FSE	FETCh:BURSt:POWer[:IMMediate]?		not available for ESU and FSET
	FSE	FETCh:MODulation[:ALL]?	ARFCn | TXBand | RXBand |COMBined | DCSRx1800	not available for ESU and FSET
	FSE	FETCh:PTEMplate:REFerence?	TXBand	not available for ESU and FSET
	FSE	FETCh:SPECtrum:MODulation:REFerence?	TXBand	not available for ESU and FSET
	FSE	FETCh:SPECtrum:SWITching:REFerence?	TXBand	not available for ESU and FSET
	FSE	FETCh:SPECtrum:SWITching[:ALL]?		not available for ESU and FSET
	FSE	FETCh:SPURious:STEP?		not available for ESU and FSET
	FSE	FETCh:SPURious[:ALL]?	TXBand OTXBand | RXBand | IDLeband	not available for ESU and FSET
	FSE	FORMat:DEXPort:APPend[:STATe] ON|OFF[,32]		not available for ESU
ESU	FSE	FORMat:DEXPort:DSEParator	POINt|COMMa	
	FSE	FORMat:DEXPort:HEADer[:STATe] ON|OFF[,32]		not available for ESU
ESU		FORMat[:DATA]	ASCii | REAL[,32]	
	FSE	FORMat[:DATA]	ASCii | REAL | UINT [,32]	UINT is not available for ESU
ESU	FSE	HCOPy:ABORt		
ESU		HCOPy:CMAP:DEFault		new function for ESU
ESU		HCOPy:CMAP:HSL	<numeric_value>, <numeric_value>, <numeric_value>	new function for ESU
ESU		HCOPy:CMAP:PDEFined	<char data>	new function for ESU
ESU		HCOPy:DESTination<1|2>	'MMEM' | 'SYST:COMM: PRIN' | 'SYST:COMM: CLIP'	

Devices		Command *(Sheet 21 of 41)*	Parameter	Notes
	FSE/ FSET	HCOPy:DESTination<1|2>	'SYST:COMM:GPIB' | 'SYST:COMM:SER1' | 'SYST:COMM:SER2' | 'SYST:COMM:CENT' | 'MMEM' | 'SYST:COMM: PRIN' | 'SYST:COMM: CLIP'	SYST:COMM:GPIB/ SER1/SER2 is not available for ESU
	FSIQ/ ESI	HCOPy:DESTination<1|2>	'MMEM' | 'SYST:COMM: PRIN' | 'SYST:COMM: CLIP'	
ESU	FSE	HCOPy:DEVice:COLor	ON | OFF	
ESU		HCOPy:DEVice:LANGuage<1|2>	GDI | WMF | EWMF | BMP	
	FSE/ FSET	HCOPy:DEVice:LANGuage<1|2>	HPGL | PCL4 | PCL5 | POSTscript | ESCP | WMF | PCX | HP7470 to	
	FSIQ/ ESI	HCOPy:DEVice:LANGuage<1|2>	WMF | GDI | EWMF | BMP to	
	FSE/ FSET	HCOPy:DEVice:PRESet<1|2>	ON | OFF	not available for ESU
	FSE/ FSET	HCOPy:DEVice:RESolution<1|2>	150 | 300	not available for ESU
ESU	FSE	HCOPy:ITEM:ALL		
	FSE	HCOPy:ITEM:FFEed<1|2>:STATe	ON | OFF	not available for ESU
	FSE	HCOPy:ITEM:LABel:TEXT	<string>	not available for ESU
	FSE	HCOPy:ITEM:PFEed<1|2>:STATe	ON | OFF	not available for ESU
ESU	FSE	HCOPy:ITEM:WINDow<1|2>:TABle:STATe	ON | OFF	
ESU	FSE	HCOPy:ITEM:WINDow<1|2>:TEXT	<string>	
	FSE	HCOPy:ITEM:WINDow<1|2>:TRACe: CAINcrement	ON | OFF	not available for ESU
ESU	FSE	HCOPy:ITEM:WINDow<1|2>:TRACe:STATe	ON | OFF	
	FSE	HCOPy:PAGE:DIMensions:FULL		not available for ESU
	FSE	HCOPy:PAGE:DIMensions:QUADrant<1...4>		not available for ESU
ESU	FSE	HCOPy:PAGE:ORIentation<1|2>	LANDscape | PORTrait	
ESU	FSE	HCOPy[:IMMediate]		
	FSET/ ESI	HOLD		not available for ESU
ESU	FSE	INITiate<1|2>:CONMeas	ON | OFF	
ESU	FSE	INITiate<1|2>:CONTinuous	ON | OFF	
ESU	FSE	INITiate<1|2>:DISPlay	ON | OFF	
ESU	FSE	INITiate<1|2>[:IMMediate]		
	FSET	INPut:PRESelection:CATalog?		not available for ESU

Devices		Command *(Sheet 22 of 41)*	Parameter	Notes
	FSET	INPut:PRESelection:USET:NAME	'name of user defined preselector set (to edit existing set or to create new set)'	not available for ESU
	FSET	INPut:PRESelection:USET:CLEar		not available for ESU
	FSET	INPut:PRESelection:USET:COMMent	'comment for preselector-set'	not available for ESU
	FSET	INPut:PRESelection:USET:LRANge[:DATA]	<numeric_value>, <numeric_value>, <numeric_value>	not available for ESU
	FSET	INPut:PRESelection:USET:MRANge[:DATA]	<numeric_value>, <numeric_value>, <numeric_value>	not available for ESU
ESU	FSE	INPut<1|2>:ATTenuation	0 to 70dB	
	FSET	INPut<1	2>:ATTenuation	0 to 70	80dB	80 dB not available for ESU
ESU	FSE	INPut<1	2>:ATTenuation:AUTO	ON	OFF	
FSP	FSE	INPut<1	2>:ATTenuation:AUTO:MODE	NORMal	LNOise	LDIStorsion	not available for models 3 and 7; not available for ESU
	FSET/ ESI	INPut<1	2>:ATTenuation:PROTection	ON	OFF	not available for ESU
ESU		INPut<1|2>:ATTenuation:PROTection:PRESet		new function for ESU
	FSET	INPut<1	2>:ATTenuation:STEPsize	1dB	10dB	not available for ESU
	FSET	INPut<1	2>:BIMPedance	150OHM	600OHM	10kOHM	not available for ESU
	FSET	INPut<1	2>:COUPling	AC	DC	only available for ESU models 3, 8, 26
		INPut<1|2>:EATT	0 to 30dB	new function for ESU
		INPut<1	2>:EATT:AUTO	ON	OFF	new function for ESU
		INPut<1	2>:EATT:STATe	ON	OFF	new function for ESU
	FSET	INPut<1|2>:GAIN	0 to 30dB	not available for ESU
	FSET/ ESI	INPut<1	2>:GAIN:AUTO	ON	OFF	not available for ESU
ESU	FSE	INPut<1	2>:GAIN:STATe	ON	OFF	
ESU	FSE	INPut<1	2>:IMPedance	50	75	
	FSE	INPut<1	2>:IMPedance:CORRection	RAM	RAZ	not available for ESU
	FSET	INPut<1	2>:LISN:PEARth	GROunded	FLOating	not available for ESU
	FSET	INPut<1|2>:LISN:PHASe	L1	L2	L3	N	not available for ESU
	FSET	INPut<1	2>:LISN[:TYPE]	TWOphase	FOURphase	OFF	not available for ESU
ESU	FSE	INPut<1|2>:MIXer	<numeric_value>	not available for ESU
		INPut<1	2>:MIXer[:POWer]:AUTO	ON	OFF	new function for ESU

Devices		Command *(Sheet 23 of 41)*	Parameter	Notes
	FSET	INPut<1|2>:PRESelection:COUPling	ON | OFF	not available for ESU
	FSET	INPut<1|2>:PRESelection:COUPling:HIGH: FREQuency	5MHz to 500MHz	not available for ESU
	FSET	INPut<1|2>:PRESelection:COUPling:HIGH:SET	'name of preselector set for high RBW'	not available for ESU
	FSET	INPut<1|2>:PRESelection:COUPling:LOW: FREQuency	10Hz to 5MHz	not available for ESU
	FSET	INPut<1|2>:PRESelection:COUPling:LOW:SET	'name of preselector set for low RBW'	not available for ESU
	FSET	INPut<1|2>:PRESelection:COUPling:MID:SET	'name of preselector set for medium RBW'	not available for ESU
	FSET	INPut<1|2>:PRESelection:FILTer:HPASS[: FREQuency]	100Hz to 5MHz	not available for ESU
	FSET	INPut<1|2>:PRESelection:FILTer:LPASS[: FREQuency]	20KHz to 40MHz	not available for ESU
	FSET	INPut<1|2>:PRESelection:FILTer[:STATe]	ON | OFF	not available for ESU
	FSET	INPut<1|2>:PRESelection:SET	NARRow | NORMal | WIDE	not available for ESU
	FSET	INPut<1|2>:PRESelection:USET[:SELect]	'name of user defined preselector set'	not available for ESU
	FSET	INPut<1|2>:PRESelection[:STATe]	ON | OFF	not available for ESU
	FSET	INPut<1|2>:TYPE	RF | BALanced	not available for ESU
	ESI	INPut<1|2>:TYPE	INPUT1 | INPUT2	not available for ESU
	FSE	INPut<1|2>:UPORt<1|2>:STATe	ON | OFF	not available for ESU
	FSE	INPut<1|2>:UPORt<1|2>[:VALue]?		not available for ESU
	ESI	INPut2:COUPling	AC | DC	not available for ESU
		INSTrument:COUPle	NONE | RLEVel | CF_B | CF_A	available coupling modes between Screen A and Screen B have been changed between FSE and ESU
	FSE	INSTrument:COUPle	NONE | MODE | X | Y | CONTrol | XY | XCONtrol | YCONtrol | ALL	Available coupling modes between screen A and screen B have been changed between FSE and ESU
		INSTrument<1|2>:NSELect	1	currently only parameter value 1 available
	ESI	INSTrument<1|2>:NSELect	1 to 3 | 6	4 parameter values are available
	FSE/ FSIQ	INSTrument<1|2>:NSELect	1 to 5	5 parameter values are available
	FSET	INSTrument<1|2>:NSELect	1 | 2 | 6	3 parameter values are available
		INSTrument<1|2>[:SELect]	SANalyzer	Currently only SANalyzer available

Devices		Command *(Sheet 24 of 41)*	Parameter	Notes
	FSE/ FSIQ	INSTrument<1|2>[:SELect]	SANalyzer | DDEMod | ADEMod | BGSM | MGSM	5 parameters are available.
	ESI	INSTrument<1|2>[:SELect]	RECeiver | SANalyzer | DDEMod | ADEMod	4 parameters are available.
	FSET	INSTrument<1|2>[:SELect]	ANalyzer | DDEMod | RECeiver	3 parameters are available.
ESU	FSE	MMEMory:CATalog?	string	
ESU	FSE	MMEMory:CDIRectory	directory name	
ESU	FSE	MMEMory:CLear:ALL		
ESU	FSE	MMEMory:CLear:STATe	1,path	
ESU	FSE	MMEMory:COMMent	<string>	
ESU	FSE	MMEMory:COPY	path\file, path\file	
ESU	FSE	MMEMory:DATA	filename[, <block data>]	
ESU	FSE	MMEMory:DELete	path\filename	
ESU	FSE	MMEMory:LOAD:AUTO	1,path	
ESU	FSE	MMEMory:LOAD:STATe	1,path	
ESU	FSE	MMEMory:MDIRectory	path	
ESU	FSE	MMEMory:MOVE	path	
ESU	FSE	MMEMory:MSIS	'F:' | 'D:'	ESU: valid drives are F: and D: FSE: valid drives are A: and C:
ESU	FSE	MMEMory:NAME	path\filename	
ESU	FSE	MMEMory:RDIRectory	directory	
ESU	FSE	MMEMory:SELect[:ITEM]:ALL		
	FSE	MMEMory:SELect[:ITEM]:CSETup	ON | OFF	not available for ESU (default setting on the ESU)
	FSE	MMEMory:SELect[:ITEM]:CVL:ALL	ON | OFF	not available for ESU and FSET
	FSE	MMEMory:SELect[:ITEM]:CVL[:ACTive]	ON | OFF	not available for ESU and FSET
ESU	FSE	MMEMory:SELect[:ITEM]:DEFault		
	FSE	MMEMory:SELect[:ITEM]:GSETup	ON | OFF	not available for ESU (default setting on the ESU)
	FSE	MMEMory:SELect[:ITEM]:HCOPy	ON | OFF	not available for ESU (default setting on the ESU)
ESU	FSE	MMEMory:SELect[:ITEM]:HWSettings	ON | OFF	
ESU	FSE	MMEMory:SELect[:ITEM]:LINes:ALL	ON | OFF	

Devices		Command *(Sheet 25 of 41)*	Parameter	Notes
	FSE	MMEMory:SELect[:ITEM]:LINes:ALL	ON | OFF	
	FSE	MMEMory:SELect[:ITEM]:LINes[:ACTive]	ON | OFF	not available for ESU (default setting on the ESU)
	FSE	MMEMory:SELect[:ITEM]:MACRos	ON | OFF	not available for ESU
ESU	FSE	MMEMory:SELect[:ITEM]:NONE		
ESU	FSE	MMEMory:SELect[:ITEM]:SCData	ON | OFF	
		MMEMory:SELect[:ITEM]:TRACe[:ACTive]	ON | OFF	no numeric suffixes behind TRACe
	FSE	MMEMory:SELect[:ITEM]:TRACe<1...4>	ON | OFF	numeric suffixes behind TRACe
	FSE	MMEMory:SELect[:ITEM]:TRANsducer:ALL	ON | OFF	not available for ESU
	FSE	MMEMory:SELect[:ITEM]:TRANsducer[:ACTive]	ON | OFF	not available for ESU
ESU	FSE	MMEMory:STORe:STATe	1,path	
ESU	FSE	MMEMory:STORe:TRACe	1 to 3,path	
	FSE	OUTPut:AF:SENSitivity	<numeric_value>	not available for ESU and FSET
	FSE	OUTPut:UPORt<1|2>:STATe	ON | OFF	not available for ESU
	FSE	OUTPut:UPORt<1|2>[:VALue]	#B00000000 to #B11111111	not available for ESU
ESU	FSE	OUTPut<1|2>[:STATe]	ON | OFF	
	FSE	READ:BURSt:FERRor:AVERage?		not available for ESU and FSET
	FSE	READ:BURSt:FERRor:MAXimum?		not available for ESU and FSET
	FSE	READ:BURSt:FERRor:STATus?		not available for ESU and FSET
	FSE	READ:BURSt:PERRor:PEAK:AVERage?		not available for ESU and FSET
	FSE	READ:BURSt:PERRor:PEAK:MAXimum?		not available for ESU and FSET
	FSE	READ:BURSt:PERRor:PEAK:STATus?		not available for ESU and FSET
	FSE	READ:BURSt:PERRor:RMS:AVERage?		not available for ESU and FSET
	FSE	READ:BURSt:PERRor:RMS:MAXimum?		not available for ESU and FSET
	FSE	READ:BURSt:PERRor:RMS:STATus?		not available for ESU and FSET
	FSE	READ:BURSt:POWer:DYNamic?		not available for ESU and FSET
	FSE	READ:BURSt:POWer:LEVel?		not available for ESU and FSET

Devices		Command *(Sheet 26 of 41)*	Parameter	Notes
	FSE	READ:BURSt:POWer:STATic?		not available for ESU and FSET
	FSE	READ:BURSt:POWer?		not available for ESU and FSET
	FSE	READ:BURSt:REFerence[:IMMediate?]		not available for ESU and FSET
	FSE	READ:SPECtrum:MODulation[:ALL]?		not available for ESU and FSET
	FSE	READ:SPECtrum:SWITching[:ALL]?		not available for ESU and FSET
	FSE	READ:SPURious:STEP?		not available for ESU and FSET
	FSE	READ:SPURious[:ALL]?		not available for ESU and FSET
	FSE	[SENSe<1|2>:]ADEMod:AF:COUPling	AC | DC	not available for ESU and FSET
	FSE	[SENSe<1|2>:]ADEMod:RTIMe	ON | OFF	not available for ESU and FSET
	FSE	[SENSe<1|2>:]ADEMod:SBANd	NORMal | INVerse	not available for ESU and FSET
	FSE	[SENSe<1|2>:]ADEMod:SQUelch:LEVel	30 to 150 dBm	not available for ESU and FSET
	FSE	[SENSe<1|2>:]ADEMod:SQUelch[:STATe]	ON | OFF	not available for ESU and FSET
	FSET	[SENSe<1|2>:]AM:RANGe[:UPPer]	3PCT | 10 PCT | 100PCT	not available for ESU
	FSE	[SENSe<1|2>:]AVERage:AUTO	ON | OFF	not available for ESU
ESU	FSE	[SENSe<1|2>:]AVERage:COUNt	0 to 32767	
	FSE	[SENSe<1|2>:]AVERage:COUNt	0 to 32767	
ESU		[SENSe<1|2>:]AVERage:TYPE	VIDeo | LINear	command is used to select logarithmic or linear averaging on the ESU; therefore parameters are incompatible to the FSE
	FSE	[SENSe<1|2>:]AVERage:TYPE	MAXimum | MINimum | SCALar	command is used to select logarithmic or linear averaging on the ESU; therefore parameters are incompatible to the FSE
ESU	FSE	[SENSe<1|2>:]AVERage[:STATe<1...3>]	ON | OFF	
	FSE	[SENSe<1|2>:]BANDwidth|BWIDth:DEMod	<numeric_value>	not available for ESU and FSET
	FSE	[SENSe<1|2>:]BANDwidth|BWIDth:PLL	AUTO | HIGH | MEDium | LOW	not available for ESU

Devices		Command *(Sheet 27 of 41)*	Parameter	Notes
ESU		[SENSe<1|2>:]BANDwidth|BWIDth:PLL	AUTO | HIGH | MEDium | NARRow	new function for ESU
ESU	FSE	[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo	1Hz to 10MHz	
	FSET	[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo	1Hz to 500MHz	
ESU	FSE	[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO	ON | OFF	
	FSET	[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo: EXTernal[:STATe]	ON | OFF	not available for ESU
ESU		[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio	0.0001 to 1	only numeric values available. Parameter ranges differ between ESU and FSE
	FSE	[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio	0.001 to 1000 | SINe | PULSe | NOISe	also text parameters are available. Parameter ranges differ between ESU and FSE

not available for FSET |
ESU	FSE	[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]	10Hz to 10MHz (anal. filter) 1Hz to 10MHz (FFT filter)	FSE: 10Hz to 10MHz (models 20) 1Hz to 10MHz (models 30)
	FSET	[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]	10 Hz to 500MHz	
ESU	FSE	[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]: AUTO	ON | OFF	
	FSE	[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]: MODE	ANALog | DIGital	not available for ESU and FSET
ESU	FSE	[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]: MODE:FFT	ON | OFF	old command that is still supported, but has been replaced on the ESU by [SENSe<1|2>:]BANDwidth|BWIDth[: RESolution]:TYPE
ESU	FSE	[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]: RATio	0.0001 to 1	
ESU		[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]: TYPE	NORMal | FFT | CFILter | RRC	new function for ESU
ESU		[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:TYPE	LINear | LOGarithmic	new function for ESU
ESU	FSE	[SENSe<1|2>:]CORRection:COLLect[:ACQuire]	THRough | OPEN	
	FSE	[SENSe<1|2>:]CORRection:CVL:BAND	A|Q|U|V|E|W|F|D|G|Y|J	not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:BIAS	<numeric_value>	not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:CATalog?		not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:CLEar		not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:COMMent	<string>	not available for ESU and FSET

Devices		Command *(Sheet 28 of 41)*	Parameter	Notes
	FSE	[SENSe<1|2>:]CORRection:CVL:DATA	<freq>,<level> to	not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:MIXer	<string>	not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:PORTs	2 | 3	not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:SELect	<file_name>	not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:SNUMber	<string>	not available for ESU and FSET
	FSE	[SENSe<1|2>:]CORRection:CVL:TYPE	ODD | EVEN | EODD	not available for ESU and FSET
	FSE/ FSIQ	[SENSe<1|2>:]CORRection:LOSS:INPut[: MAGNitude]	<numeric_value>	not available for ESU
ESU	FSE	[SENSe<1|2>:]CORRection:METHod	TRANsmission | REFLexion	
ESU	FSE	[SENSe<1|2>:]CORRection:RECall		
	FSE	[SENSe<1|2>:]CORRection:RXGain:INPut[: MAGNitude]	<numeric_value>	not available for ESU, FSET and ESI
ESU	FSE	[SENSe<1|2>:]CORRection[:STATe]	ON | OFF	
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer: ACTive?		
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer: CATalog?		
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer: COMMent	<string>	
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer:DATA	<freq>,<level> to	
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer:DELete		
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer: SCALing	LINear|LOGarithmic	
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer:SELect	<name>	
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer:UNIT	<string>	
ESU	FSE	[SENSe<1|2>:]CORRection:TRANsducer[:STATe]	ON | OFF	
	FSE	[SENSe<1|2>:]CORRection:TSET:ACTive?		not available for ESU
	FSE	[SENSe<1|2>:]CORRection:TSET:BREak	ON | OFF	not available for ESU
	FSE	[SENSe<1|2>:]CORRection:TSET:CATalog?		not available for ESU
	FSE	[SENSe<1|2>:]CORRection:TSET:COMMent	<string>	not available for ESU
	FSE	[SENSe<1|2>:]CORRection:TSET:DELete		not available for ESU
	FSE	[SENSe<1|2>:]CORRection:TSET: RANGe<1...10>	<freq>,<freq>,<name> to	not available for ESU
	FSE	[SENSe<1|2>:]CORRection:TSET:SELect	<name>	not available for ESU
	FSE	[SENSe<1|2>:]CORRection:TSET:UNIT	<string>	not available for ESU

Devices		Command *(Sheet 29 of 41)*	Parameter	Notes
	FSE	[SENSe<1|2>:]CORRection:TSET[:STATe]	ON | OFF	not available for ESU
ESU	FSE	[SENSe<1|2>:]CORRection:YIG:TEMPerature:AUTO	ON | OFF	new function for ESU
	FSE	[SENSe<1|2>:]DDEMod:FILTer:ALPHa	0.2 to 1	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:FILTer:MEASurement	OFF | RCOSine | RRCosine | GAUSsian | B22 | B25 | B44 | QFM | QFR | QRM | QRR | A25Fm | EMES | EREF	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:FILTer:REFerence	RCOSine | RRCosine | GAUSsian | B22 | B25 | B44 | QFM | QFR | QRM | QRR | A25Fm | EMES | EREF	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:FORMat	QPSK | PSK | MSK |QAM | FSK	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:FSK:NSTate	2 | 4	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:MSK:FORMat	TYPE1 | TYPE2 | NORMal | DIFFerential	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:NORMalize	ON | OFF	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:PRATe	1 | 2 | 4 | 8 | 16	not available for ESU
	FSE/ ESI	[SENSe<1|2>:]DDEMod:PRESet	GSM | EDGe | NADC | TETRa | DCS1800 | PCS1900 | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FQCDma | RQCDma | FNADc | RNADc | BPSK18 | GMSK18 | QPSK18 | GMSK36	not available for ESU
	FSIQ	[SENSe<1|2>:]DDEMod:PRESet	GSM | EDGe | NADC | TETRa | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FWCDma | RWCDma | FW3Gppcdma | RW3Gppcdma | BPSK18 | GMSK18 | QPSK18 | GMSK36	not available for ESU

Devices		Command *(Sheet 30 of 41)*	Parameter	Notes
	FSET	[SENSe<1|2>:]DDEMod:PRESet	GSM | EDGe | NADC | TETRa | DCS1800 | PCS1900 | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FQCDma | RQCDma | FNADc | RNADc | BPSK18 | GMSK18 | QPSK18 | GMSK36	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:PSK:FORMat	NORMal | DIFFerential | N3Pi8	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:PSK:NSTate	2 | 8	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:QAM:NSTate	16	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:QPSK:FORMat	NORMal | DIFFerential | OFFSet | DPI4	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SBANd	NORMal | INVerse	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:PULSe:STATe	ON | OFF	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC: CATalog?		not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC: COMMent	<string>	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:DATA	<string>	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:NAME	<string>	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:OFFSet	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:PATTern	<string>	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:SELect	<string>	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:STATe	ON | OFF	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SEARch:TIME	100 to 1600	not available for ESU
	FSE	[SENSe<1|2>:]DDEMod:SRATe	160 Hz to 1,6 MHz	not available for ESU
	FSIQ	[SENSe<1|2>:]DDEMod:SRATe	160 Hz to 7 MHz	not available for ESU
		[SENSe<1|2>:]DDEMod:TIME	1 to Frame Length	not available for ESU
	FSET	[SENSe<1|2>:]DEMod	OFF | AM | AMVideo | FM | PM	not available for ESU
	ESI	[SENSe<1|2>:]DEMod	OFF | AM | FM	not available for ESU
	FSET	[SENSe<1|2>:]DEMod:FILTer:HPASs: FREQuency	0 Hz | 10 Hz | 100 Hz | 1 kHZ	not available for ESU
	FSET	[SENSe<1|2>:]DEMod:FILTer[:LPASs]:AUTO	ON | OFF	not available for ESU
	FSET	[SENSe<1|2>:]DEMod:FILTer[:LPASs]: FREQuency	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]DETector<1...4>:CMEM[:STATe]	ON | OFF	not available for ESU

Devices		Command *(Sheet 31 of 41)*	Parameter	Notes
ESU		[SENSe<1|2>:]DETector<1...3>[:FUNCtion]	APEak |NEGative | POSitive | SAMPle | RMS | AVERage | QPEak	ESU: number of traces restricted to 3; detector settings correspond to selected screen FSE: Qpeak not available
	ESI	[SENSe<1|2>:]DETector<1..4>[:FUNCtion]	APEak |NEGative | POSitive | SAMPle | RMS | AVERage | QPEak	
ESU	FSE	[SENSe<1|2>:]DETector<1...3>[:FUNCtion]:AUTO	ON | OFF	number of traces restricted to 3
	FSET	[SENSe<1|2>:]DETector<1...4>:PSTRetch:AUTO	ON | OFF	not available for ESU
	FSET	[SENSe<1|2>:]DETecto<1...4>r:PSTRetch[:STATe]	ON | OFF	not available for ESU
	ESI	[SENSe<1|2>:]DETector<1...4>:RECeiver[:FUNCtion]	POSitive |NEGative| RMS | AVERage | QPEak	not available for ESU
	FSET	[SENSe<1|2>:]DETector<1...4>:RECeiver[:FUNCtion]	POSitive | NEGative | RMS | AVERage	not available for ESU
	FSE	[SENSe<1|2>:]FILTer:CCITt[:STATe]	ON | OFF	not available for ESU and FSET
	FSE	[SENSe<1|2>:]FILTer:CMESsage[:STATe]	ON | OFF	not available for ESU and FSET
	FSE	[SENSe<1|2>:]FILTer:DEMPhasis:LINK	DISPlay | AUDio	not available for ESU and FSET
	FSE	[SENSe<1|2>:]FILTer:DEMPhasis:TCONstant	<numeric_value>	not available for ESU and FSET
	FSE	[SENSe<1|2>:]FILTer:DEMPhasis[:STATe]	ON | OFF	not available for ESU and FSET
	FSE	[SENSe<1|2>:]FILTer:HPASs:FREQuency	30 Hz | 300 HZ	not available for ESU and FSET
	FSET	[SENSe<1|2>:]FILTer:HPASs:FREQuency	10 kHz | 1 kHz | 100 Hz	not available for ESU
	FSE	[SENSe<1|2>:]FILTer:HPASs[:STATe]	ON | OFF	not available for ESU
	FSE	[SENSe<1|2>:]FILTer:LPASs:FREQuency	3 kHz| 15 kHz	not available for ESU and FSET
	FSE	[SENSe<1|2>:]FILTer:LPASs[:STATe]	ON | OFF	not available for ESU and FSET
	FSET	[SENSe<1|2>:]FILTer:NOTCh[:STATe]	ON | OFF	not available for ESU
	FSET	[SENSe<1|2>:]FM[:DEViation]:RANGe:UPPer	ON | OFF	not available for ESU
	FSET	[SENSe<1|2>:]FM[:DEViation]:RANGe[:UPPer]	<numeric_value>	not available for ESU
ESU	FSE	[SENSe<1|2>:]FREQuency:CENTer	0 to f_{max}	frequency ranges are different for ESU and FSE
	FSE	[SENSe<1|2>:]FREQuency:CENTer:LINK	STARt | STOP | SPAN	not available for ESU

Devices		Command *(Sheet 32 of 41)*	Parameter	Notes
ESU	FSE	[SENSe<1|2>:]FREQuency:CENTer:STEP	0 to f_{max}	frequency ranges are different for ESU and FSE
ESU	FSE	[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK	SPAN | RBW | OFF	
ESU	FSE	[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor	1 to 100 PCT	
ESU	FSE	[SENSe<1|2>:]FREQuency:MODE	CW|FIXed | SWEep	
ESU	FSE	[SENSe<1|2>:]FREQuency:OFFSet	<numeric_value>	
	FSET	[SENSe<1|2>:]FREQuency:RANGe	2 GHz | 22 GHz	not available for ESU
ESU	FSE	[SENSe<1|2>:]FREQuency:SPAN	0 to f_{max}	frequency ranges are different for ESU and FSE
ESU	FSE	[SENSe<1|2>:]FREQuency:SPAN:FULL		
	FSE	[SENSe<1|2>:]FREQuency:SPAN:LINK	CENTer | STOP | SPAN	not available for ESU
ESU	FSE	[SENSe<1|2>:]FREQuency:STARt	0 to f_{max}	frequency ranges are different for ESU and FSE
	FSET	[SENSe<1|2>:]FREQuency:STARt:FLINe[:STATe]	ON | OFF	not available for ESU. Replaced by CALC:MARK:FUNC:SLIMits
	FSE	[SENSe<1|2>:]FREQuency:STARt:LINK	CENTer | STOP | SPAN	not available for ESU
ESU	FSE	[SENSe<1|2>:]FREQuency:STOP	0 to f_{max}	frequency ranges are different for ESU and FSE
	FSET	[SENSe<1|2>:]FREQuency:STOP:FLINe[:STATe]	ON | OFF	not available for ESU; replaced by CALC:MARK:FUNC:SLIMits.
	FSE	[SENSe<1|2>:]FREQuency:STOP:LINK	CENTer | STARt | SPAN	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]FREQuency[:CW|:FIXed]	f_{min} to f_{max}	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]FREQuency[:CW|:FIXed]:STEP	f_{min} to f_{max}	not available for ESU
ESU		[SENSe<1|2>:]LIST:POWer:RESult?		new function for ESU
ESU		[SENSe<1|2>:]LIST:POWer[:SEQuence]	<analyzer freq>, <ref level>, <rf att>, <el att>, <filter type>, <rbw>, <vbw>, <meas time>, <trigger level>,...	new function for ESU
ESU		[SENSe<1|2>:]LIST:POWer:SET	<PEAK meas>, <RMS meas>, <AVG meas>, <trigger mode>, <trigger slope>, <trigger offset>, <gate length>	new function for ESU

Devices		Command *(Sheet 33 of 41)*	Parameter	Notes
ESU	ESU	[SENSe<1|2>:]LIST:POWer:STATe	ON | OFF	new function for ESU
	FSE	[SENSe<1|2>:]MIXer:BIAS	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:BIAS:LIMit:MIN	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:BIAS:LIMit[:MAX]	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:BLOCk	ON | OFF	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:HARMonic	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:HARMonic:BAND	A | Q | U | V | E | W | F | D | G | Y | J	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:HARMonic:TYPE	ODD | EVEN | EODD	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:LOSS:HIGH	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:LOSS:TABLE	<file_name>	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:LOSS[:LOW]	<numeric_value>	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:PORTs	2 | 3	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:SIGNal	2 | 3	not available for ESU
	FSE	[SENSe<1|2>:]MIXer:THReshold	0.1 to 100 dB	not available for ESU
	FSE	[SENSe<1|2>:]MIXer[:STATe]	ON | OFF	not available for ESU
ESU		[SENSe<1|2>:]MPOWer[:SEQuence]	<analyzer freq>, <rbw>, <meas time>, <trigger source>, <trigger level>, <trigger offset>, <type of meas>, <# of meas>	new function for ESU
ESU		[SENSe<1|2>:]MPOWer:RESult[:LIST]?		new function for ESU
ESU		[SENSe<1|2>:]MPOWer:RESult:MIN?		new function for ESU
	FSE	[SENSe<1|2>:]MSUMmary:AHOLd[:STATe]	ON | OFF	not available for ESU and FSET
	FSE	[SENSe<1|2>:]MSUMmary:MODE	ABSolute | RELative	not available for ESU and FSET
	FSE	[SENSe<1|2>:]MSUMmary:MTIMe	0.1S | 1S	not available for ESU and FSET
	FSE	[SENSe<1|2>:]MSUMmary:REFerence	<numeric_value>	not available for ESU and FSET
	FSE	[SENSe<1|2>:]MSUMmary:REFerence:AUTO	ONCE	not available for ESU and FSET
	FSE	[SENSe<1|2>:]MSUMmary:RUNit	PCT | DB	not available for ESU and FSET
	FSET	[SENSe<1|2>:]PM[:DEViation]:RANGe[:UPPer]	<numeric_value>	not available for ESU
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:ACPairs	0 to 3	ESU: new parameter value 0 for channel power measurement

Devices		Command *(Sheet 34 of 41)*	Parameter	Notes
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel	100 to 1000MHz	ESU: parameter range starts at 100Hz FSE: parameter range starts at 0 Hz
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2>	100 to 1000MHz	ESU: parameter range starts at 100Hz FSE: parameter range starts at 0 Hz
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]	100 to 1000MHz	ESU: parameter range starts at 100Hz FSE: parameter range starts at 0 Hz
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:MODE	ABSolute | RELative	
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:PRESet	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0 | MCACpower	MCACpower not available for FSE
ESU		[SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel		new function for ESU
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO	ONCE	
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:SPACing[:ACHannel]	100Hz to 2000MHz	different parameter range
ESU		[SENSe<1|2>:]POWer:CHannel:SPACing:CHANnel	100Hz to 2000MHz	new function for ESU
	FSE	[SENSe<1|2>:]POWer:ACHannel:SPACing[:UPPer]	0 to 1000MHz	not available for ESU and FSET
ESU	FSE	[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1|2>	100Hz to 2000MHz	different parameter range
ESU		[SENSe<1|2>:]POWer:ACHannel:TXCHannel:COUNt	1 | 2 | 3 | 4	new function for ESU
ESU		[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:AUTO	MINimum | MAXimum | LHIGhest	new function for ESU
ESU		[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:MANual	1 | 2 | 3 | 4	new function for ESU
ESU	FSE	[SENSe<1|2>:]POWer:BANDwidth|BWIDth	10 to 99.9PCT	different parameter range
ESU		[SENSe<1|2>:]POWer:HSPeed	ON | OFF	new function for ESU
ESU		[SENSe<1|2>:]POWer:NCORrection	ON | OFF	new function for ESU
ESU		[SENSe<1|2>:]POWer:TRACe	1 to 3	new function for ESU
ESU	FSE	[SENSe<1|2>:]ROSCillator:[INTernal:]TUNe	0 to 4095	
ESU	FSE	[SENSe<1|2>:]ROSCillator:[INTernal:]TUNe:SAVe		
	FSE	[SENSe<1|2>:]ROSCillator:EXTernal:FREQuency	1MHz to 16MHz	not available for ESU
ESU	FSE	[SENSe<1|2>:]ROSCillator:SOURce	INTernal | EXTernal	
	FSET/ ESI	[SENSe<1|2>:]SCAN<:RANGes[COUNt]	1 to 10	not available for ESU

Devices		Command *(Sheet 35 of 41)*	Parameter	Notes
	FSE/ ESI	[SENSe<1|2>:]SCAN<1...10>:BANDwidth: RESolution	f_{min} to f_{max}	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:ATTenuation	dB_{min} to dB_{max}	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:ATTenuation: AUTO	ON | OFF	not available for ESU
	FSET	[SENSe<1|2>:]SCAN<1...10>:INPut:BIMPedance	150OHM | 600OHM | 10kOHM	not available for ESU
	FSET	[SENSe<1|2>:]SCAN<1...10>:INPut:GAIN	0dB to 30dB	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:GAIN:AUTO	ON | OFF	not available for ESU
	ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:GAIN:STATe	ON | OFF	not available for ESU
	ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:TYPE	INPUT1 | INPUT2	not available for ESU
	FSET	[SENSe<1|2>:]SCAN<1...10>:INPut:TYPE	RF | BALanced	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:STARt	f_{min} to f_{max}	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:STEP	f_{min} to f_{max}	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:STOP	f_{min} to f_{max}	not available for ESU
	FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:TIME	100 µs to 100 s	not available for ESU
ESU	FSE	[SENSe<1|2>:]SWEep:COUNt	0 to 32767	
ESU	FSE	[SENSe<1|2>:]SWEep:EGATe	ON | OFF	
ESU	FSE	[SENSe<1|2>:]SWEep:EGATe:HOLDoff	0 to 100s	
ESU	FSE	[SENSe<1|2>:]SWEep:EGATe:LENGth	0 to 100s	
	FSE	[SENSe<1|2>:]SWEep:EGATe:LENGth	0 to 100s	
	FSE	[SENSe<1|2>:]SWEep:EGATe:LEVel	-5V to +5V	not availabe for ESU
ESU	FSE	[SENSe<1|2>:]SWEep:EGATe:POLarity	POSitive | NEGative	
ESU	FSE	[SENSe<1|2>:]SWEep:EGATe:SOURce	EXTernal | IFPower | RFPower	
ESU	FSE	[SENSe<1|2>:]SWEep:EGATe:TYPE	LEVel | EDGE	
	FSE	[SENSe<1|2>:]SWEep:GAP	ON | OFF	not available for ESU
	FSE	[SENSe<1|2>:]SWEep:GAP:LENGth	0 to 100s	not available for ESU
	FSE	[SENSe<1|2>:]SWEep:GAP:PRETrigger	0 to 100s	not available for ESU
	FSE	[SENSe<1|2>:]SWEep:GAP:TRGTogap	0 to 100s	not available for ESU
FSP		[SENSe<1|2>:]SWEep:POINts	<numeric_value>	not available for FSE
	FSET/ ESI	[SENSe<1|2>:]SWEep:SPACing	LINear | LOGarithmic | AUTO	not available for ESU
	FSE/ FSIQ	[SENSe<1|2>:]SWEep:SPACing	LINear | LOGarithmic	not available for ESU

Devices		Command *(Sheet 36 of 41)*	Parameter	Notes
ESU	FSE	[SENSe<1|2>:]SWEep:TIME	2.5ms to 1000s | 1µs to 16000s	different parameter ranges for ESU and FSE
ESU	FSE	[SENSe<1|2>:]SWEep:TIME:AUTO	ON | OFF	
	FSE	[SENSe<1|2>:]TCAPture:LENGth	1024 | 2048 | 4096 | 8192 | 16384	not available for ESU
	FSE	[SENSe<1|2>:]TV:PSOFfset	0 to 6.5 MHz	not available for ESU and FSET
ESU		[SENSe<1|2>:]TV:CCVS	INTernal | EXTernal	new function for ESU
ESU	FSE	[SENSe<1|2>:]TV[:STATe]	ON | OFF	
ESU	FSE	SOURce:AM:STATe	ON | OFF	
ESU	FSE	SOURce:DM:STATe	ON | OFF	
ESU		SOURce:EXTernal[:STATe]	ON | OFF	new command for ESU
ESU		SOURce:EXTernal:FREQuency:OFFset	<numeric_value>	new command for ESU
ESU		SOURce:EXTernal:FREQuency[:FACTor]:NUMerator	<numeric_value>	new command for ESU
ESU		SOURce:EXTernal:FREQuency[:FACTor]:DENominator	<numeric_value>	new command for ESU
ESU		SOURce:EXTernal:FREQuency:SWEep[:STATe]	ON | OFF	new command for ESU
ESU		SOURce:EXTernal:POWer[:LEVel]	<numeric_value>	new command for ESU
ESU	FSE	SOURce:FM:STATe	ON | OFF	
ESU	FSE	SOURce:FREQuency:OFFSet	-150Hz to 150MHz	different value ranges for ESU and FSE
	FSE	SOURce:POWer:ALC:SOURce	INTernal | EXTernal	not available for ESU and FSET
ESU	FSE	SOURce:POWer[:LEVel][:IMMediate]:OFFSet	-200dB to +200dB	
ESU	FSE	SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]	-30dBm to 0dBm	different value ranges for ESU and FSE
ESU	FSE	STATus:OPERation:CONDition?		
	FSE	STATus:OPERation:CONDition?		
ESU	FSE	STATus:OPERation:ENABle	0 to 65535	
ESU	FSE	STATus:OPERation:NTRansition	0 to 65535	
ESU	FSE	STATus:OPERation:PTRansition	0 to 65535	
ESU	FSE	STATus:OPERation[:EVENt?]		
ESU	FSE	STATus:PRESet		
ESU	FSE	STATus:QUEStionable:ACPLimit:CONDition?		
ESU	FSE	STATus:QUEStionable:ACPLimit:ENABle	0 to 65535	
ESU	FSE	STATus:QUEStionable:ACPLimit:NTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:ACPLimit:PTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:ACPLimit[:EVENt]?		
ESU	FSE	STATus:QUEStionable:CONDition?		

Devices		Command *(Sheet 37 of 41)*	Parameter	Notes
ESU	FSE	STATus:QUEStionable:ENABle	0 to 65535	
ESU	FSE	STATus:QUEStionable:FREQuency:CONDition?		
ESU	FSE	STATus:QUEStionable:FREQuency:ENABle	0 to 65535	
ESU	FSE	STATus:QUEStionable:FREQuency:NTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:FREQuency:PTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:FREQuency[:EVENt]?		
ESU	FSE	STATus:QUEStionable:LIMit<1|2>:CONDition?		ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LIMit<1|2>:ENABle	0 to 65535	ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LIMit<1|2>:NTRansition	0 to 65535	ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LIMit<1|2>:PTRansition	0 to 65535	ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LIMit<1|2>[:EVENt]?		ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LMARgin<1|2>: CONDition?		ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LMARgin<1|2>:ENABle	0 to 65535	ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LMARgin<1|2>: NTRansition	0 to 65535	ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LMARgin<1|2>: PTRansition	0 to 65535	ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:LMARgin<1|2>[:EVENt]?		ESU: individual registers for screen A and B
ESU	FSE	STATus:QUEStionable:NTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:POWer:CONDition?		
ESU	FSE	STATus:QUEStionable:POWer:ENABle	0 to 65535	
ESU	FSE	STATus:QUEStionable:POWer:NTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:POWer:PTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:POWer[:EVENt]?		
ESU	FSE	STATus:QUEStionable:PTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:SYNC:CONDition?		
ESU	FSE	STATus:QUEStionable:SYNC:ENABle	0 to 65535	
ESU	FSE	STATus:QUEStionable:SYNC:NTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:SYNC:PTRansition	0 to 65535	
ESU	FSE	STATus:QUEStionable:SYNC[:EVENt]?		
	FSE	STATus:QUEStionable:TRANsducer:CONDition?		not available for ESU
	FSE	STATus:QUEStionable:TRANsducer:ENABle	0 to 65535	not available for ESU

Devices		Command *(Sheet 38 of 41)*	Parameter	Notes
	FSE	STATus:QUEStionable:TRANsducer:NTRansition	0 to 65535	not available for ESU
	FSE	STATus:QUEStionable:TRANsducer:PTRansition	0 to 65535	not available for ESU
	FSE	STATus:QUEStionable:TRANsducer[:EVENt]?		not available for ESU
ESU	FSE	STATus:QUEStionable[:EVENt]?		
ESU	FSE	STATus:QUEue[:NEXT?]		
	FSE	SYSTem:BINFo?		not available for ESU
ESU		SYSTem:COMMunicate:GPIB:RDEVice: GENerator<1|2>:ADDRess	0 to 30	new command for ESU
	FSE	SYSTem:COMMunicate:GPIB:RDEVice<1|2>: ADDRess	0 to 30	not available for ESU
ESU	FSE	SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0 to 30	
ESU	FSE	SYSTem:COMMunicate:GPIB[:SELF]: RTERminator	LFEOI | EOI	
ESU	FSE	SYSTem:COMMunicate:PRINter:ENUMerate: FIRSt?		
ESU	FSE	SYSTem:COMMunicate:PRINter:ENUMerate: NEXT?		
ESU		SYSTem:COMMunicate:PRINter:SELect<1|2>	<printer_name>	numeric suffix behind SELect
	FSIQ/ ESI	SYSTem:COMMunicate:PRINter<1|2>:SELect	<printer_name>	numeric suffix behind PRINters
ESU		SYSTem:COMMunicate:RDEVice: GENerator<1|2>:LINK	GPIB | TTL	new function for ESU
ESU		SYSTem:COMMunicate:RDEVice: GENerator<1|2>:TYPE	<name>	new function for ESU
ESU	FSE	SYSTem:COMMunicate:SERial:CONTrol:DTR	IBFull | OFF	only SERial1 available for ESU
ESU	FSE	SYSTem:COMMunicate:SERial:CONTrol:RTS	IBFull | OFF	only SERial1 available for ESU
ESU	FSE	SYSTem:COMMunicate:SERial[:RECeive]:BAUD	110 | 300 | 600 | 1200 | 2400 | 9600 | 19200	only SERial1 available for ESU
ESU	FSE	SYSTem:COMMunicate:SERial[:RECeive]:BITS	7 | 8	only SERial1 available for ESU
ESU	FSE	SYSTem:COMMunicate:SERial[:RECeive]:PACE	XON | NONE	only SERial1 available for ESU
ESU	FSE	SYSTem:COMMunicate:SERial[:RECeive]: PARity[:TYPE]	EVEN | ODD | NONE	only SERial1 available for ESU
ESU	FSE	SYSTem:COMMunicate:SERial[:RECeive]:SBITs	1 | 2	only SERial1 available for ESU
ESU	FSE	SYSTem:DATE	1980 to 2099, 1 to 12, 1 to 31	
ESU		SYSTem:DISPlay:FPANel	ON | OFF	new function for ESU
ESU	FSE	SYSTem:DISPlay:UPDate	ON | OFF	

Devices		Command *(Sheet 39 of 41)*	Parameter	Notes
ESU	FSE	SYSTem:ERRor[:NEXT]?		new function for ESU, but compatible to SYSTem:ERRor? on the FSE
ESU		SYSTem:ERRor:LIST?		new function for ESU
ESU		SYSTem:ERRor:CLEar:ALL		new command for ESU
ESU	FSE	SYSTem:FIRMware:UPDate	\<path\>	
ESU		SYSTem:LANGuage	'SCPI' | '8560E' | '8561E' | '8562E' | '8563E' | '8564E' | '8565E' | '8566A' | '8566B' | '8568A' | '8568B' | '8594E'	new command for ESU
ESU	FSE	SYSTem:PASSword[:CENable]	'pass word'	
ESU	FSE	SYSTem:PRESet		
	ESI/ FSIQ	SYSTem:PRESet:COMPatible	FSE | OFF	not available for ESU
ESU	FSE	SYSTem:SET		
ESU	FSE	SYSTem:SPEaker:VOLume	0 to 1	
ESU	FSE	SYSTem:TIME	0 to 23, 0 to 59, 0 to 59	
ESU	FSE	SYSTem:VERSion?		
ESU	FSE	TRACe:COPY	TRACE1 | TRACE2 | TRACE3 , TRACE1 | TRACE2 | TRACE3	only TRACE1...TRACE3 available for ESU
	FSET/ ESI	TRACe:FEED:CONTrol\<1...4\>	ALWays | NEVer	not available for ESU
ESU	FSE	TRACe[:DATA]	TRACE1 | TRACE2 | TRACE3 , \<block\> | \<numeric_value\>	only TRACE1...TRACE3 available for ESU
	FSET/ ESI	TRACe[:DATA]	TRACE1| TRACE2| TRACE3| TRACE4| SINGle| SCAN| STATus, \<block\> | \<numeric_value\>	
ESU		TRACe:IQ:DATA?		new function for ESU
ESU		TRACe:IQ:SET	\<filter type\>, \<rbw\>, \<sample rate\>, \<trigger source\>, \<trigger slope\>, \<pretrigger samples\>, \<# of samples\>	new function for ESU
ESU		TRACe:IQ:AVERage[:STATe]	ON | OFF	new function for ESU
ESU		TRACe:IQ:AVERage:COUNt	\<numeric_value\>	new function for ESU
ESU		TRACe:IQ:SRATe	16kHz to 32MHz	new function for ESU
ESU		TRACe:IQ[:STATe]	ON | OFF	new function for ESU
ESU	FSE	TRIGger\<1|2\>[:SEQuence]:HOLDoff	0 to 100s	

Devices		Command *(Sheet 40 of 41)*	Parameter	Notes
	FSE	TRIGger<1|2>[:SEQuence]:LEVel:AF	-120 to +120PCT	not available for ESU
	FSE	TRIGger<1|2>[:SEQuence]:LEVel:VIDeo	0 to 100PCT	not available for ESU; replaced by TRIGger: SEQuence:SOURce: VIDeo
	FSE	TRIGger<1|2>[:SEQuence]:LEVel[:EXTernal]	-5.0 to +5.0V	not available for ESU
ESU		TRIGger<1|2>[:SEQuence]:LEVel:IFPower	<numeric_value>	new command for ESU
ESU	FSE	TRIGger<1|2>[:SEQuence]:SLOPe	POSitive | NEGative	
ESU		TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo | IFPower	
	FSE/ ESI	TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo | RFPower | TV | AF	
	FSIQ	TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo | RFPower | AF	
	FSET	TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo	
ESU	FSE	TRIGger<1|2>[:SEQuence]:SOURce:VIDeo: FORMat:LPFrame	525 | 625	requires option B6 on FSP
ESU	FSE	TRIGger<1|2>[:SEQuence]:SOURce:VIDeo: FIELd:SELect	ALL|ODD|EVEN	requires option B6 on FSP
ESU	FSE	TRIGger<1|2>[:SEQuence]:SOURce:VIDeo:LINE: NUMBer	<numeric_value>	requires option B6 on FSP
ESU	FSE	TRIGger<1|2>[:SEQuence]:SOURce:VIDeo: SSIGnal:POLarity	NEGative | POSitive	requires option B6 on FSP
	FSE/ ESI	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust: FRAMe	0 to 100s	not available for ESU
	FSE	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust: FRAMe:AUTO	ONCE	not available for ESU and FSET
	FSE	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust: SLOT	0 to 100s	not available for ESU and FSET
	FSE	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust: SLOT:AUTO	ONCE	not available for ESU and FSET
	FSE	TRIGger<1|2>[:SEQuence]:SYNChronize: SOURce	FRAMe | TSC	not available for ESU and FSET
ESU		UNIT<1|2>:POWer	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | V | A | W	available units are compatible to the FSE.
	FSE/ FSIQ	UNIT<1|2>:POWer	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | DB | PCT | UNITLESS | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ|DBUV_M | DBIA_M | DBUV_MMHZ | DBUA_MMHZ	for ESU, the following units apply:DBM|DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | V | A | W

Devices		Command *(Sheet 41 of 41)*	Parameter	Notes	E-1
	FSET/ ESI	UNIT<1|2>:POWer	DBM | DBPW | DBPT | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | V | W | DB | PCT | UNITLESS | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBIA_M | DBUV_MMHZ | DBUA_MMHZ	for ESU, the following units apply:DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | V | A | W	
	FSE	UNIT<1|2>:PROBe	ON | OFF	not available for ESU	

7 Remote Control – Programming Examples

Introduction

The following programming examples have a hierarchical structure, i.e. subsequent examples are based on previous ones. It is thus possible to compile very easily an operational program from the modules of the given examples. VISUAL BASIC has been used as programming language. However, the programs can be translated into other languages.

In this chapter, more complex programming examples are given. In the Quick Start Guide, chapter 6, basic steps in remote control programming are provided.

Basic Steps of IEC/IEEE-Bus Programming

In this section, all basic programming examples about the topic service request are included:

- "Initiate Service Request" on page 7.3
- "Waiting for the Arrival of a Service Request" on page 7.3
- "Waiting Without Blocking the Keyboard and Mouse" on page 7.4
- "Service Request Routine" on page 7.5
- "Reading Out the Output Buffer" on page 7.5
- "Reading Out Error Messages" on page 7.6
- "Evaluation of SCPI Status Registers" on page 7.6
- "Evaluation of Event Status Register" on page 7.6

Basic examples that explain the programming of the instrument and can serve as a basis to solve more complex programming tasks are provided in the Quick Start Guide, chapter 6.

Service Request

The service request routine requires an extended initialization of the instrument in which the relevant bits of the transition and enable registers are set. In order to use the service request function in conjunction with a National Instruments GPIB driver, the setting "Disable Auto Serial Poll" must be changed to "yes" by means of IBCONF.

Initiate Service Request

```
REM ---- Example of initialization of the SRQ in the case of errors --------
PUBLIC SUB SetupSRQ()
CALL IBWRT(analyzer%, "*CLS")                    'Reset status reporting system
CALL IBWRT(analyzer%,"*SRE 168")                 'Permit service request for
                                                 'STAT:OPER,STAT:QUES and ESR
                                                 'register
CALL IBWRT(analyzer%,"*ESE 60")                  'Set event enable bit for
                                                 'command, execution, device-
                                                 'dependent and query error
CALL IBWRT(analyzer%,"STAT:OPER:ENAB 32767")     'Set OPERation enable bit for
                                                 'all events
CALL IBWRT(analyzer%,"STAT:OPER:PTR 32767")      'Set appropriate OPERation
                                                 'Ptransition bits
CALL IBWRT(analyzer%,"STAT:QUES:ENAB 32767")     'Set questionable enable bits
                                                 'for all events
CALL IBWRT(analyzer%,"STAT:QUES:PTR 32767")      'Set appropriate questionable
                                                 'Ptransition bits

END SUB
REM *********************************************************************
```

Waiting for the Arrival of a Service Request

There are basically two methods of waiting for the arrival of a service request:

Blocking (user inputs not possible)

This method is appropriate if the waiting time until the event to be signalled by an SRQ is short (shorter than the selected time-out), if no response to user inputs is required during the waiting time, and if – as the main criterion – the event is absolutely certain to occur.

Reason:
From the time the WaitSRQ() function is called until the occurrence of the expected event, it does not allow the program to respond to mouse clicks or key entries during the waiting time. Moreover, it causes program abort if the SRQ event does not occur within the predefined time-out period.
The method is, therefore, in many cases not suitable for waiting for measurement results, especially with triggered measurements.

The following function calls are required:

```
CALL WaitSRQ(boardID%,result%)    'Wait for service request
                                  'User inputs are not possible
                                  'during the waiting time!
IF (result% = 1) THEN CALL Srq    'If SRQ is recognized =>
                                  'subroutine for evaluation
```

Non-blocking (user inputs possible)

This method is recommended if the waiting time until the event to be signalled by an SRQ is long (longer than the selected time-out), and user inputs should be possible during the waiting time, or if the event is not certain to occur. This method is, therefore, the preferable choice for waiting for the end of measurements, i.e. the output of results, especially in the case of triggered measurements.

The method necessitates a waiting loop that checks the status of the SRQ line at regular intervals and returns control to the operating system during the time the expected event has not yet occurred. In this way, the system can respond to user inputs (mouse clicks, key entries) during the waiting time.

It is advisable to employ the Hold() auxiliary function, which returns control to the operating system for a selectable waiting time (see section "Waiting Without Blocking the Keyboard and Mouse" on page 7.4), so enabling user inputs during the waiting time.

```
result% = 0
For i = 1 To 10                       'Abort after max. 10 loop iterations
  CALL TestSRQ(boardID%,result%)      'Check service request line
  If (result% <> 0) Then
    CALL Srq                          'If SRQ is recognized =>
                                      'subroutine for evaluation
  Else
    CALL Hold(20)                     'Call hold function with
                                      '20 ms waiting time.
                                      'User inputs are possible.
  Endif
Next i
If result% = 0 Then
  PRINT "Timeout Error; Program aborted"    'Output error message
  STOP                                      'Stop software
Endif
```

Waiting Without Blocking the Keyboard and Mouse

A frequent problem with remote control programs using Visual Basic is to insert waiting times without blocking the keyboard and the mouse.

If the program is to respond to user inputs also during a waiting time, control over the program events during this time must be returned to the operating system. In Visual Basic, this is done by calling the *DoEvents* function. This function causes keyboard- or mouse-triggered events to be executed by the associated elements. For example, it allows the operation of buttons and input fields while the user waits for an instrument setting to be completed.

The following programming example describes the *Hold()* function, which returns control to the operating system for the period of the waiting time selectable in milliseconds.

```
Rem **************************************************************
Rem The waiting function below expects the transfer of the desired
Rem waiting time in milliseconds. The keyboard and the mouse remain
Rem operative during the waiting period, thus allowing desired elements
Rem to be controlled
```

```
REM *********************************************************************
Public SUB Hold(delayTime As Single)
Start = Timer          'Save timer count on calling the function
DO While Timer < Start + delayTime / 1000   'Check timer count
  DoEvents              'Return control to operating system
                        'to enable control of desired elements as long as
                        'timer has not elapsed
LOOP
END SUB
REM *********************************************************************
```

The waiting procedure is activated simply by calling *Hold(<Waiting time in milliseconds>)*.

Service Request Routine

A service request is processed in the service request routine.

Note: the variables userN% and userM% must be pre-assigned usefully!

```
REM ------------ Service request routine -------------------------------
Public SUB Srq()
ON ERROR GOTO noDevice           'No user existing
CALL IBRSP(analyzer%, STB%)      'Serial poll, read status byte
IF STB% > 0 THEN                 'This instrument has bits set in the STB
  SRQFOUND% = 1
  IF (STB% AND 16)  > 0 THEN CALL Outputqueue
  IF (STB% AND 4)   > 0 THEN CALL ErrorQueueHandler
  IF (STB% AND 8)   > 0 THEN CALL Questionablestatus
  IF (STB% AND 128) > 0 THEN CALL Operationstatus
  IF (STB% AND 32)  > 0 THEN CALL Esrread
END IF
noDevice:
END SUB
REM *********************************************************************
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

Reading Out the Output Buffer

```
REM -------- Subroutine for the individual STB bits ----------------------
Public SUB Outputqueue()        'Reading the output buffer
result$ = SPACE$(100)           'Make space for response
CALL IBRD(analyzer%, result$)
PRINT "Contents of Output Queue : "; result$
END SUB
REM *********************************************************************
```

Reading Out Error Messages

```
REM -------- Subroutine for reading the error queue ----------------------
Public SUB ErrorQueueHandler()
ERROR$ = SPACE$(100)                          'Make space for error variable
CALL IBWRT(analyzer%, "SYSTEM:ERROR?")
CALL IBRD(analyzer%, ERROR$)
PRINT "Error Description : "; ERROR$
END SUB
REM ***********************************************************************
```

Evaluation of SCPI Status Registers

```
REM ------ Subroutine for evaluating Questionable Status Register ---------
Public SUB Questionablestatus()
Ques$ = SPACE$(20)                   'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "STATus:QUEStionable:EVENt?")
CALL IBRD(analyzer%, Ques$)
PRINT "Questionable Status: "; Ques$
END SUB
REM ***********************************************************************
REM ------ Subroutine for evaluating Operation Status Register ------------
Public SUB Operationstatus()
Oper$ = SPACE$(20)                   'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "STATus:OPERation:EVENt?")
CALL IBRD(analyzer%, Oper$)
PRINT "Operation Status: "; Oper$
END SUB
REM ***********************************************************************
```

Evaluation of Event Status Register

```
REM ------ Subroutine for evaluating the Event Status Register ------------
Public SUB Esrread()
Esr$ = SPACE$(20)                   'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "*ESR?")    'Read ESR
CALL IBRD(analyzer%, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN PRINT "Operation complete"
IF (VAL(Esr$) AND 2) > 0 THEN PRINT "Request Control"
IF (VAL(Esr$) AND 4) > 0 THEN PRINT "Query Error"
IF (VAL(Esr$) AND 8) > 0 THEN PRINT "Device dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN
  PRINT "Execution Error; Program aborted"  'Output error message
  STOP                                       'Stop software
END IF
```

```
IF (VAL(Esr$) AND 32) > 0 THEN
  PRINT "Command Error; Program aborted"  'Output error message
  STOP                                     'Stop software
END IF
IF (VAL(Esr$) AND 64) > 0 THEN PRINT "User request"
IF (VAL(Esr$) AND 128) > 0 THEN PRINT "Power on"
END SUB
REM ********************************************************************
```

More Complex Programming Examples

In this section, the more advanced programming examples are included:

For basic programming examples, refer to section "Basic Steps of IEC/IEEE-Bus Programming" on page 7.2 and the Quick Start Guide, chapter 6.

Using Marker and Delta Marker

Measuring Spurious Emissions

In transmission measurements, it is often necessary to search a large frequency range for unwanted spurious emissions.

This can be done by means of the ESU's LIST PEAKS function, which finds up to 50 peaks in a preselected frequency range and outputs them as a list. The search range can be defined both in terms of frequency and level, and the number of peaks to be found is selectable as well.

In the following example, the 10 highest peaks are to be found in a preselected frequency range. Only signals >-60 dBm in a range ± 400 kHz about the center frequency are of interest, so the search range is limited accordingly. The signals found are output in the order of ascending frequency.

```
REM ********************************************************************
Public Sub SpuriousSearch()
powerlist$ = Space$(1000)
freqlist$ = Space$(1000)
count$ = Space$(30)
'--------- ESU default setting -----------------------------------------
CALL SetupInstrument                    'Default setting
CALL IBWRT(analyzer%,"INIT:CONT OFF")   'Default setting
```

```
'--------- Definition of search range -------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:X:SLIM:STAT ON")
CALL IBWRT(analyzer%,"CALC:MARK:X:SLIM:LEFT 99.6MHz;RIGHt 100.4MHz")
                                          'Activate search limit and
                                          'set to ±400 kHz about
                                          'center frequency
CALL IBWRT(analyzer%,"CALC:THR:STAT ON")
CALL IBWRT(analyzer%,"CALC:THR -60DBM")   'Activate threshold and
                                          'set to -60 dBm
'--------- Activate search for spurious -----------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:FPE:SORT X")  'Sort according to
                                                   'frequency
CALL IBWRT(analyzer%,"INIT;*WAI")                  'Perform sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:FPE 10")      'Search for
                                                   '10 highest peaks
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:FPE:COUN?")   'Call number of
                                                   'peaks, check it,
CALL IBRD(analyzer%, count$)                        'and read it in
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:FPE:X?")      'Query and read
CALL IBRD(analyzer%, freqlist$)                     'frequency list
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:FPE:Y?")      'Query and read
CALL IBRD(analyzer%, powerlist$)                    'level list
Print "# of spurious: ";count$                      'Output number of results
Print "Frequencies: ";freqlist$                     'Output frequency list
Print "Power: ";powerlist$                          'Output level list
END SUB
REM ********************************************************************
```

Shape Factor Measurement (Using n dB Down)

The n-dB-down function of the ESU is used twice to determine the shape factor of a filter (ratio of bandwidths at 60 dB and 3 dB below the filter maximum).

The following example is again based on a signal with a level of –30 dBm at 100 MHz. The shape factor is determined for the 30 kHz resolution bandwidth. The default setting of the ESU is used for measurements (SetupInstrument).

```
REM ********************************************************************
Public Sub ShapeFactor()
result$ = Space$(100)
'--------- ESU default setting ------------------------------------------
CALL SetupInstrument                      'Default setting
CALL IBWRT(analyzer%,"INIT:CONT OFF")   'Single sweep
'--------- Set frequency -----------------------------------------------
CALL IBWRT(analyzer%,"FREQ:SPAN 1MHz")   'Span
CALL IBWRT(analyzer%,"BAND:RES 30kHz")   'Resolution bandwidth
CALL IBWRT(analyzer%,"INIT;*WAI")        'Perform sweep with sync
```

```
'--------- Measure 60 dB value ------------------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")        'Peak excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")         'Marker1 on
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")          'Assign marker1 to trace1
CALL IBWRT(analyzer%,"CALC:MARK:MAX")             'Set marker1 to 100 MHz
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD 60dB")'Read out bandwidth measured
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD:RES?")'at 60 dB
CALL IBRD(analyzer%,result$)
result60 = Val(result$)
'--------- Measure 3 dB Down value  -------------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD 3dB") 'Read out bandwidth measured
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD:RES?")'at 60 dB
CALL IBRD(analyzer%,result$)
result3 = Val(result$)
'--------- Read out shape factor-----------------------------------------------
Print "Shapefaktor 60dB/3dB: ";result60/result3
END SUB
REM ***************************************************************************
```

Measuring the Third Order Intercept Point

The third order intercept point (TOI) is the (virtual) level of two adjacent useful signals at which the intermodulation products of third order have the same level as the useful signals.

The intermodulation product at f_{S2} is obtained by mixing the first harmonic of the useful signal P_{N2} with signal P_{N1}, the intermodulation product at f_{S1} by mixing the first harmonic of the useful signal P_{N1} with signal P_{N2}.

$$f_{S1} = 2 \times f_{n1} - f_{n2} \tag{1}$$

$$f_{S2} = 2 \times f_{n2} - f_{n1} \tag{2}$$

The following example is based on two adjacent signals with a level of −30 dBm at 100 MHz and 110 MHz. The intermodulation products lie at 90 MHz and 120 MHz according to the above formula. The frequency is set so that the examined mixture products are displayed in the diagram. Otherwise, the default setting of the ESU is used for measurements (SetupInstrument).

```
REM ***************************************************************************
Public Sub TOI()
result$ = Space$(100)
'--------- ESU default setting -------------------------------------------------
CALL SetupStatusReg                       'Set status registers
CALL IBWRT(analyzer%,"*RST")              'Reset instrument
CALL IBWRT(analyzer%,"INST:SEL SAN")      'Change into analyzer mode
CALL IBWRT(analyzer%,"INIT:CONT OFF")     'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")  'ON: display on
                                          'OFF: off
'--------- Set frequency -------------------------------------------------------
CALL IBWRT(analyzer%,"FREQ:STARt 85MHz;STOP 125 MHz")  'Span
'--------- Set level -----------------------------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV −20dBm")   'Reference level
CALL IBWRT(analyzer%,"INIT;*WAI")         'Perform sweep with sync
```

```
'--------- TOI measurement -------------------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")      'Peak excursion
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:TOI ON")    'Switch on TOI measurement
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:TOI:RES?")  'and read out results
CALL IBRD(analyzer%,result$)
'--------- Read out result -------------------------------------------------
Print "TOI [dBm]: ";result$
END SUB
REM **********************************************************************
```

Measuring the AM Modulation Depth

The example below is based on an AM-modulated signal at 100 MHz with the following characteristics:

- Carrier signal level: –30 dBm

- AF frequency: 100 kHz

- Modulation depth: 50%

The default setting of the analyzer can be used for the measurements described below (SetupInstrument).

```
REM **********************************************************************
Public Sub AMMod()
result$ = Space$(100)
CALL SetupInstrument                           'Default setting
'--------- Peak search -----------------------------------------------------
CALL IBWRT(analyzer%,"INIT:CONT OFF")          'Single sweep
CALL IBWRT(analyzer%,"INIT;*WAI")              'Perform sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")     'Peak excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")      'Marker 1 on
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")       'Assign marker1 to trace1
'--------- Measure modulation depth-----------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:MAX;FUNC:MDEP ON")  'Marker to Peak;
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:MDEP:RES?")    'Measure mod. depth
CALL IBRD(analyzer%, result$)                       'Read out result
'--------- Read out result -------------------------------------------------
Print "AM Mod Depth [%]: ";result$
END SUB
REM **********************************************************************
```

Limit Lines and Limit Test

The example below shows the definition and use of a new limit line 5 for trace 1 on screen A and trace 2 on screen B with the following characteristics:

- Upper limit line

- Absolute x axis in the frequency range

- 5 reference values: 120 MHz/-70 dB, 126 MHz/-40 dB, 127 MHz/-40 dB, 128 MHz/-10 dB, 129 MHz/-40 dB, 130 MHz/-40 dB, 136 MHz/-70 dB

- Relative y axis with unit dB

- Absolute threshold at -75 dBm

- No margin

The signal of the integrated calibration source (128 MHz, -30 dBm) is used to check the limit test.

```
REM **********************************************************************
Public Sub LimitLine()
result$ = Space$(100)
'--------- ESU default setting ----------------------------------------
CALL SetupInstrument                                    'Default setting
CALL IBWRT(analyzer%,"FREQUENCY:CENTER 128MHz;Span 10MHz")'Span
Call ibwrt(analyzer%,"Diag:Serv:Inp Cal;CSO -30dBm")     'Cal signal on
'--------- Definition of limit lines ----------------------------------
CALL IBWRT(analyzer%,"CALC:LIM5:NAME 'TEST1'")        'Define name
CALL IBWRT(analyzer%,"CALC:LIM5:COMM 'Upper limit'") 'Define comment
CALL IBWRT(analyzer%,"CALC1:LIM5:TRAC 1")            'Assign trace in screen A
CALL IBWRT(analyzer%,"CALC2:LIM5:TRAC 2")            'Assign trace in screen B
CALL IBWRT(analyzer%,"CALC:LIM5:CONT:DOM FREQ")   'Define x axis range
CALL IBWRT(analyzer%,"CALC:LIM5:CONT:MODE ABS")   'Define x axis scaling
CALL IBWRT(analyzer%,"CALC:LIM5:UNIT DB")         'Define y axis unit
CALL IBWRT(analyzer%,"CALC:LIM5:UPP:MODE REL")    'Define y axis scaling
'--------- Definition of data points and threshold --------------------
xlimit$ = "CALC:LIM5:CONT 120MHZ,126MHZ,127MHZ,128MHZ,129MHZ,130MHZ,136MHZ"
CALL IBWRT(analyzer%, xlimit$)                        'Set values for x axis
CALL IBWRT(analyzer%,"CALC:LIM5:UPP -70,-40,-40,-20,-40,-40,-70")
                                                      'Set values for y axis
CALL IBWRT(analyzer%,"CALC:LIM5:UPP:THR -75DBM") 'Set y threshold (only
                                                  'possible for relative
                                                  'y axis)
'----------------------------------------------------------------------
'A margin or an x /y offset can be defined here.
'----------- Activate and evaluate the limit line in screen A -------------
CALL IBWRT(analyzer%,"CALC1:LIM5:UPP:STAT ON") 'Activate line 5 in screen A
CALL IBWRT(analyzer%,"CALC1:LIM5:STAT ON")     'Activate limit check in
                                                'screen A
CALL IBWRT(analyzer%,"INIT;*WAI")              'Perform sweep with sync
CALL IBWRT(analyzer%,"CALC1:LIM5:FAIL?")       'Query result of limit check
CALL IBRD(analyzer%, result$)                  'Result: 1 (= FAIL)
```

```
'--------- Read out result -------------------------------------------------
Print "Limit Result Line 5: ";result$
'------ Evaluate limit line in screen A by means of status register -------
CALL IBWRT(analyzer%,"*CLS")            'Reset status register
'--------- Measure ---------------------------------------------------------
CALL IBWRT(analyzer%,"INIT;*OPC")       'Perform sweep with sync
CALL WaitSRQ(boardID%,status%)          'Wait for service request
'--------- Read out result -------------------------------------------------
IF (status% = 1) THEN
  CALL IBWRT(analyzer%,"STAT:QUES:LIM1:COND?") 'Read out STAT:QUES:LIMit
  CALL IBRD(analyzer%, result$)                'register
  IF ((Val(result$) And 16) <> 0) THEN
    Print "Limit5 failed"
  ELSE
    Print "Limit5 passed"
  END IF
END IF
END SUB
REM ************************************************************************
```

Measuring the Channel and Adjacent Channel Power

In the following example, the channel and adjacent channel power is first measured on a signal with a level of 0 dBm at 800 MHz to IS95. Then the channel and adjacent channel power is measured on a GSM signal at 935.2 MHz with fast ACP measurement (FAST ACP).

In addition, the limit test is activated.

```
REM ************************************************************************
Public Sub ACP()
result$ = Space$(100)
'--------- ESU default setting -----------------------------------------------
CALL SetupStatusReg                         'Set status register
CALL IBWRT(analyzer%,"*RST")                'Reset instrument
CALL IBWRT(analyzer%,"INST:SEL SAN")        'Change into analyzer mode
CALL IBWRT(analyzer%,"INIT:CONT OFF")       'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")    'ON: display on
                                            'OFF: off
'--------- Set frequency -----------------------------------------------------
CALL IBWRT(analyzer%,"FREQ:CENT 800MHz")    'Set frequency
'--------- Set level ---------------------------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV 10dBm")   'Reference level
'--------- Example 1: Configure CP/ACP for CDMA  -----------------------------
CALL IBWRT(analyzer%,"CALC2:MARK:FUNC:POW:SEL ACP")   'ACP measurement on
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:PRES F8CDMA")'Select CDMA800 FWD
CALL IBWRT(analyzer%,"SENS:POW:ACH:ACP 2")      'Select 2 adjacent channels
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES ACP")   'Optimize settings
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES:RLEV")  'Optimize reference level
CALL IBWRT(analyzer%,"SENS:POW:ACH:MODE ABS")   'Absolute measurement
CALL IBWRT(analyzer%,"SENS:POW:HSP ON")         'Fast ACP measurement
'--------- Perform measurement and query results ----------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                 'Perform sweep with sync
CALL IBWRT(analyzer%,"CALC2:MARK:FUNC:POW:RES? ACP")   'Query result
CALL IBRD(analyzer%, result$)
'--------- Read out result ---------------------------------------------------
Print "Result (CP, ACP low, ACP up, Alt low, Alt up): "
Print result$
'--------- Example 2: Configure CP/ACP manually for GSM  --------------------
result$ = Space$(100)
CALL IBWRT(analyzer%,"FREQ:CENT 935.2MHz")            'Set frequency
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:SEL ACP")    'ACP measurement on
CALL IBWRT(analyzer%,"SENS:POW:ACH:ACP 1")            '1 adjacent channel
CALL IBWRT(analyzer%,"SENS:POW:ACH:BAND 200KHZ")      'Channel bandw. 200 kHz
CALL IBWRT(analyzer%,"SENS:POW:ACH:BAND:ACH 200KHZ")'Adjacent channel band-
                                                    'width 200 kHz
CALL IBWRT(analyzer%,"SENS:POW:ACH:SPAC 200KHZ")      'Channel spacing 200 kHz
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES ACP")         'Optimize settings
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES:RLEV")        'Optimize reference level
CALL IBWRT(analyzer%,"SENS:POW:ACH:MODE ABS")         'Absolute measurement
```

```
'--------- Start measurement and query result ----------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                    'Perform sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:RES? ACP") 'Query result
CALL IBRD(analyzer%, result$)
'--------- Read out result ------------------------------------------------
Print "Result (CP, ACP low, ACP up): "
Print result$
'--------- Active limit check ---------------------------------------------
result$ = Space$(100)
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH 30DB, 30DB")  'Set relative limit
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:ABS -35DBM,-35DBM")
                                                     'Set absolute limit
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:STAT ON")     'Rel. limit check on
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:ABS:STAT ON") 'Abs. limit check on
CALL IBWRT(analyzer%,"CALC:LIM:ACP ON")              'Limit check on
'--------- Start measurement and query result ----------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                    'Perform sweep with sync
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:RES?")        'Query result of
CALL IBRD(analyzer%, result$)                        'limit check
'--------- Read out result ------------------------------------------------
Print "Result Limit Check: ";result$
END SUB
REM ************************************************************************
```

Occupied Bandwidth Measurement

In the following example, the bandwidth is to be found in which 95% of the power of a GSM signal is contained. Signal frequency is 935,2 MHz; channel bandwidth is 200 kHz.

```
REM ********************************************************************
Public Sub OBW()
result$ = Space$(100)
'--------- ESU default setting -----------------------------------------
CALL SetupStatusReg                       'Set status register
CALL IBWRT(analyzer%,"*RST")              'Reset instrument
CALL IBWRT(analyzer%,"INST:SEL SAN")      'Change into analyzer mode
CALL IBWRT(analyzer%,"INIT:CONT OFF")     'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")  'ON: display on
                                          'OFF: off
'--------- Configure ESU for OBW for GSM  -----------------------------
CALL IBWRT(analyzer%,"FREQ:CENT 935.2MHz")        'Set frequency
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:SEL OBW") 'OBW measurement on
CALL IBWRT(analyzer%,"SENS:POW:ACH:BAND 200KHZ")   'Channel bandw. 200 kHz
CALL IBWRT(analyzer%,"SENS:POW:BWID 95PCT")        'Percentage of power
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES OBW")      'Set frequency and
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES:RLEV")     'optimize reference level
CALL IBWRT(analyzer%,"SENS:POW:NCOR OFF")          'Noise correction
                                                   'OFF: switch off
                                                   'ON:  switch on
'--------- Perform measurement and query results -------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                  'Perform sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:RES? OBW")'Query result
CALL IBRD(analyzer%, result$)
Print result$
END SUB
REM ********************************************************************
```

Time Domain Power Measurement

In the following example, the mean carrier power of a signal with 300 kHz bandwidth at 100 MHz is to be determined. In addition, the peak power, the rms value and the standard deviation are measured. To do this, the time-domain-power measurement functions are used.

```
REM ********************************************************************
Public Sub TimeDomainPower()
result$ = Space$(100)
'--------- ESU default setting ----------------------------------------------
CALL SetupStatusReg                        'Set status register
CALL IBWRT(analyzer%,"*RST")               'Reset instrument
CALL IBWRT(analyzer%,"INST:SEL SAN")      'Change into analyzer mode
CALL IBWRT(analyzer%,"INIT:CONT OFF")      'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")   'ON: display on
                                           'OFF: off
'--------- Configure ESU for time domain power measurement ----------------
CALL IBWRT(analyzer%,"FREQ:CENT 100MHz;SPAN 0Hz")    'Set frequency
CALL IBWRT(analyzer%,"BAND:RES 300kHz")              'Resolution bandwidth
CALL IBWRT(analyzer%,"SWE:TIME 200US")               'Sweep time
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:PPE ON")   'Peak measurement on
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:MEAN ON")  'Mean measurement on
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:RMS ON")   'RMS measurement on
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:SDEV ON")  'Standard deviation on
'--------- Perform measurement and query results --------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                    'Perform sweep with sync
                                                     'Query results:
query$ =           " CALC:MARK:FUNC:SUMM:PPE:RES?;"   'Peak measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:MEAN:RES?;"   'Mean measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:RMS:RES?;"    'RMS measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:SDEV:RES?"    'Standard deviation
Call IBWRT(analyzer%, query$)
CALL IBRD(analyzer%, result$)
Print result$
END SUB
REM ********************************************************************
```

Fast Power Measurement on Power Ramps

A frequent task in mobile radio tests is measurement of a DUT at various power control levels at the highest possible speed. The ESU offers two test functions for this task, which can be used depending on the signal characteristics.

In the following, the two methods are presented by means of two examples.

Power Measurement with Multi-Summary Marker

The multi-summary marker function is suitable for measuring the power of a sequence of pulses with the following characteristics:

• The pulses occur at identical time intervals, which is typical of GSM transmission in slots, for example.

• The level of the first signal is reliably above threshold.

• The subsequent pulses may have any levels.

The function uses the first pulse as a trigger signal. The power of the subsequent pulses is determined exclusively via the timing pattern selected for the pulse sequence. The function is, therefore, suitable for adjustments where the DUT output power varies considerably and is not reliably above the trigger threshold.

The measurement accuracy is determined by the ratio of pulse duration to total measurement time; this should not be below 1:50.

The function always uses TRACE 1 of the selected screen.
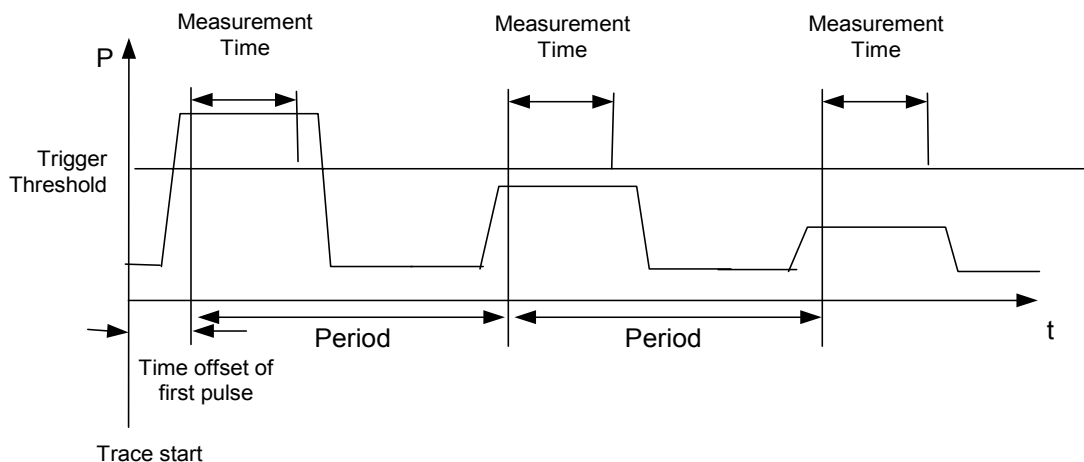
Fig. 7-1   Block diagram illustrating signal processing in analyzer

In the example below, a sequence of 8 pulses is measured with an offset of 50 µs of the first pulse, 450 µs measurement time/pulse and 576.9 µs pulse period.

```
REM ********************************************************************
Public Sub MultiSumMarker()
result$ = Space$(200)
'--------- ESU default setting--------------------------------------
CALL SetupStatusReg                          'Configure status register
CALL IBWRT(analyzer%,"*RST")                 'Reset instrument
CALL IBWRT(analyzer%,"INST:SEL SAN")         'Change into analyzer mode
CALL IBWRT(analyzer%,"INIT:CONT OFF")        'Single sweep mode
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")     'ON:  switch display on
                                             'OFF: switch display off
'--------- Configure ESU for power measurement in time domain -------------
CALL IBWRT(analyzer%,"FREQ:CENT 935.2MHz;SPAN 0Hz")  'Frequency setting
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV 10dBm")  'Set reference level
                                                     'to 10 dB
CALL IBWRT(analyzer%,"INP:ATT 30 dB")         'Set input attenuation to 30 dB
CALL IBWRT(analyzer%,"BAND:RES 1MHz;VID 3MHz")  'Bandwidth setting
CALL IBWRT(analyzer%,"DET RMS")               'Select RMS detector
CALL IBWRT(analyzer%,"TRIG:SOUR VID")         'Trigger source: video
CALL IBWRT(analyzer%,"TRIG:LEV:VID 50 PCT")   'Trigger threshold: 50%
CALL IBWRT(analyzer%,"SWE:TIME 50ms")         'Sweep time ≥ 1 frame
'--------- Perform measurement and query results --------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")             'Perform sweep with sync
                                              'Query results:
cmd$ = "CALC:MARK:FUNC:MSUM? "
cmd$ = cmd$ + "50US,"            'Offset of first pulse
cmd$ = cmd$ + "450US,"          'Measurement time
cmd$ = cmd$ + "576.9US,"        'Pulse period
cmd$ = cmd$ + "8"               'Number of bursts
CALL IBWRT(analyzer%,cmd$)
CALL IBRD(analyzer%, result$)   'Read results
Print result$
END SUB
REM ********************************************************************
```

Multi-Burst Power Measurement

The multi-burst power measurement function is suitable for measuring the power of a sequence of pulses with the following characteristics:

- The pulses occur at variable time intervals.

- The levels of all pulses of the sequence are reliably above the trigger threshold, or an external trigger signal is used.

The function requires one trigger event per pulse. This means that if the video trigger or the IF power trigger is used, the levels of all pulses must be above the trigger threshold.

The function is, therefore, particularly suitable for re-measuring DUTs already adjusted and whose output power is within the specified range. The measurement is optimized for minimum overhead relative to the actual measurement time.
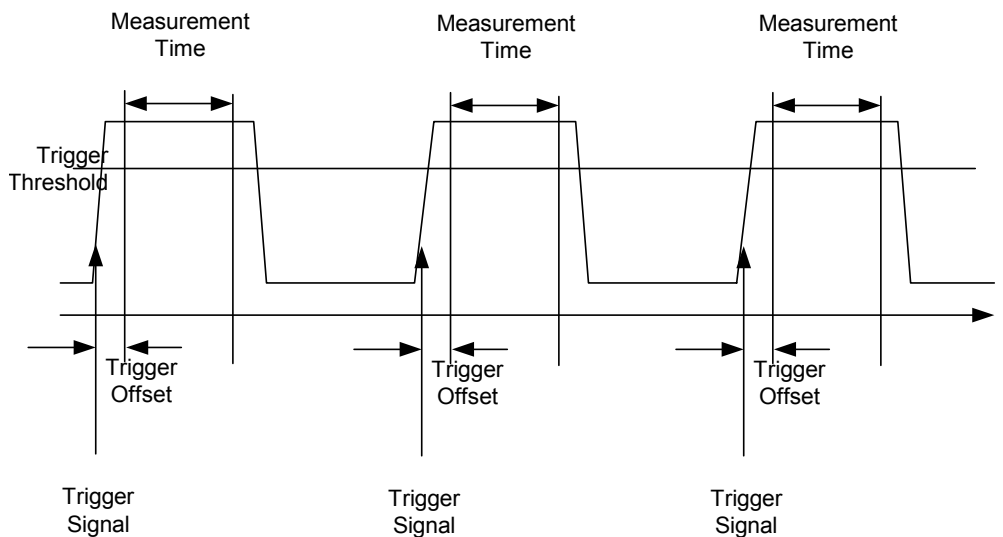
Fig. 7-2   Block diagram illustrating signal processing in analyzer

Either the root-mean-square power or the peak power is measured, depending on whether the RMS detector or the PEAK detector is selected. The function always uses TRACE 1 of the selected screen.

The following parameters are to be set for this measurement:

- Analyzer frequency

- Resolution bandwidth

- Measurement time per single pulse

- Trigger source

- Trigger threshold

- Trigger offset

- Type of power measurement (PEAK, MEAN)

- Number of pulses to be measured

During the measurement, each pulse is mapped into a pixel of the screen, i.e. any change of the trace can be detected only at the left-hand edge of the screen. Maximum measurement speed is as usual achieved with the display switched off.

In the example below, a GSM pulse sequence of 8 pulses is measured with 5 μs trigger offset, 434 μs measurement time/pulse, video trigger with 50% trigger threshold, and peak detection:

```
REM ********************************************************************
Public Sub MultiBurstPower()
result$ = Space$(200)
'--------- ESU default setting --------------------------------------
CALL SetupStatusReg                          'Configure status register
CALL IBWRT(analyzer%,"*RST")                 'Reset instrument
CALL IBWRT(analyzer%,"INST:SEL SAN")         'Change into analyzer mode
CALL IBWRT(analyzer%,"INIT:CONT OFF")        'Single sweep mode
CALL IBWRT(analyzer%,"SYST:DISP:UPD OFF")  'OFF: display off
'--------- Perform measurement and query results --------------------------
cmd$ = "MPOW? "
cmd$ = cmd$ + "935.2 MHZ,"     'Center frequency
cmd$ = cmd$ + "1MHZ,"          'Resolution bandwidth
cmd$ = cmd$ + "434US,"         'Measurement time
cmd$ = cmd$ + "VID,"           'Trigger source
cmd$ = cmd$ + "50PCT,"         'Trigger threshold
cmd$ = cmd$ + "1US,"           'Trigger offset, must be > 125 ns
cmd$ = cmd$ + "PEAK,"          'Peak detector
cmd$ = cmd$ + "8"              'Number of bursts
CALL IBWRT(analyzer%, cmd$)
CALL IBRD(analyzer%, result$)  'Read results
Print result$
END SUB
REM ********************************************************************
```

Fast Level Measurement Using Frequency Lists

A typical task for the ESU is power measurement at a number of frequency points, e.g. at multiples of the fundamental (harmonics measurement), or at frequencies defined by a mobile radio standard (e.g. spectrum due to transients at ± 200 kHz, ± 400 kHz, etc. about the carrier frequency of a GSM signal). In many cases, different level and/or bandwidth settings are required for the different frequency points to match the channel spacing and meet the requirements of dynamic range.

Especially for this application, the ESU offers a number of remote-control functions (commands available in SENSe:LIST subsystem) that allow level measurement based on a frequency list with different instrument settings assigned to different frequencies. Not only the frequency list can be programmed, but also the measurement types (PEAK, RMS, AVG) to be performed simultaneously can be selected.

The example below describes a harmonics measurement on a dual-band amplifier. The harmonics level in general decreases as the frequency increases. To boost measurement sensitivity, therefore, the reference level is lowered by 10 dB from the third harmonic.

The following settings are used:

*   Reference level: 10.00 dBm up to 2nd harmonic, 0 dBm from 3rd harmonic

*   RF attenuation: 20 dB

*   Electronic attenuation: 0 dB

*   RBW: 1 MHz

*   VBW: 3 MHz

*   Filter type: NORMal

*   Measurement time: 300 μs

*   Trigger delay: 100 μs

*   Trigger: video, 45%

Frequency	Type
935.2 MHz	GSM 900 fundamental
1805.2 MHz	GSM 1800 fundamental
1870.4 MHz	GSM 900 2nd harmonic
2805.6 MHz	GSM 900 3rd harmonic
3610.4 MHz	GSM 1800 2nd harmonic
3740.8 MHz	GSM 900 4th harmonic
5815.6 MHz	GSM 1800 3rd Harmonic

The frequencies are selected in ascending order to minimize system-inherent waiting times resulting from frequency changes.

At each frequency point the peak power and the rms power are measured. The peak power and the rms power values are stored alternately in the results memory.

```
REM *************************************************************************
Public Sub FrequencyList()
result$ = Space$(500)
'--------- ESU default setting --------------------------------------------
CALL SetupStatusReg                          'Configure status register
CALL IBWRT(analyzer%,"*RST")                 'Reset instrument
CALL IBWRT(analyzer%,"INST:SEL SAN")         'Change into analyzer mode
CALL IBWRT(analyzer%,"INIT:CONT OFF")        'Single sweep mode
CALL IBWRT(analyzer%,"SYST:DISP:UPD OFF")    'Display off
'-------- Configure ESU for power measurement based on frequency list -----
Call IBWRT(analyzer%, "TRIG:LEV:VID 45PCT")     'Video trigger threshold
Call IBWRT(analyzer%, "LIST:POWer:SET ON,ON,OFF,VID,POS,100us,0")
'-------- Perform measurement and query results ---------------------------
cmd$ = "LIST:POWer? "
cmd$ = cmd$ + "935.2MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "1805.2MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "1870.4MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "2805.6MHZ,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "3610.4MHz,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "3740.8MHz,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "5815.6MHz,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0"
Call IBWRT(analyzer%, cmd$)
Call IBRD(analyzer%, result$)
Print result$
END SUB
REM *************************************************************************
```

Level Correction of Transducers (Definition of Transducer Factors)

In more complex test systems, the frequency response of the test setup must be taken into account in all power measurements to avoid any measurement errors being introduced from sources other than the DUT.

The ESU offers the possibility of defining a frequency-dependent attenuation correction factor (transducer factor).

In the example below, a factor with the following characteristics is defined:

Name: Transtest
Unit: dB
Scaling: lin
Comment: simulated cable correction

Frequency	Level
10 MHz	0 dB
100 MHz	3 dB
1 GHz	7 dB
3 GHz	10 dB

The factor is defined and can be activated as required.

```
REM ********************************************************************
Public Sub TransducerFactor()
'--------- Define transducer factor -------------------------------------
CALL IBWRT(analyzer%,"CORR:TRAN:SEL 'TRANSTEST'")  'Define "Transtest"
                                                   'transducer factor
CALL IBWRT(analyzer%,"CORR:TRAN:UNIT 'DB'")        'Unit 'dB'
CALL IBWRT(analyzer%,"CORR:TRAN:SCAL LIN")         'Linear frequency axis
CALL IBWRT(analyzer%,"CORR:TRAN:COMM 'Simulated cable correction'")
cmd$ = "CORR:TRAN:DATA "                'Enter frequency and level
cmd$ = cmd$ + "10MHz, 0,"               'values. Level values without
cmd$ = cmd$ + "100MHz, 3,"              'unit!
cmd$ = cmd$ + "1GHz, 7,"
cmd$ = cmd$ + "3GHz, 10"
CALL IBWRT(analyzer%,cmd$)              'Enter frequency and level values
'--------- Activate transducer -------------------------------------
CALL IBWRT(analyzer%,"CORR:TRAN:STAT ON") 'Activate transducer factor
END SUB
REM ********************************************************************
```

Measuring the Magnitude and Phase of a Signal (I/Q Data Acquisition)

Due to the ESU's internal architecture, it is capable of measuring and outputting the magnitude and phase of a signal in addition to its power values. This opens up a variety of possibilities for more in-depth analysis (FFT, demodulation, etc.).

Fig. 7-3 shows the analyzer hardware from the IF to the processor. The IF filter is the resolution filter of the signal analyzer and can be set between 300 kHz and 50 MHz. The A/D converter samples the IF (20.4 MHz) at 64 MHz (spectrum analysis) or 81.6 MHz (signal analysis).

Lowpass filtering and reduction of the sampling rate follow the down-conversion to the complex baseband. The output sampling rate is set as continuous between 10 kHz and 81.6 MHz during signal analysis. This prevents superfluous oversampling at narrow bandwidths, which reduces computation time and increases the maximum recording time. In spectrum analysis, the output sampling rate is 32 MHz.

The I/Q data is stored in memory areas that each contain 16 M words. The data can then be read out from these areas in blocks that are 512 k words each. Hardware triggering controls the memory.
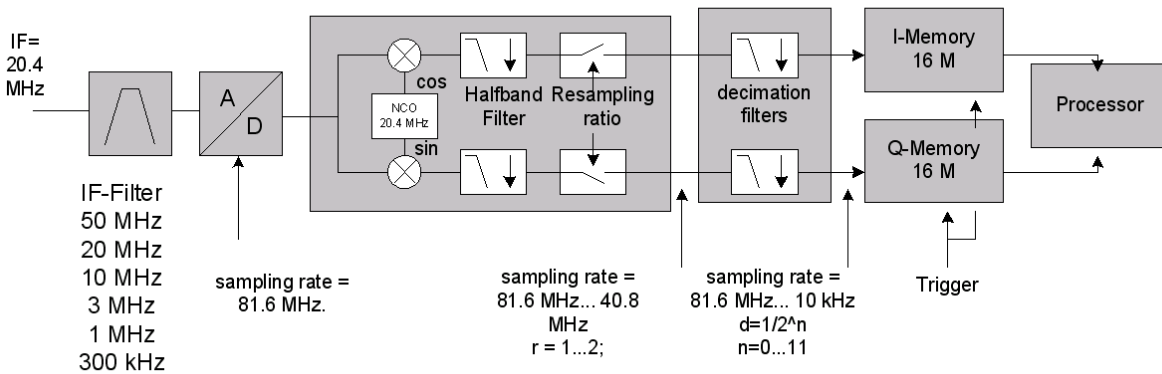
Fig. 7-3   Block diagram illustrating signal processing in the analyzer

The following maximum bandwidths are possible in this measurement depending on the selected sampling rate:

Sample rate (from)	Sample rate (to)	Max. bandwidth	Notes
81.6 MHz	40.8 MHz	30 MHz	Half band filter for the half sampling rate (81.6 MHz)
40.8 MHz	20.4 MHz	0.68 sampling rate	
20.4 MHz	10.2 MHz	0.8 sampling rate	
10.2 MHz	5.1 MHz	0.8 sampling rate	
5.1 MHz	2.55 MHz	0.8 sampling rate	
2.55 MHz	1.275 MHz	0.8 sampling rate	
1.275 MHz	0.6375 MHz	0.8 sampling rate	
0.6375 MHz	318.75 kHz	0.8 sampling rate	
318.75 kHz	159.375 kHz	0.8 sampling rate	

Sample rate (from)	Sample rate (to)	Max. bandwidth	Notes
159.375 kHz	79.6875 kHz	0.8 sampling rate	
79.6875 kHz	39.84375 kHz	0.8 sampling rate	
39.84375 kHz	19.921875 kHz	0.8 sampling rate	
19.921875 kHz	10 kHz	0.8 sampling rate	

The following example shows the steps necessary to collect data at a predefined sampling rate and read it from the I/Q memory.

Data is output in the form of voltage values referred to the analyzer input.

In binary format, the length information carried in the message header is evaluated and used for calculating the x axis values.

Binary data is read in three steps:

1. The number of digits carrying the length information is read.

2. The length information itself is read.

3. The trace data is read.

This procedure is necessary with programming languages like Visual Basic which support only structures of identical data types (arrays), whereas the binary data format uses different data types in the header and the data section.

Note

The arrays for measured data are dynamically dimensioned to allow the example to be easily adapted to individual requirements.

```
Rem *********************************************************************
Public Sub ReadIQData()
'--------- Create variables ----------------------------------------------
Dim IData() As Single  'I values as single floats
Dim QData() As Single  'Q values as single floats
Dim digits As Byte     'No. of digits as length information
Dim IQBytes As Long    'Length of trace data in bytes
Dim IQSamples As Long  'No. of trace data in SamplesDim LastSize As Long
'Length of last block in bytes
Const BlockSize = 524288  'Block size in ESU, as per manual
result$ = Space$(100)     'Buffer for simple results
```

```
'--------- ESU default setting --------------------------------------
Call SetupInstrument    'Default setting
'Activate I/Q data acquisition mode; must be done before TRAC:IQ:SET!
Call ibwrt(analyzer%, "TRAC:IQ:STAT ON")


' Number of test points (800 000)
'   (max. test points allowed (= 16 * 1024 * 1024 - 512))
'   at RBW 50 MHz,
'   sample rate 80 MHz, trigger free run, pos. trigger edge
'   and 0 s trigger delay.


Call ibwrt(analyzer%, "TRAC:IQ:SET NORM,50MHz,80MHz,IMM,POS,0,800000")
'--------- Read-out in binary format --------------------------------------
Call ibwrt(analyzer%, "FORMAT REAL,32")   'Set binary format
Call ibwrt(analyzer%, "TRAC:IQ:DATA?")    'Meas. + read out I/Q data


' The data must be retrieved from device
' They have the following format:
' Example:
' "#42000"
'   |||||_____ Length of data in bytes
'   |_____ No. of digits as length


Call ilrd(analyzer%, result$, 2)       'Read and store length for
digits = Val(Mid$(result$, 2, 1))      'number of digits
result$ = Space$(100)                  'Re-initialize buffer
Call ilrd(analyzer%, result$, digits)  'Read length
' Total number of bytes that are read
IQBytes = Val(Left$(result$, digits)) 'and store
' Total number of samples (I and Q) that are read
IQSamples = IQBytes / 8                '4 bytes each for I and Q samples
If IQBytes > 0 Then
  ' Dynamically create buffer for I/Q data
  ReDim IData(0 To IQSamples - 1)
  ReDim QData(0 To IQSamples - 1)
  ' "Blocks" with 512 k I/Q data each are read
  Blocks = (IQSamples - 1) \ BlockSize
  ' 0 or 1 block, each with "LastSize" I/Q data, is read
  LastSize = IQSamples - (Blocks * BlockSize)

' Entire blocks with 512 k samples each
  For Index = 0 To Blocks - 1
    ' Read I and Q data in buffer; index for I data counts samples
    ' Size of data for ibrd32 in bytes
    Call ibrd32(analyzer%, IData(Index * BlockSize), BlockSize * 4)
    Call ibrd32(analyzer%, QData(Index * BlockSize), BlockSize * 4)
  Next Index
```

```
  ' The last block (if any) with < 512 k data)
  If LastSize > 0 Then
    ' Read I/Q data; see above
    Call ibrd32(analyzer%, IData(Blocks * BlockSize), LastSize * 4)
    Call ibrd32(analyzer%, QData(Blocks * BlockSize), LastSize * 4)
  End If
End If
Call ilrd(analyzer%, result$, 1)             'Read in end character <NL>
Call ibwrt(analyzer%, "TRAC:IQ:STAT OFF")  'I/Q data acquisition mode
Call ibwrt(analyzer%, "DISP:WIND:Trac:Stat ON") 'Re-start screen
Call ibwrt(analyzer%, "INITiate:CONTinuous ON") 'continuous sweep on
'--------- Output of binary data as frequency/level pair ----------------
Open ".\traceiq.dat" For Output As #1             'Store in current directory
For i = 0 To IQSamples - 1
  Print #1, i; " ; "; Str(IData(i)); " ; "; Str(QData(i))
Next i
Close #1
END SUB
REM ************************************************************************
```

Reading and Writing Files

Reading a File from the Instrument

In the following example, file TEST1.SET stored under D:\USER\DATA is read from the instrument and stored in the controller.

```
REM ********************************************************************
Public Sub ReadFile()
'--------- Generate variables ------------------------------------------
Dim digits As Byte       'Number of digits of length information
Dim fileBytes As Long    'Length of file with trace data in bytes
result$ = Space$(100)    'Buffer for simple results
'--------- Default setting of status register --------------------------
Call SetupStatusReg      'Configure status register
'--------- Read out file -----------------------------------------------
Call ibwrt(analyzer%, "MMEM:DATA? 'D:\USER\DATA\TEST1.SET'")
                                       'Select file
Call ilrd(analyzer%, result$, 2)       'Read and store number of
digits = Val(Mid$(result$, 2, 1))      'digits of length information
Call ilrd(analyzer%, result$, digits)  'Read and store length
fileBytes = Val(Left$(result$, digits)) 'information
FileBuffer$ = Space$(fileBytes)        'Buffer for file
Call ilrd(analyzer%, FileBuffer, fileBytes) 'Read file into buffer
Call ilrd(analyzer%, result$, 1)            'Read terminator <NL>
'--------- Store file to controller ------------------------------------
Open "TEST1.SET" For Output As #1
Print #1, FileBuffer;            ' ; to avoid linefeed at end of file
Close #1
END SUB
REM ********************************************************************
```

Creating a File on the Instrument

In the following example, the TEST1.SET file available on the controller is stored in the instrument under D:\USER\DATA\DUPLICAT.SET.

```
REM ***********************************************************************
Public Sub WriteFile()
'--------- Generate variables ------------------------------------------
FileBuffer$ = Space$(100000)  'Buffer for file
Dim digits As Long            'Number of digits of length information
Dim fileBytes As Long         'Length of file in bytes
fileSize$ = Space$(100)       'Length of file as a string
result$ = Space$(100)         'Buffer for simple results
'--------- Default setting of status register --------------------------
Call SetupStatusReg           'Configure status register
'--------- Prepare the definite length block data ----------------------
fileBytes = FileLen("H:\work\vb\test1.set")  'Determine length of file
fileSize$ = Str$(fileBytes)
digits = Len(fileSize$) – 1               'Determine number of digits of
fileSize$ = Right$(fileSize$, digits)     'length information
FileBuffer$ = "#" + Right$(Str$(digits), 1) + fileSize$
                                          'Store length information in
                                          'file buffer

'--------- Read file from controller -----------------------------------
Open "H:\work\vb\TEST1.SET" For Binary As #1
FileBuffer$ = FileBuffer$ + Left$(Input(fileBytes, #1), fileBytes)
Close #1
'--------- Write file --------------------------------------------------
Call ibwrt(analyzer%, "SYST:COMM:GPIB:RTER EOI")  'Set receive
                                                  'terminator on the
                                                  'instrument
Call ibwrt(analyzer%, "MMEM:DATA 'D:\USER\DATA\DUPLICAT.SET'," +
        FileBuffer$)                              'Select file
END SUB
REM ***********************************************************************
```

8 Maintenance and Instrument Interfaces

Introduction

The following chapter contains information on the maintenance of the ESU and on the instrument interfaces:

*   "Maintenance" on page 8.2

*   "Instrument Interfaces" on page 8.3

Please follow the instructions in the service manual when exchanging modules or ordering spares. The order no. for spare parts can be found in the service manual.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) and calibration.

Maintenance

Mechanical and Electrical Maintenance

The ESU does not require any special maintenance. Remove any contamination on the instrument by means of a soft cloth. Make sure that the air vents are not obstructed.

Cleaning the Outside

The outside of the instrument is suitably cleaned using a soft, line-free dust cloth. Make sure that vents are not obstructed.

ATTENTION

Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.

Storing and Packing

The ESU can be stored at a temperature of –5°C to +60°C. When stored for an extended period of time the instrument should be protected against dust.

The original packing should be used, particularly the protective covers at the front and rear, when the instrument is to be transported or dispatched. If the original packing is no longer available, use a sturdy cardboard box of suitable size and carefully wrap the instrument to protect it against mechanical damage.

List of Power Cables Available

Table 8-1   List of power cables available

Stock No.	Earthed-contact connector	Preferably used in
DS 006.7013	BS1363: 1967' complying with IEC 83: 1975 standard B2	Great Britain
DS 006.7020	Type 12 complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 006.7036	Type 498/13 complying with US-regulation UL 498, or with IEC 83	USA/Canada
DS 006.7107	Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap.	Australia
DS 0025.2365	DIN 49 441, 10 A, 250 V, angular	Europe (except Switzerland)
DS 0099.1456	DIN 49 441, 10 A, 250 V, straight	

Instrument Interfaces

In this section, only a selection of connectors is described:

-
-
-

For further information on the front and back panel connectors refer to the Quick Start Guide, chapter 1.

IEC/IEEE Bus Interface

The standard instrument is equipped with an IEC/IEEE Bus connector. An IEEE 488 interface connector is located on the rear panel of the ESU. An external controller for remote control of the instrument can be connected via the IEEE 488 interface connector using a shielded cable.

Interface Characteristics

- 8-bit parallel data transfer
- bi-directional data transfer
- three-line handshake
- high data transfer rate
- up to 15 instruments can be connected
- maximal length of the interconnecting cables 15 m (single connection, 2m)
- wired-OR connection if several instruments are connected in parallel.
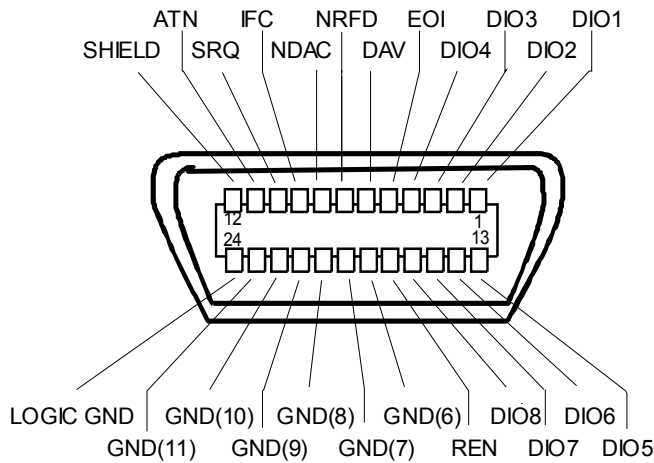
Fig. 8-1   Pin assignment of IEC/IEEE Bus interface

Bus Lines

Data bus with 8 lines DIO 1 to DIO 8.

The transmission is bit-parallel and byte-serial in the ASCII/ISO code. DIO1 is the least significant, DIO8 the most significant bit.

Control bus with 5 lines.

IFC (Interface Clear),
active low resets the interfaces of the devices connected to the default setting.

ATN (Attention),
active low signals the transmission of interface messages
inactive high signals the transmission of device messages.

SRQ (Service Request),
active low enables a device connected to send a service request to the controller.

REN (Remote Enable),
active low permits the switch over to remote control.

EOI (End or Identify),
has two functions in connection with ATN:
active low marks the end of data transmission when ATN=high
active low triggers a parallel poll when ATN=low.

Handshake bus with three lines.

DAV (Data Valid),
active low signals a valid data byte on the data bus.

NRFD (Not Ready For Data),
active low signals that one of the devices connected is not ready for data transfer.

NDAC (Not Data Accepted),
active low as long as the device connected is accepting the data present on the data bus.

Interface Functions

Instruments which can be remote controlled via the IEC/IEEE bus can be equipped with different interface functions. Table 8-1 lists the interface functions appropriate for the instrument.

Table 8-1   Interface functions

Control character	Interface function
SH1	Handshake source function (source handshake), full capability
AH1	Handshake sink function (acceptor handshake), full capability
L4	Listener function, full capability, unaddress if MTA.
T6	Talker function, full capability, ability to respond to serial poll, unaddress if MLA
SR1	Service request function (Service Request), full capability
PP1	Parallel poll function, full capability
RL1	Remote/Local switch over function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability
C0	No controller function

IEC/IEEE Bus Messages

The messages transferred via the data lines of the IEC/IEEE bus can be divided into two groups:

– "Interface Messages" on page 8.5

– "Instrument Messages" on page 8.6

Interface Messages

Interface messages are transferred on the data lines of the IEC/IEEE bus when the "ATN" control line is active (LOW). They are used for communication between controller and instruments and can only be sent by the controller which currently has control of the IEC/IEEE bus.

Universal Commands

The universal commands are encoded 10 - 1F hex. They affect all instruments connected to the bus without addressing.

Table 8-2   Universal Commands

Command	QuickBASIC command	Effect on the instrument
DCL(Device Clear)	IBCMD (controller%, CHR$(20))	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument settings.
IFC(Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.
LLO(Local Lockout)	IBCMD (controller%, CHR$(17))	The LOC/IEC ADDR key is disabled.
SPE(Serial Poll Enable)	IBCMD (controller%, CHR$(24))	Ready for serial poll.
SPD(Serial Poll Disable)	IBCMD (controller%, CHR$(25))	End of serial poll.

Table 8-2   Universal Commands

Command	QuickBASIC command	Effect on the instrument
PPU (Parallel Poll Unconfigure)	IBCMD (controller%, CHR$(21))	End of the parallel-poll state.

Addressed Commands

The addressed commands are encoded 00 - 0F hex. They are only effective for instruments addressed as listeners.

Table 8-3   Addressed Commands

Command	QuickBASIC command	Effect on the instrument
SDC(Selected Device Clear)	IBCLR (device%)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
GTL(Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual control).
PPC(Parallel Poll Configure)	IBPPC (device%, data%)	Configure instrument for parallel poll. Additionally, the QuickBASIC command executes PPE/PPD.

Instrument Messages

Instrument messages are transferred on the data lines of the IEC/IEEE bus when the "ATN" control line is not active. ASCII code is used.

Structure and syntax of the instrument messages are described in chapter "Remote Control – Basics". The commands are listed and explained in detail in chapter "Remote Control – Description of Commands".

Printer Interface (LPT)

The instrument is equipped with a 25-pin LPT connector on the rear panel for connecting a printer. In Fig. 8-2 the pin assignment is described. The LPT interface is compatible with the CENTRONICS printer interface.
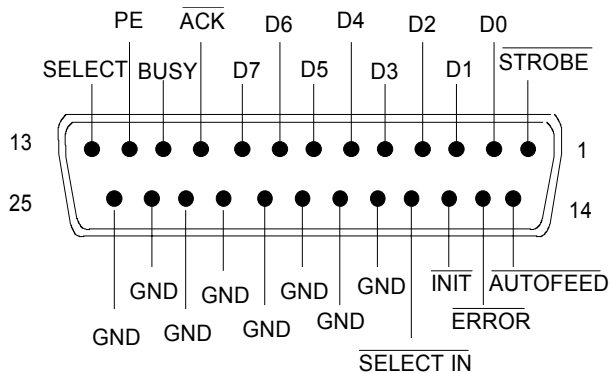
Fig. 8-2   LPT connector pin assignment

Pin	Signal	Input (I) Output (O)	Description
1	STROBE	O	Pulse for transmitting a data byte, min. 1µs pulse width (active LOW)
2	D0	O	Data Line 0
3	D1	O	Data Line 1
4	D2	O	Data Line 2
5	D3	O	Data Line 3
6	D4	O	Data Line 4
7	D5	O	Data Line 5
8	D6	O	Data Line 6
9	D7	O	Data Line 7
10	ACK	I	Indicates that the printer is ready to receive the next byte. (active LOW)
11	BUSY	I	Signal is active when the printer cannot accept data. (active HIGH)
12	PE	I	Signal is active when the paper tray is empty. (active HIGH)
13	SELECT	I	Signal is active when the printer is selected. (active HIGH)
14	AUTOFEED	O	When signal is active, the printer automatically performs a line feed after each line. (active LOW)
15	ERROR	I	This signal is high when the printer has no paper, is not selected or has an error status. (active LOW)
16	INIT	O	Initialize the printer. (active LOW)
17	SELECT IN	O	If signal is active, the codes DC1/DC3 are ignored by the printer. (active LOW).
18 - 25	GND		Ground connection.

Fig. 8-3   Pin assignments for the LPT connector.

RS-232-C Interface (COM)

The standard ESU is equipped with a serial interfaces (RS-232-C; COM connector at the rear of the instrument). The interface can be set up and activated manually in the *SETUP-GENERAL SETUP* menu in the *COM PORT* table (Selection *OWNER = INSTRUMENT*).

Interface Characteristics

- Serial data transmission in asynchronous mode
- Bi-directional data transfer via two separate lines
- Transmission rate selectable from 110 to 19200 baud
- Logic '0' signal from +3 V to +15 V
- Logic '1' signal from -15 V to -3 V
- External instrument (controller) can be connected
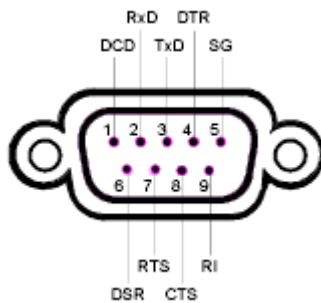
Fig. 8-4   Pin assignment of the RS-232-C interface

Signal Lines

- **DCD** (Data Carrier Detect)

  Not used in ESU.

  Input; active LOW.

  Using this signal, the local terminal recognizes that the modem of the remote station receives valid signals with sufficient level. DCD is used to disable the receiver in the local terminal and prevent reading of false data if the modem cannot interpret the signals of the remote station.

- **RxD** (Receive Data)

  Input, LOW = logic '1', HIGH = logic '0'.

  Data line, local terminal receives data from remote station.

- **TxD** (Transmit Data)

  Output, LOW = logic '1', HIGH = logic '0'.

  Data line, local terminal transmits data to remote station.

- **DTR** (Data Terminal Ready)

  Output, active LOW,

  Indicates that the local terminal is ready to receive data.

- **GND**

  Interface ground, connected to instrument ground

- **DSR** (Data Set Ready)

  Input, active LOW,

  Indicates that the remote station is ready to receive data.

- **RTS** (Request To Send)

  Output, active LOW.

  Indicates that the local terminal wants to transmit data.

- **CTS** (Clear To Send)

  Input, active LOW.

  Used to tell the local terminal that the remote station is ready to receive data.

- **RI** (Ring Indicator)

  Not used in ESU.

  Input, active LOW.

  Used by a modem to indicate that a remote station wants to establish a connection.

Transmission Parameters

To ensure error-free data transmission, the parameters of the instrument and the controller must have the same settings. The parameters are defined in the SETUP-GENERAL SETUP menu.

Transmission rate (baud rate)	The following transmission rates can be set in the instrument: 110, 300, 600, 1200, 2400, 4800, 9600, 19200.
Data bits	Data transmission is in 7- or 8-bit ASCII code. The first bit transmitted is the LSB (least significant bit).
Start bit	Each data byte starts with a start bit. The falling edge of the start bit indicates the beginning of the data byte.
Parity bit	In order to detect errors, a parity bit may be transmitted. No parity, even parity or odd parity may be selected. In addition, the parity bit can be set to logic '0' or to logic '1'.
Stop bits	The transmission of a data byte is terminated by 1, 1,5 or 2 stop bits.

Example

Transmission of character 'A' (41 hex) in 7-bit ASCII code, with even parity and 2 stop bits:
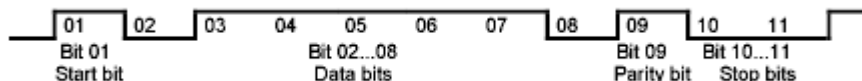
Control Characters

For interface control, several strings are defined and control characters are reserved which are based upon IEC/IEEE bus control.

Table 8-1   Control strings or control characters of the RS-232 interface

Control string or character	Function
'@REM'	Switch over to remote
'@LOC'	Switch over to local
'@SRQ'	Service Request SRQ (SRQ is sent by the instrument)
'@GET'	Group Execute Trigger (GET)
'@DCL'	Reset instrument (Device Clear DCL)
\<Ctrl Q\> 11 Hex	Enables character output / XON
\<Ctrl S\> 13 Hex	Inhibits character output / XOFF
0D Hex, 0A Hex	Terminator \<CR\>, \<LF\>

Handshake

Software handshake

In the software handshake mode of operation, the data transfer is controlled using the two control characters XON / XOFF.

The instrument uses the control character XON to indicate that it is ready to receive data. If the receive buffer is full, it sends the XOFF character via the interface to the controller. The controller then interrupts the data output until it receives another XON from the instrument. The controller indicates to the instrument that it is ready to receive data in the same way.

Cable required for software handshake

The connection of the instrument with a controller for software handshake is made by crossing the data lines. The following wiring diagram applies to a controller with a 9-pin or 25-pin configuration.
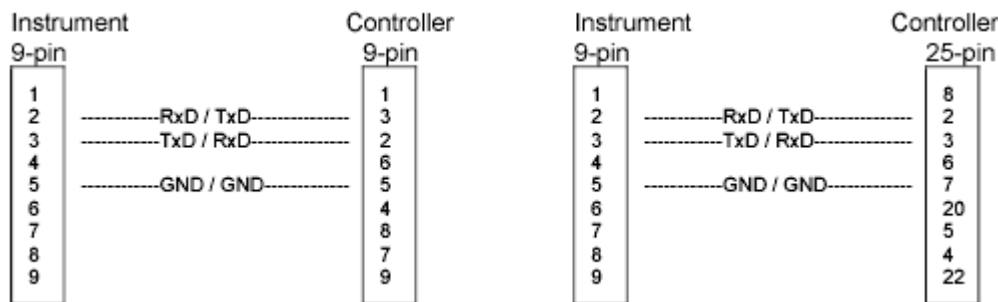
Fig. 8-5   Wiring of the data lines for software handshake

Hardware handshake

For hardware handshake, the instrument indicates that it is ready to receive data via the lines DTR and RTS. A logic '0' on both lines means 'ready' and a logic '1' means 'not ready'. The RTS line is always active (logic '0') as long as the serial interface is switched on. The DTR line thus controls the readiness of the instrument to receive data.

The readiness of the remote station to receive data is reported to the instrument via the CTS and DSR line. A logic '0' on both lines activates the data output and a logic '1' on both lines stops the data output of the instrument. The data output takes place via the TxD line.

Cable for hardware handshake

The connection of the instrument to a controller is made with a so-called zero modem cable. Here, the data, control and acknowledge lines must be crossed. The following wiring diagram applies to a controller with a 9-pin or 25-pin configuration.

```
Instrument                  Controller      Instrument                  Controller
9-pin                       9-pin           9-pin                       25-pin

1                           1               1                           8
2      ----------RxD / TxD--------------    3         2      ----------RxD / TxD--------------    2
3      ----------TxD / RxD--------------    2         3      ----------TxD / RxD--------------    3
4      ----------DTR /DSR--------------     6         4      ----------DTR /DSR--------------     6
5      ----------GND / GND-------------     5         5      ----------GND / GND-------------     7
6      ----------DSR / DTR-------------     4         6      ----------DSR / DTR-------------     20
7      ----------RTS / CTS-------------     8         7      ----------RTS / CTS-------------     5
8      ----------CTS / RTS-------------     7         8      ----------CTS / RTS-------------     4
9                           9               9                           22
```
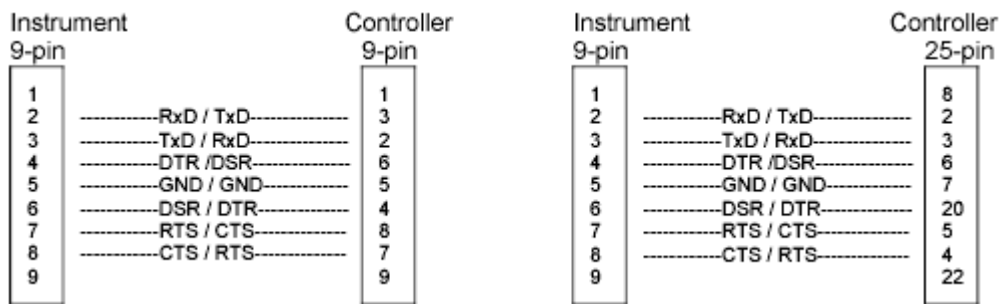
Fig. 8-6   Wiring of the data, control and acknowledge lines for hardware handshake

9 Error Messages

Introduction

Error messages are entered in the error/event queue of the status reporting system in the remote control mode and can be queried with the command `SYSTem:ERRor?`. The answer format of ESU to the command is as follows:

> <error code>, "<error text with queue query>;
> <remote control command concerned>"

The indication of the remote control command with prefixed semicolon is optional.

Example:

The command "`TEST:COMMAND`" generates the following answer to the query `SYSTem:ERRor?`:

> -113,"Undefined header;TEST:COMMAND"

The subsequent list contains the description of error texts displayed on the instrument.

Distinction is made between error messages defined by SCPI, which are marked by negative error codes, and the device-specific error messages for which positive error codes are used:

- "SCPI-Specific Error Messages" on page 9.3
- "Device-Specific Messages" on page 9.9

The right-hand column in the following tables contains the error text in bold which is entered in the error/event queue and can be read out by means of query `SYSTem:ERRor?`. A short explanation of the error cause is given below. The left-hand column contains the associated error code.

SCPI-Specific Error Messages

Table 9-1   No Error

Error code	Error text in the case of queue poll
	Error explanation
0	**No error**
	This message is output if the error queue does not contain any entries.

Table 9-2   Command Error - Faulty command; sets bit 5 in the ESR register

Error code	Error text in the case of queue poll
	Error explanation
-100	**Command Error**
	The command is faulty or invalid.
-101	**Invalid Character**
	The command contains an invalid sign.
	Example: A header contains an ampersand, "`SENSe&`".
-102	**Syntax error**
	The command is invalid.
	Example: The command contains block data the instrument does not accept.
-103	**Invalid separator**
	The command contains an invalid sign instead of a separator.
	Example: A semicolon is missing after the command.
-104	**Data type error**
	The command contains an invalid value indication.
	Example: ON is indicated instead of a numeric value for frequency setting.
-105	**GET not allowed**
	A Group Execute Trigger (GET) is within a command line.
-108	**Parameter not allowed**
	The command contains too many parameters.
	Example: Command `SENSe:FREQuency:CENTer` permits only one frequency indication.
-109	**Missing parameter**
	The command contains too few parameters.
	Example: The command `SENSe:FREQuency:CENTer` requires a frequency indication.
-110	**Command header error**
	The header of the command is faulty.
-111	**Header separator error**
	The header contains an invalid separator.
	Example: the header is not followed by a "White Space", "`*ESE255`"
-112	**Program mnemonic too long**
	The header contains more than 12 characters.

Table 9-2   Command Error - Faulty command; sets bit 5 in the ESR register (Continued)

Error code	Error text in the case of queue poll Error explanation
-113	**Undefined header** The header is not defined for the instrument. Example: `*XYZ` is undefined for every instrument.
-114	**Header suffix out of range** The header contains an invalid numeric suffix. Example: `SENSe3` does not exist in the instrument.
-120	**Numeric data error** The command contains a faulty numeric parameter.
-121	**Invalid character in number** A number contains an invalid character. Example: An "A" in a decimal number or a "9" in an octal number.
-123	**Exponent too large** The absolute value of the exponent is greater than 32000.
-124	**Too many digits** The number includes too many digits.
-128	**Numeric data not allowed** The command includes a number which is not allowed at this position. Example: The command `INPut:COUPling` requires indication of a text parameter.
-130	**Suffix error** The command contains a faulty suffix.
-131	**Invalid suffix** The suffix is invalid for this instrument. Example: nHz is not defined.
-134	**Suffix too long** The suffix contains more than 12 characters.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this position of the command. Example: The command `*RCL` does not permit a suffix to be indicated.
-140	**Character data error** The command contains a faulty text parameter
-141	**Invalid character data** The text parameter either contains an invalid character or it is invalid for this command. Example: Write error with parameter indication;`INPut:COUPling XC.`
-144	**Character data too long** The text parameter contains more than 12 characters.
-148	**Character data not allowed** The text parameter is not allowed for this command or at this position of the command. Example: The command `*RCL` requires a number to be indicated.
-150	**String data error** The command contains a faulty string.

Table 9-2   Command Error - Faulty command; sets bit 5 in the ESR register (Continued)

Error code	Error text in the case of queue poll Error explanation
-151	**Invalid string data** The command contains a faulty string. Example: An END message has been received prior to the terminating apostrophe.
-158	**String data not allowed** The command contains a valid string at a position which is not allowed. Example: A text parameter is set in quotation marks, `INPut:COUPling "DC"`
-160	**Block data error** The command contains faulty block data.
-161	**Invalid block data** The command contains faulty block data. Example: An END message was received prior to reception of the expected number of data.
-168	**Block data not allowed** The command contains valid block data at an invalid position. Example: The command `*RCL` requires a number to be indicated.
-170	**Expression error** The command contains an invalid mathematical expression.
-171	**Invalid expression** The command contains an invalid mathematical expression. Example: The expression contains mismatching parentheses.
-178	**Expression data not allowed** The command contains a mathematical expression at an invalid position.

Table 9-3   Execution Error - Error on execution of a command; sets bit 4 in the ESR register

Error code	Error text in the case of queue poll Error explanation
-200	**Execution error** Error on execution of the command.
-201	**Invalid while in local** The command is not executable while the device is in local due to a hard local control. Example: The device receives a command which would change the rotary knob state, but the device is in local so the command can not be executed.
-202	**Settings lost due to rtl** A setting associated with hard local control was lost when the device changed to LOCS from REMS or to LWLS from RWLS.
-210	**Trigger error** Error on triggering the device.
-211	**Trigger ignored** The trigger (GET, *TRG or trigger signal) was ignored because of device timing considerations. Example: The device was not ready to respond.

Table 9-3   Execution Error - Error on execution of a command; sets bit 4 in the ESR register (Continued)

Error code	Error text in the case of queue poll
	Error explanation
-212	**Arm ignored**
	An arming signal was ignored by the device.
-213	**Init ignored**
	Measurement initialization was ignored as another measurement was already in progress.
-214	**Trigger deadlock**
	The trigger source for the initiation of measurement is set to GET and subsequent measurement is received. The measurement cannot be started until a GET is received, but the GET would cause an interrupted-error)
-215	**Arm deadlock**
	The trigger source for the initiation of measurement is set to GET and subsequent measurement is received. The measurement cannot be started until a GET is received, but the GET would cause an interrupted-error.
-220	**Parameter error**
	The command contains a faulty or invalid parameter.
-221	**Settings conflict**
	There is a conflict between setting of parameter value and instrument state.
-222	**Data out of range**
	The parameter value lies out of the allowed range of the instrument.
-223	**Too much data**
	The command contains too many data.
	Example: The instrument does not have sufficient storage space.
-224	**Illegal parameter value**
	The parameter value is invalid.
	Example: The text parameter is invalid, `TRIGger:SWEep:SOURce TASTe`
-230	**Data corrupt or stale**
	The data are incomplete or invalid.
	Example: The instrument has aborted a measurement.
-231	**Data questionable**
	The measurement accuracy is suspect.
-240	**Hardware error**
	The command cannot be executed due to problems with the instrument hardware.
-241	**Hardware missing**
	Hardware is missing.
	Example: An option is not fitted.
-250	**Mass storage error**
	A mass storage error occurred.
-251	**Missing mass storage**
	The mass storage is missing.
	Example: An option is not installed.

Table 9-3 Execution Error - Error on execution of a command; sets bit 4 in the ESR register (Continued)

Error code	Error text in the case of queue poll Error explanation
-252	**Missing media** The media is missing. Example: There is no memory stick connected.
-253	**Corrupt media** The media is corrupt. Example: The memory stick has a defect.
-254	**Media full** The media is full. Example: There is no room on the memory stick.
-255	**Directory full** The media directory is full.
-256	**File name not found** The file name cannot be found on the media.
-257	**File name error** The file name is wrong. Example: An attempt is made to copy to a duplicate file name.
-258	**Media protected** The media is protected. Example: The write-protect tab on the memory stickis present.
-260	**Expression error** The expression contains an error.

Table 9-4 Device Specific Error; sets bit 3 in the ESR register

Error code	Error text in the case of queue poll Error explanation
-300	**Device-specific error** ESU-specific error not defined in greater detail.
-310	**System error** This error message suggests an error within the instrument. Please inform the R&S Service.
-313	**Calibration memory lost** Loss of the non-volatile data stored using the *CAL? command. This error occurs when the correction data recording has failed.
-330	**Selftest failed** The selftest could not be executed.
-350	**Queue overflow** This error code is entered in the queue instead of the actual error code if the queue is full. It indicates that an error has occurred but not been accepted. The queue can accept 5 entries.

Table 9-5   Query Error - Error in data request; sets bit 2 in the ESR register

Error code	Error text in the case of queue poll Error explanation
-400	**Query error** General error occurring when data are requested by a query.
-410	**Query INTERRUPTED** The query has been interrupted. Example: After a query, the instrument receives new data before the response has been sent completely.
-420	**Query UNTERMINATED** The query is incomplete. Example: The instrument is addressed as a talker and receives incomplete data.
-430	**Query DEADLOCKED** The query cannot be processed. Example: The input and output buffers are full, the instrument cannot continue operation.
-440	**Query UNTERMINATED after indefinite response** A query is in the same command line after a query which requests an indefinite response.

Device-Specific Messages

Table 9-6   Device-specific messages

Error code	Error text in the case of queue poll Error explanation
1036	**MS: The correction table based amplifier gain exceeds the amplifier range for CALAMP1 and CALAMP2 on IF board** This message is output when the setting range of the calibration amplifier is not sufficient for the required correction. The error occurs only with modules which are not correctly adjusted or defective.
1052	**Frontend LO is Unlocked** This message is output when the phase regulation of the local oscillator fails in the RF frontend.
1060	**Trigger-Block Gate Delay Error- gate length < Gate Delay** This message is output when the gate signal length is not sufficient for the pull-in delay with a predefined gate delay.
2022	**OPTIONS.INI invalid** This message is output when an error has been recognized in the file OPTIONS.INI which contains the clearing codes for retrofitable firmware applications. If this file is not correctly recognized, all firmware applications are blocked for this instrument.
2028	**Hardcopy not possible during measurement sequence** This message is output when a printout is started during scan sequences that cannot be interrupted. Such sequences are for example: • Recording the system error correction data (calibration) • Instrument selftest In such cases a synchronization to the end of the scan sequence should be performed prior to starting the printout.
2033	**Printer Not Available** This message is output when the selected printer is not included in the list of available output devices. A possible cause is that the required printer driver is missing or incorrectly installed.
2034	**CPU Temperature is too high** This message is output when the temperature of the processor exceeds 70 °C.

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