R&S®SMF100A
Microwave Signal Generator
Operating Manual

1167.2319.32 — 04

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the R&S®SMF100A, stock no. 1167.0000.02 and its options.

- R&S®SMF-B1
- R&S®SMF-B2
- R&S®SMF-B20
- R&S®SMF-B22
- R&S®SMF-B26
- R&S®SMF-B27
- R&S®SMF-B32/34
- R&S®SMF-B81/B82
- R&S®SMF-B83/84/85
- R&S®SMF-B122/144
- R&S®SMF-K3
- R&S®SMF-K4
- R&S®SMF-K23
- R&S®SMF-K27
- R&S®SMF-K28

The firmware of the instrument makes use of the operating system LINUX® and other valuable open source software packages. The most important of them together with their corresponding open source license and the verbatim license texts are provided on the user documentation CD-ROM (included in delivery).
The OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/) includes cryptographic software written by Eric Young (eay@cryptsoft.com) and software written by Tim Hudson (tjh@cryptsoft.com). LINUX® is a trademark of Linus Torvalds.
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

Muehldorfstr. 15, 81671 Munich, Germany
Phone: +49 89 41 29 - 0
Fax: +49 89 41 29 12 164
E-mail: info@rohde-schwarz.com
Internet: http://www.rohde-schwarz.com

The following abbreviations are used throughout this manual: R&S®SMF100A is abbreviated as R&S SMF.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached 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, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies 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, if expressly permitted, also 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 any 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 product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

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 and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Symbols and safety labels

							
Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

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

Tags and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

DANGER	indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	indicates the possibility of incorrect operation which can result in damage to the product. In the product documentation, the word ATTENTION is used synonymously.

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 in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency.
2. 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). An installation that is not carried out as described in the product documentation could result in personal injury or death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

Electrical safety

If the information on electrical safety is not observed either at all to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure 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.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
3. 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.
4. If the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. 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.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. 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 licensed electrician.
13. 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 anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.

14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1. Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts 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). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.
5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
6. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
7. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
8. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.

2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal

1. If products or their 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 by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
2. If handling the product releases 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. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

Informaciones elementales de seguridad

Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!

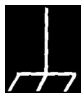
El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad adjunto de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas 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 está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Símbolos y definiciones de seguridad

							
Aviso: punto de peligro general Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Adver-tencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

I ○	⏻	⎓	~	≂	⧈
Tensión de alimentación de PUESTA EN MARCHA / PARADA	Indicación de estado de espera (Standby)	Corriente continua (DC)	Corriente alterna (AC)	Corriente continua / Corriente alterna (DC/AC)	El aparato está protegido en su totalidad por un aislamiento doble (reforzado)

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

PELIGRO	PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.
ADVERTENCIA	ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.
ATENCIÓN	ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.
AVISO	AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo. En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto 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 interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, pueden causarse lesiones o incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, 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 bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. 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. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados, los llamados alérgenos (p. ej. el níquel). Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

6. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
7. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
8. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación

1. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
2. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

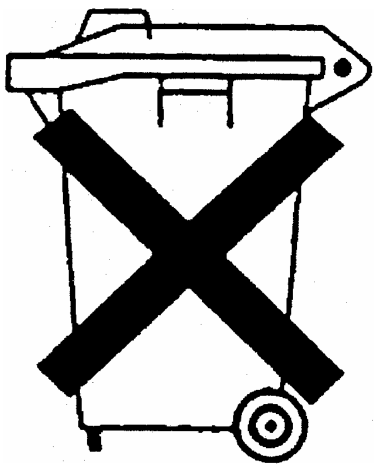
Kundeninformation zur Batterieverordnung (BattV)

Dieses Gerät enthält eine schadstoffhaltige Batterie. Diese darf nicht mit dem Hausmüll entsorgt werden.

Nach Ende der Lebensdauer darf die Entsorgung nur über eine Rohde&Schwarz-Kundendienststelle oder eine geeignete Sammelstelle erfolgen.

Safety Regulations for Batteries (according to BattV)

This equipment houses a battery containing harmful substances that must not be disposed of as normal household waste.



After its useful life, the battery may only be disposed of at a Rohde & Schwarz service center or at a suitable depot.

Normas de Seguridad para Baterías (Según BattV)

Este equipo lleva una batería que contiene sustancias perjudiciales, que no se debe desechar en los contenedores de basura domésticos.

Después de la vida útil, la batería sólo se podrá eliminar en un centro de servicio de Rohde & Schwarz o en un depósito apropiado.

Consignes de sécurité pour batteries (selon BattV)

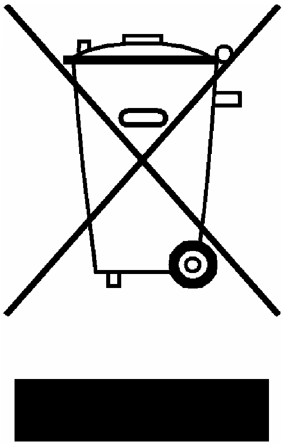
Cet appareil est équipé d'une pile comprenant des substances nocives. Ne jamais la jeter dans une poubelle pour ordures ménagéres.

Une pile usagée doit uniquement être éliminée par un centre de service client de Rohde & Schwarz ou peut être collectée pour être traitée spécialement comme déchets dangereux.

Customer Information Regarding Product Disposal

The German Electrical and Electronic Equipment (ElektroG) Act is an implementation of the following EC directives:

- 2002/96/EC on waste electrical and electronic equipment (WEEE) and
- 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).



Product labeling in accordance with EN 50419

Once the lifetime of a product has ended, this product must not be disposed of in the standard domestic refuse. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Rohde & Schwarz GmbH & Co. KG has developed a disposal concept for the environmental-friendly disposal or recycling of waste material and fully assumes its obligation as a producer to take back and dispose of electrical and electronic waste in accordance with the ElektroG Act.

Please contact your local service representative to dispose of the product.

ROHDE&SCHWARZ

Qualitätszertifikat
Certificate of quality
Certificat de qualité

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

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 Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

Dear Customer,
You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde & Schwarz quality management system is certified according to standards such as ISO 9001 and ISO 14001.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Cher client,
Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde & Schwarz a été homologué, entre autres, conformément aux normes ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de gestion de l'environnement certifié selon ISO 14001

1171.0200.11 V 04.01

ROHDE & SCHWARZ

ROHDE&SCHWARZ

EC Certificate of Conformity

Certificate No.: 2006-101

This is to certify that:

Equipment type	Stock No.	Designation
SMF100A	1167.0000.02	Signal Generator Basic Unit
SMF-B122	1167.7004.03	Frequency Range 1 GHz to 22 GHz
SMF-B144	1167.7204.03	Frequency Range 1 GHz to 43.5 GHz
SMF-B1	1167.9159.02	Reference Oscillator OCXO
SMF-B2	1167.4005.02	Frequency Extension 100 kHz to 1 GHz
SMF-B20	1167.9594.02	AM/FM/Scan Modulator
SMF-B22	1415.2204.02	Enhanced Phase Noise Performance
SMF-B26	1167.5553.02	Step Attenuator 100 kHz bis 22 GHz
SMF-B27	1167.5776.02	Step Attenuator 100 kHz bis 43,5 GHz
SMF-B31	1167.7404.02	High-Output-Power 1 GHz bis 22 GHz
SMF-B32	1415.2304.02/ .03	High Output Power
SMF-B34	1415.2424.02	High-Output-Power
SMF-B81	1167.5999.02	Rear Connectors for RF to 22 GHz, AF
SMF-B82	1167.6208.02	Rear Connectors for RF to 43,5 GHz, AF
SMF-B83	1167.6408.02	Removable GPIB
SMF-B84	1167.6608.02	Removable USB
SMF-B85	1167.6808.02	Removable Flash-Card

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 (2006/95/EC)
- relating to electromagnetic compatibility (2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61010-1 : 2001
EN 61326-1 : 2006
EN 61326-2-1 : 2006
EN 55011 : 1998 + A1 : 1999 + A2 : 2002, class A
EN 61000-3-2 : 2006
EN 61000-3-3 : 1995 + A1 : 2001 + A2 : 2005

For the assessment of electromagnetic compatibility, the limits of radio interference for Class A 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, 2009-03-17

Central Quality Management MF-QZ / Radde

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

USA & Canada

Monday to Friday	(except US public holidays)
8:00 AM – 8:00 PM	Eastern Standard Time (EST)
Tel. from USA	888-test-rsa (888-837-8772) (opt 2)
From outside USA	+1 410 910 7800 (opt 2)
Fax	+1 410 910 7801
E-mail	CustomerSupport@rohde-schwarz.com

East Asia

Monday to Friday	(except Singaporean public holidays)
8:30 AM – 6:00 PM	Singapore Time (SGT)
Tel.	+65 6 513 0488
Fax	+65 6 846 1090
E-mail	CustomerSupport@rohde-schwarz.com

Rest of the World

Monday to Friday	(except German public holidays)
08:00 – 17:00	Central European Time (CET)
Tel.	+49 89 4129 13774
Fax	+49 (0) 89 41 29 637 78
E-mail	CustomerSupport@rohde-schwarz.com

ROHDE&SCHWARZ

1171.0200.22-04.00

Address List

Headquarters, Plants and Subsidiaries

Headquarters

ROHDE&SCHWARZ GmbH & Co. KG
Mühldorfstraße 15 · D-81671 München
P.O.Box 80 14 69 · D-81614 München
Phone +49 (89) 41 29-0
Fax +49 (89) 41 29-121 64
info.rs@rohde-schwarz.com

Plants

ROHDE&SCHWARZ Messgerätebau GmbH
Riedbachstraße 58 · D-87700 Memmingen
P.O.Box 16 52 · D-87686 Memmingen
Phone +49 (83 31) 1 08-0
+49 (83 31) 1 08-1124
info.rsmb@rohde-schwarz.com

ROHDE&SCHWARZ GmbH & Co. KG
Werk Teisnach
Kaikenrieder Straße 27 · D-94244 Teisnach
P.O.Box 11 49 · D-94240 Teisnach
Phone +49 (99 23) 8 50-0
Fax +49 (99 23) 8 50-174
info.rsdts@rohde-schwarz.com

ROHDE&SCHWARZ závod
Vimperk, s.r.o.
Location Spidrova 49
CZ-38501 Vimperk
Phone +420 (388) 45 21 09
Fax +420 (388) 45 21 13

ROHDE&SCHWARZ GmbH & Co. KG
Dienstleistungszentrum Köln
Graf-Zeppelin-Straße 18 · D-51147 Köln
P.O.Box 98 02 60 · D-51130 Köln
Phone +49 (22 03) 49-0
Fax +49 (22 03) 49 51-229
info.rsdc@rohde-schwarz.com
service.rsdc@rohde-schwarz.com

Subsidiaries

R&S BICK Mobilfunk GmbH
Fritz-Hahne-Str. 7 · D-31848 Bad Münder
P.O.Box 20 02 · D-31844 Bad Münder
Phone +49 (50 42) 9 98-0
Fax +49 (50 42) 9 98-105
info.bick@rohde-schwarz.com

ROHDE&SCHWARZ FTK GmbH
Wendenschloßstraße 168, Haus 28
D-12557 Berlin
Phone +49 (30) 658 91-122
Fax +49 (30) 655 50-221
info.ftk@rohde-schwarz.com

ROHDE&SCHWARZ SIT GmbH
Am Studio 3
D-12489 Berlin
Phone +49 (30) 658 84-0
Fax +49 (30) 658 84-183
info.sit@rohde-schwarz.com

R&S Systems GmbH
Graf-Zeppelin-Straße 18
D-51147 Köln
Phone +49 (22 03) 49-5 23 25
Fax +49 (22 03) 49-5 23 36
info.rssys@rohde-schwarz.com

GEDIS GmbH
Sophienblatt 100
D-24114 Kiel
Phone +49 (431) 600 51-0
Fax +49 (431) 600 51-11
sales@gedis-online.de

HAMEG Instruments GmbH
Industriestraße 6
D-63533 Mainhausen
Phone +49 (61 82) 800-0
Fax +49 (61 82) 800-100
info@hameg.de

Locations Worldwide

Please refer to our homepage: www.rohde-schwarz.com

- Sales Locations
- Service Locations
- National Websites

Contents

1 Preface

1.1 Documentation Overview

The user documentation for the R&S SMF consists of the following parts:

- Online Help system on the instrument,
- "Quick Start Guide" printed manual,
- Documentation CD-ROM with:
  - Online help system (*.chm) as a standalone help,
  - Operating Manual,
  - Service Manual,
  - Data sheet and specifications,
  - Links to useful sites on the R&S internet.

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. The online help contains help on operating the R&S SMF and all available options.

Quick Start Guide

This manual is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and an example of setup are described. The manual includes also general information, e.g., Safety Instructions.

Operating Manual

The Operating Manual is a supplement to the Quick Start Guide. The manual are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given. The manual can also be orderd in printed form (see ordering information in the data sheet).

Service Manual

This Service Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. It describes how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the instrument by the replacement of modules.

This manual can also be orderd in printed form (see ordering information in the data sheet).

Release Notes

The release notes describe new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided in the Internet.

1.2 Conventions Used in the Documentation

The following conventions are used throughout this documentation:

Typographical conventions

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by parentheses.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by parentheses.

2 Putting into Operation

Refer to the corresponding chapter in the Quick Start Guide.

3 Getting Started

Refer to the corresponding chapter in the Quick Start Guide.

4 Manual Operation

Refer to the corresponding chapter in the Quick Start Guide.

5 Instrument Function

5.1 Overview of Instrument Functions

This chapter explains the functions of the R&S SMF and the options available in the setting menus. The associated SCPI command is specified for each parameter (where applicable).

The description begins with the general instrument settings which do not directly affect signal generation. The majority of these settings can be accessed by means of front-panel softkey menus and not by means of function block menus.

The signal generation functions are then described, beginning with the functions which affect the RF signal (RF Frequency block), the level control (Level Control block), and the analog and digital modulations (Modulation block).

The next section describes the LF signal generation (LF Gen./Noise block) and the LF output (LF Output block).

This is followed by an description about the configuration of the internal pulse generator (Pulse Gen. block) and the modulation of the internal or external pulse signal (Pulse Mod. block).

The remaining part of this chapter describes the attenuator settings (Attenuator block).

The general instrument settings include various functions, such as:

- Setting a defined basic setup using the PRESET key
  see chapter 5.2.2, "Default Instrument Settings - Preset Key", on page 21
- Switching from remote control to manual control using the LOCAL key
  see chapter 5.2.4, "Switching to Manual Control - Local Key", on page 42
- Configuring the generator and its interfaces in the "Setup" menu - e.g. setting the GPIB address, starting an adjustment, querying instrument data
  see chapter 5.2.3, "General Configuration of Instrument - Setup Key", on page 22
- Generating a hardcopy of the display using the HCOPY key
  see chapter 5.2.5, "Generating a Hard Copy of the Display", on page 43
- Calling up the online help using the HELP key
  see chapter 5.2.7, "Help System - Help Key", on page 46
- Querying messages using the INFO key
  see chapter 5.2.6, "Messages - Info Key", on page 46
- Loading and storing complete instrument settings in the "File" menu
  see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 47

The RF signal and the reference oscillator are configured in the "RF Frequency" function block:

- CW mode
  see chapter 5.3.1, "Overview of RF Signal", on page 53
- List mode
  see chapter 5.3.5, "List Mode", on page 68

- Frequency and Level Sweep mode
  see chapter 5.3.4.1, "Overview", on page 58
- Reference Oscillator
  see chapter 5.3.6, "Reference Oscillator", on page 77

The RF level control is configured in the "Level Control" function block:

- RF Level
  see chapter 5.4.1, "Overview RF Level Settings", on page 80
- RF Level Sweep
  see chapter 5.4.4, "RF Level Sweep", on page 84
- ALC
  see chapter 5.4.5, "Automatic Level Control - ALC", on page 90
- Power Sensors
  see chapter 5.4.6, "Power Sensors", on page 93
- User Correction
  see chapter 5.4.7, "User Correction", on page 134

The analog and external digital modulations are activated in the "Modulation" function block:

- Amplitude Modulation
  see chapter 5.5.2, "Amplitude Modulation (AM)", on page 144
- Frequency Modulation
  see chapter 5.5.3, "Frequency Modulation (FM)", on page 146
- Phase Modulation
  see chapter 5.5.4, "Phase Modulation (PhiM)", on page 148
- Digital Modulation
  see chapter 5.5.5, "Digital Modulation", on page 150
- Pulse Modulation
  see chapter 5.5.6, "Pulse Modulation (PM)", on page 153

The internal LF generators, the LF frequency sweep, and the noise generator are configured in the "LF Gen./Noise" function block:

- LF Gen./Noise
  see chapter 5.6, "LF Gen./Noise", on page 159
- LF Frequency Sweep
  see chapter 5.6.3, "LF Frequency Sweep", on page 163

- The LF output is configured in the "LF Output" block, see chapter 5.7, "LF Output", on page 170.
- The pulse generation is configured in the "Pulse Gen." block, see chapter 5.8, "Pulse Generator", on page 179
- The attenuator is configured in the "Attenuator" block, see chapter 5.9, "Attenuator", on page 187

5.2 General Instrument Settings

5.2.1 Overview of General Instrument Settings

This section describes the settings which do not directly affect signal generation. Most of these settings can only be accessed by means of menus which are opened using keys or key combinations on the external keyboard or keys on the front panel key emulation.

The general instrument settings therefore affect various functions, such as storing instrument settings using the FILE key or setting the GPIB address in the menu of the SETUP key. The order in which the descriptions are given corresponds to the layout of the keys on the front panel of the R&S SMF (from top left to bottom right).

5.2.2 Default Instrument Settings - Preset Key

The PRESET key calls up a defined instrument setup. All parameters and switching states are preset (also those of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings.

However, functions that concern the integration of the instrument into a measurement setup are not changed, e.g. GPIB address or reference oscillator source settings.

When the instrument is switched on, it is not the preset state that is active, but rather the instrument state that was set before the instrument was switched on.

User-defined instrument states can be stored and called up in the "File" menu.

Resetting the instrument to the factory state is possible in with the Factory Preset function.

Preset
Presets all parameters and switching states.

The following list gives an overview of the presets for the most important generator settings. The other presets can be found in the preset tables of the individual menus and the information accompanying the remote commands.

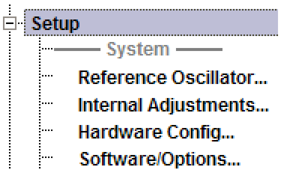
- "RF frequency" = 1 GHz
- "RF level" RF output switched off
- "Offsets" = 0
- "Modulations State" = Off
- Uninterrupted level settings are switched off
  "Level Attenuator Mode" = AUTO
- Internal level control "Level ALC" = AUTO
- User correction "Level Ucor" = OFF
- "LF output State" = Off
- "Sweep State" = Off
- "List mode State" = Off

Settings that are not affected by the PRESET key

- Reference frequency settings ("Ref Oscillator" menu)
- Power on settings ("Level/EMF" menu)
- Network settings ("Setup" menu)
- GPIB address ("Setup" menu)
- *IDN? Identification and emulation ("Setup" menu)
- Password and settings protected by passwords ("Setup" menu)
- Start/Stop Gui Update ("Setup" menu)
- Display and keyboard settings ("Setup" menu)

SCPI command:
`*RST` on page 232

5.2.3 General Configuration of Instrument - Setup Key



The SETUP key opens the "Setup" dialog.

The "Setup" dialog is divided into several sections.

- The "System" section is used to set general instrument parameters.
- The "Test" section is used to perform function tests.
- The "Environment" section is used to configure the controller interfaces.
- The "Remote" section is used to configure the remote control interfaces.
- The "Protection" is used to set the protection level for service functions.
- The "Settings" section contains the "Save/Recall" dialog.

Most submenus of this key can be accessed only via the SETUP key or the menu tree (MENU key), with the following exceptions:

- The "Reference Oscillator" dialog can also be called up in the "RF" block and is therefore described in the section on this block (see chapter 5.3.6, "Reference Oscillator", on page 77).
- The "Save/Recall" dialog can also be called up with the FILE key and is therefore described in the section on this key (see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 47.

5.2.3.1 Internal Adjustments

The R&S Microwave Signal Generator is extremely accurate thanks to the integrated procedures for adjustments.

All internal adjustments for which no external measuring equipment is needed can be started in the "Internal Adjustments..." menu. The adjustments with external measuring equipment are described in the Service Manual (on CD ROM, supplied with the instrument).

Adjustment is recommended if the temperature range in which the instrument is operated changes, or prior to all applications which require maximum level and frequency accuracy.

During adjustment a bar indicates the status of progress. If an error occurs, adjustment is terminated and an error message is output in the info line.

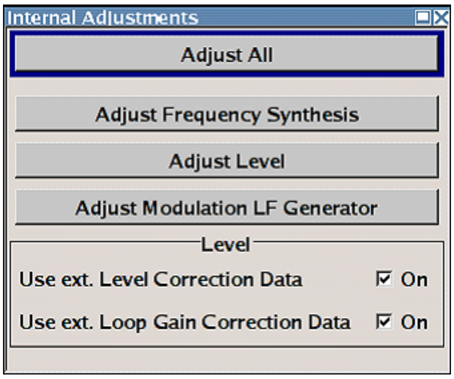
NOTICE

Risk of invalid adjustment

In order to achieve correct adjustment of the instrument, make sure that the instrument is warm before performing adjustments. The warm-up time is 30 minutes.

To access the "Internal Adjustments" dialog, press the SETUP or MENU key under "System".

The adjustments offered also depend on the installed options.



Adjust All

Starts all internal adjustments for which no external measuring equipment is needed. The adjustments with external measuring equipment are described in the Service Manual (supplied).

SCPI command:

`:CALibration:ALL[:MEASure]` on page 236

Adjust Synthesis

Performs all adjustments which affect the frequency.

This includes adjustment of option R&S SMF-B20, AM/FM/SCAN modulator, LF and Low Phase Noise.

SCPI command:

`:CALibration<hw>:FREQuency[:MEASure]` on page 236

Adjust Level

Performs all adjustments which affect the level. The acquired correction values improve the settling time and the signal quality.

SCPI command:

`:CALibration<hw>:LEVel[:MEASure]` on page 237

Adjust Modulation LF Generator

Performs all adjustments that affect the internal modulation generators.

SCPI command:

`:CALibration:LFOutput[:MEASure]` on page 237

Use ext. Level Correction Data

This feature not yet available, but it is intended for future use.

SCPI command:
n.a.

Use ext. Loop Gain Correction Data

Switch on or off use of external loop gain correction data.

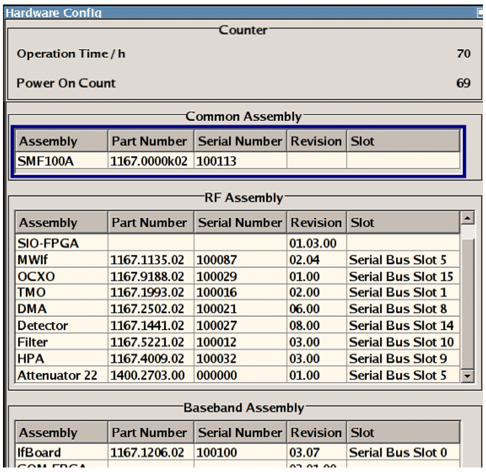
This feature is a protected function (see service manual, chapter "Adjustment").

SCPI command:
`:CALibration<hw>:LEVel:LOOPgain:STATe` on page 236

5.2.3.2 Hardware Config

In the "Hardware Config" dialog, the installed assemblies together with their variants and revision states can be displayed for servicing purposes.

To open the "Hardware Config" dialog, select "System" and press the SETUP or MENU key.



Section "Counter" in the upper part of the menu shows the "Operation Time" (in hours) and the number of power-on ("Power On Counter").

The second part of the menu is a table that lists the installed assemblies. It is divided into the sections:

- "Common Assembly"
- "RF Assembly"
- "Baseband Assembly"

Operation Time / h

Displays the operation time in hours.

SCPI command:
`:DIAGnostic:INFO:OTIMe` on page 238

Power On Count

Displays the number of power-on.

SCPI command:

`:DIAGnostic:INFO:POCount` on page 239

Assembly

The tables list the installed assemblies.

"Assembly"	Assembly name
"Part Number"	Part Number of assembly
"Serial Number"	Serial Number of assembly
"Revision"	Revision state of assembly
"Slot"	Indicates whether the assembly is connected to the serial bus or PCI bus.

SCPI command:

`:DIAGnostic<hw>:BGINfo` on page 237

5.2.3.3 Software / Options

The "Software/Options" dialog shows the firmware version of the instrument software as well as all installed hardware and software options.

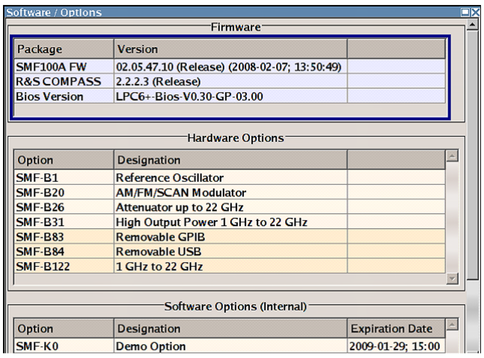
Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in Chapter 4 of the Service Manual (supplied with the instrument).

The installation of hardware options purchased at a later stage is also described in Chapter 4 of the Service Manual (supplied with the instrument). Most hardware options need to be installed at an authorized Rohde&Schwarz service shop.

To access the "Software/Options" dialog, select "System" and press the SETUP or MENU key.

The menu is devided into the following sections:

- "Firmware"
- "Hardware Options"
- "Software Options"



Firmware
The Firmware section of the menu shows the firmware version and the version of the software platform.

Note: Your instrument is delivered with the latest firmware version available. Firmware updates as well as the Release Notes describing the improvements and modifications are provided on the Internet at the download site of the Rohde & Schwarz Signal generator home page. This home page always offers the latest information on your signal generator, e.g. also on changes of the firmware update procedure.

SCPI command:
n.a.

Hardware Options / Software Options
The tables in the sections "Hardware" and "Software" list the installed hardware and software options.

"Option"	Short name of option
"Designation"	Name of Option
"Licenses"	Number of licenses.
"Expiration Date"	For regular options, "Permanent" is indicated in this column. Some options are available as trial versions. This column shows their expiration date. After this date, the option is no longer available on the instrument.

SCPI command:
`*OPT?`
`*IDN?`

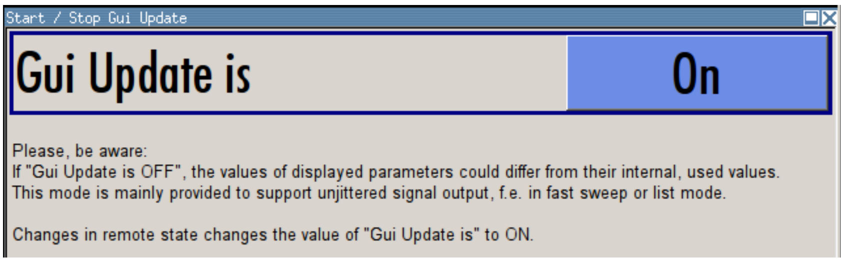
Loaded Modules
Section "Loaded Modules" is provided for service purposes. It lists all loaded software modules with their versions and offers a short description of each module.

SCPI command:
n.a.

5.2.3.4 Gui Update

The "Start/Stop Gui Update" dialog provides the possibility to switch off update of the displayed parameters in order to increase speed for certain settings.

The indicated values are not updated and may therefore differ from the intern, used values.



On/Off GUI Update

Switchs on/off update of the displayed parameters.

Switching off the update of the displayed parameters increases the speed for certain settings.

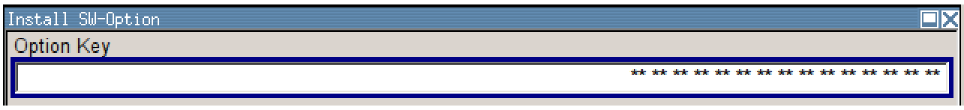
Note: It is especially recommended to switch off the GUI update for optimum sweep performance with short dwell times and for fast settling times.

SCPI command:

`:SYSTem:DISPlay:UPDate` on page 433

5.2.3.5 Install SW-Option

Newly purchased software options are enabled in the "Install SW-Options" menu. They are ready to operate after they are enabled by means of a key code supplied with the option.

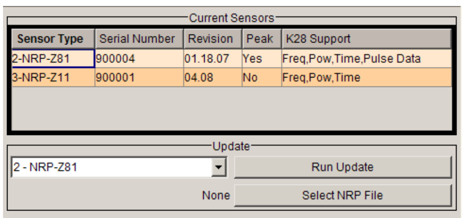


Only if the R&S Microwave Signal Generator is equipped with an older firmware version, a firmware update prior to enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option. The firmware update is described in the service manual instrument, chapter 4 (on CD ROM, supplied with the instrument).

5.2.3.6 NRP-Z Info/Update

In the "NRP-Z Info/Update…" dialog, the connected power sensors are indicated together with their serial number, revision state and features in terms of support of the R&S SMF-K28 Power Analysis option. The software of a connected sensor can be updated to a new version.

To access the "NRP-Z Info/Update…" dialog, select "System" and press the SETUP or MENU key.



Current Sensors

Section "Current Sensors" lists the sensors that are connected to the generator and indicates their serial number, the revision state and some features.

SCPI command:

n.a.

Update

Section "Update" provides access to the file system in order to select a file for an R&S NRP sensor update (Button "Select NRP File"), the selected file is indicated to the left of the button. On the left side, the sensor to be updated is selected.

Button "Run Update" starts the update. If the update is interrupted for example by accidently pulling off the sensor, selection "Rescue" is offered to restart the update process. Prerequisite is that no other sensor is connected to the instrument.

The procedure is as follows:

- Do not reconnect the sensor but keep it ready to be connected
- Select "Rescue" in the left sensor selection field
- Activate "Run Update"
- Confirm query in message box
- Connect sensor within 4 seconds
  The update starts, a bar informs about the progress.

SCPI command:

`SENSe<ch>[:POWer]:TYPE` on page 303

`SENSe<ch>[:POWer]:SVERsion` on page 274

`SENSe<ch>[:POWer]:SNUMber` on page 273

5.2.3.7 Update

After a firmware update it is occasionally required to also update the "PCI-FPGA". This is enabled in the "Update" dialog.

At the first start of the new firmware, a message appears during the boot process if a "PCI-FPGA" update is required. Execute a PCI-FPGA update by pressing the "PCI-FPGA" button.

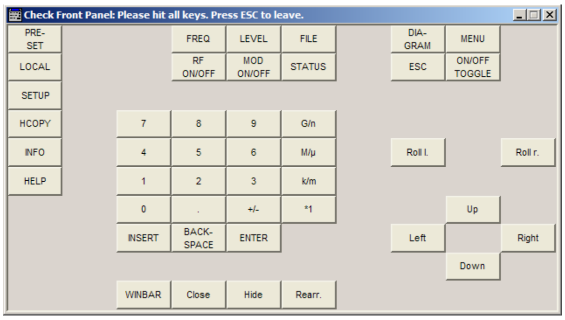
NOTICE

Impairment of instrument functions

To avoid impairment of instrument functions, the update of the "PCI-FPGA" must not be cancelled and the instrument must not be switched off during this update.

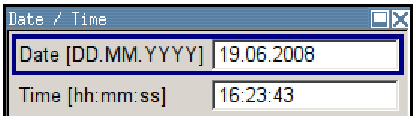
5.2.3.8 Check Front Panel

The "Check Front Panel" dialog is used to check whether the front panel keys are functioning correctly. The menu displays all the front panel keys arranged in the same way as on the front panel. The respective function is executed by pressing the associated key.



5.2.3.9 Date and Time

The "Date/Time..." dialog provides access to the system time and date settings. It is opened using the SETUP or MENU key under "Environment". The time is used on the internal controller.



Date

Enters the date in the format day.month.year.

SCPI command:

`:SYSTem:DATE` on page 433

Time

Enters the time in the format hour.minute.second

SCPI command:

`:SYSTem:TIME` on page 439

5.2.3.10 Network Settings

The "Network Settings" dialog provides access to the network settings. To access this dialog, press the SETUP or MENU key under "Environment". The R&S SMF is equipped with a network interface and can be connected to an Ethernet LAN (local area network).

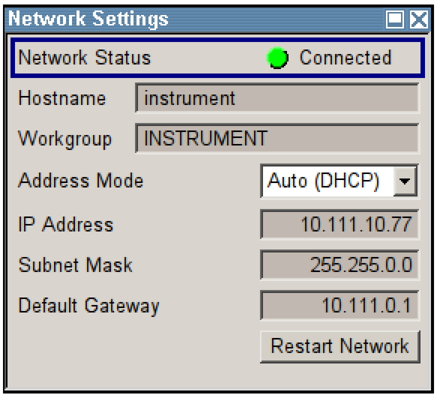
NOTICE

Risk of network errors!

Connecting errors may affect the entire network.

We recommend to coordinate the connection of the instrument to the network with the network administrator.

Do not connect or disconnect the network cable until the instrument is **switched off** (standby). Only then the network connection can be reliably detected and impairments to instrument operation can be avoided.



The dialog provides an access to the network settings, like settings about the general network environment and specific identification of the computer in the network, as well as an indication whether the instrument is connected to the network or not.

Network Status

Indicates whether the instrument is connected to the network or not.

SCPI command:
n.a.

Hostname

Enters the individual computer name of the R&S Microwave Signal Generator.

Note: The computer name can only be changed after protection level 1 is deactivated (see chapter 5.2.3.14, "Protection", on page 36).

A predefined name is indicated and can be used for network connections.

SCPI command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 429

Workgroup

Enters the individual windows workgroup name of the R&S Microwave Signal Generator. This parameter is necessary in case the instrument is integrated in a windows network.

Note: The workgroup can only be changed after protection level 1 is deactivated (see chapter 5.2.3.14, "Protection", on page 36).

SCPI command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup` on page 430

Address Mode

Selects if the IP address is assigned automatically or manually.

"Auto (DHCP)" The IP address is assigned automatically.
The network used must support automatic assignment of IP address via DHCP or APIPA (Zeroconf) in order to use this function.

"Static" The IP address is assigned manually.

SCPI command:
`:SYSTem:COMMunicate:NETWork:IPADdress:MODE` on page 430

IP Address
Displays the IP address. To enter the IP address manually, select "Static" Address Mode.

SCPI command:
`:SYSTem:COMMunicate:NETWork:IPADdress` on page 430

Subnet Mask
Displays the Subnet mask. To enter the Subnet mask manually, select "Static" Address Mode.

This number is used together with the IP address to identify the network segment the instrument is in.

SCPI command:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK` on page 431

Default Gateway
Displays the IP address of the default gateway. To enter the default gateway manually, select "Static" Address Mode.

This address identifies the router on the same network as the instrument that is used to forward traffic to destinations beyond the local network.

SCPI command:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway` on page 430

Restart Network
Shuts down the network connection of the instrument and subsequently re-establishes the connection.

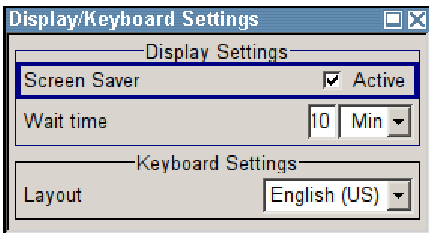
This function can be used to resolve network problems.

Note: Only the connection of the instrument to the network restarts, the network itself is not affected.

SCPI command:
n.a.

5.2.3.11 Display/Keyboard Settings

In the "Display/Keyboard Settings" menu the power-save mode and external keyboard settings are made. It is opened using the SETUP or MENU key under "Environment".



Screen Saver Active
Activates/deactivates the screen-save mode of the display.

If activated, the display including backlight is completely switched off after the elapse of the "Wait Time" when no entries via front panel, external mouse or external keyboard are made.

This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.

SCPI command:
`:DISPlay:PSAVe[:STATe]` on page 239

Wait Time
Enters the idle time that must elapse before the display lamp is shut off when no entries are made.

SCPI command:
`:DISPlay:PSAVe:HOLDoff` on page 239

Layout - Setup
Selects the keyboard layout for the selected keyboard language.

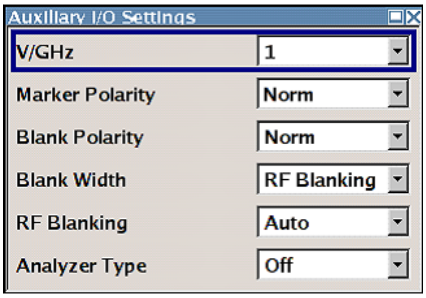
The assignment of some keys depends on the selected layout and language.

SCPI command:
`:KBOard:LAYout` on page 248
`:KBOard:LANGuage` on page 248

5.2.3.12 Auxiliary I/O Settings

The "Auxiliary I/O Settings" dialog provides access to the settings for the V/GHz, BLANK and MARKER auxiliary output.

To access this dialog, press the SETUP or MENU key under "Environment".



V/GHz
Selects the V/GHz ratio for the V/GHz output. This output provides a voltage which is proportional to the current sweep frequency. The voltage is always available, even with the sweep switched off.

SCPI command:
`:OUTPut:FPRoportional:SCALe` on page 259

Marker Polarity

Selects the polarity of the **MARKER** output signal. The user-programmable marker signal can be used for brightness control of an oscilloscope. The output becomes active when the sweep run has reached the marker. Up to 10 markers can be set to mark positions in the sweep run. The duration of the active signal is equal to the dwell time (DWELL) of a step.

SCPI command:

`[:SOURce<HW>]:SWEep:FREQuency:MARKer:OUTPut:POLarity`
`[:SOURce<HW>]:SWEep:POWer:MARKer:OUTPut:POLarity`
`[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer:OUTPut:POLarity`
`[:SOURce]:LFOutput:SWEep:VOLTage:MARKer:OUTPut:POLarity`
`[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity` on page 418

Blank Polarity

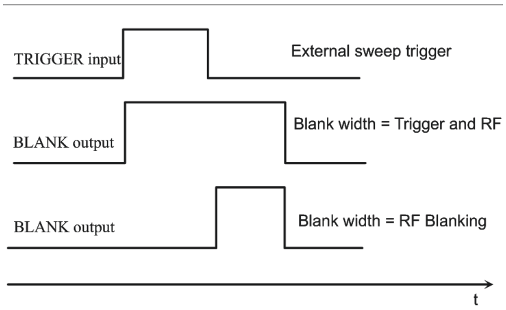
Selects the polarity of the Blank marker.

SCPI command:

`:OUTPut:BLANk:POLarity` on page 259

Blank Width

Selects the start of the blank marker in relation to the external sweep trigger (blank width).



"RF Blanking"	The blank marker starts after the external sweep trigger signal.
"Trigger and RF"	The blank marker starts with the external sweep trigger signal.

SCPI command:

`:OUTPut:BLANk:WIDTh` on page 259

RF Blanking

Selection of the RF blanking method for sweeps with step widths less than 10 MHz.

"Auto"	RF blanking only when the step synthesizer switches to the next step (provides a clean RF spectrum).
"On"	RF blanking after each step.
"Off"	No RF blanking.

SCPI command:

`:OUTPut:BLANk:MODE` on page 259

Analyzer Type

Allows to switch the HP8757D/E scalar network analyzer (selection HP8757D/E).

Note: The HP8757D/E has a special control mechanism via GPIB bus. RF blanking is internally set to "Auto". Start and stop frequencies are transferred to the network analyzer. An GPIB command is not available, since it is used for controlling the network analyzer.

"Off" RF blanking as selected under RF blanking is active.

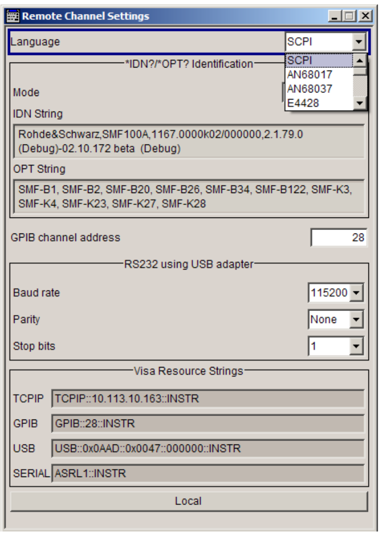
"8757D/E" An additional sawtooth signal from start and stop frequency is output at the Z-AXIS output for control of the HP8757D/E scalar network analyzer.

SCPI command:
n.a.

5.2.3.13 Remote Channel Settings

The "Remote Channel Settings" dialog provides access to the settings for remote control. The dialog is opened using the SETUP or MENU key under "Remote".

Besides the standard GPIB-setting, the selection of one of the possible emulations and a user defined definition of the `*IDN` and `*OPT` string is possible.



Language

Selects the instrument whose remote command set is emulated by the R&S SMF.

The R&S SMF can also be remote controlled via the command set of several other generators, e.g. of an HP generator. You find the available command sets for the generator in the selection list. This feature allows to replace a generator by an R&S SMF in existing test setups. Refer to the corresponding Application Note at the download area of the product site on the Internet. The Application Note is also provided on the user documentation CD-ROM (included in delivery).

The selected instrument also defines the identification string that is retrieved with query `*IDN?`. If required, use the parameter "Mode" and "IDN String" to change this string.

As any other parameter, the remote control command set can also be changed remotely by means of the SCPI command `SYST:LANG`. However, this remote control command is enabled only in the instrument's specific SCPI command set, i.e. it is possible to change the command set remotely from the original one (`SYST:LANG SCPI`) to the command set to be emulated but not vice versa.

Note: While working in a emulation mode, the R&S SMF specific command set is disabled, i.e. the SCPI command `SYST:LANG` will be discarded.
To return to the SCPI command set of the R&S SMF, use the appropriate command of the selected command set. If for example a HP generator is emulated, the HP command `EX` returns to the instrument-specific GPIB command set.

SCPI command:
`:SYSTem:LANGuage` on page 437

Identification Mode
Selects the way the instrument identification is performed.

"Automatic" The "IDN String" and the "OPT String" are set automatically for the instrument select with the parameter "Language".

"User Defined" Enables the selection of user definable "IDN String" and "OPT String" for the instrument selected with the parameter "Language".

SCPI command:
`:SYSTem:IDENtification` on page 436

Set to default
Overwrites the user-defined `*IDN` and `*OPT` strings with default strings. The default strings vary depending on the selected emulation mode (Language)

SCPI command:
n.a.

IDN String
Indicates the identification string of the instrument when queried with the common command `*IDN?`.

In addition to the preset values, a user defined identification string can be entered, e.g. to provide individual identification for each generator, like 'MY_R&S SMF' for instance.

SCPI command:
`:SYSTem:IRESponse` on page 436

OPT String
Indicates the option string of the instrument as queried with common command `*OPT?`.

If a "User Defined" Identification Mode is selected, a user defined option string can be created, additionally to the automatically created one.

SCPI command:
`:SYSTem:ORESponse` on page 438 for the user defined OPT String
`*OPT?`

GPIB channel address

Sets the GPIB address of the instrument.

SCPI command:

`:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` on page 429

RS232 using USB adapter

Requires a USB serial adapter (recommended extra, see data sheet)

Sets the parameters of the serial interface.

Either a RS232 interface or a Bluetooth connection can be used for remote control via the serial interface. The settings are effective for both interfaces (see also "Bluetooth Pin" on page 41).

SCPI command:

`:SYSTem:COMMunicate:SERial:BAUD` on page 432

`:SYSTem:COMMunicate:SERial:PARity` on page 432

`:SYSTem:COMMunicate:SERial:SBITs` on page 433

Visa Resource Strings

Indicates the visa resource strings, used for remote control of the instrument. A separate string is provided for remote control via the different interfaces.

SCPI command:

`:SYSTem:COMMunicate:NETWork:RESource` on page 431

`:SYSTem:COMMunicate:GPIB:RESource` on page 432

`:SYSTem:COMMunicate:SERial:RESource` on page 432

Local (Remote Channel Settings)

Switches the instrument to operate in local control mode.

Switching from remote to local control mode can be also done with one of the following actions:

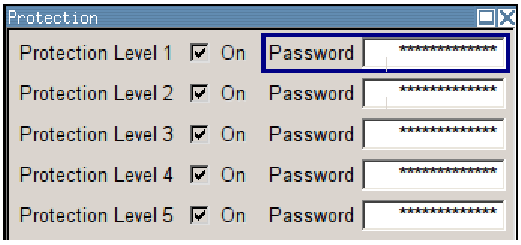
- manually with the LOCAL key on the front panel
- with the interface command `&GTL` via the remote-control interface
- with the key combination CTRL + Q.

SCPI command:

`&GTL`

5.2.3.14 Protection

The "Protection" menu provides access to the unlocking of protected service functions (authorized personnel of R&S Service Departments only). To deactivate the protection, the correct password has to be entered. After the instrument has been switched on, the protection levels 1 to 5 are automatically activated.



Protection Level/Password

Protection Level 1 can be activated to expand the functionality of the internal adjustment and to access the selftests.

The password is 123456.

SCPI command:

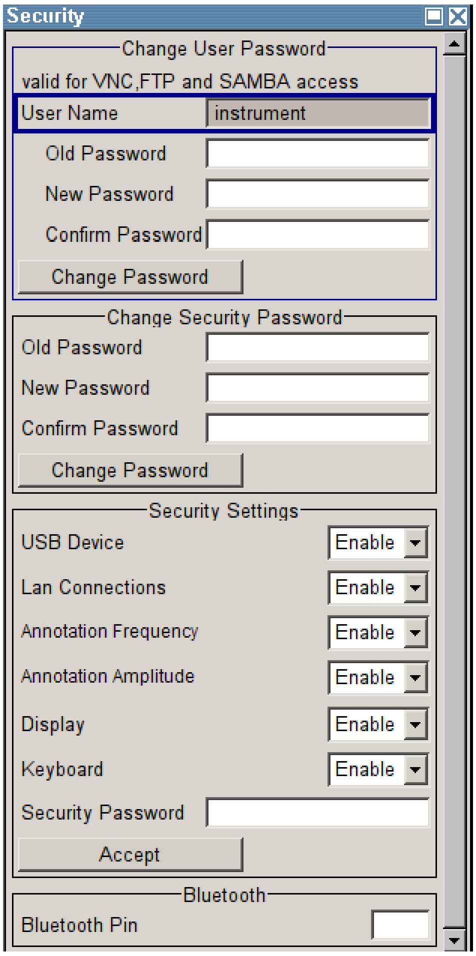
:SYSTem:PROTect<ch>[:STATe] on page 438

5.2.3.15 Security

The "Security" dialog provides access to the passwords and mass storage security settings. To open this menu, use the SETUP or MENU key under "Protection".

The menu is divided into the password sections and the security settings section. In the password section, the passwords for securing a controlled access to the instrument are defined and changed.

A change of passwords for the operating system and security password requires the entry of the old and new password and the conformation of the new password. All settings are only accepted after the "Change Password" button is pressed.



User Name

Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SAMBA access.

The user name and password are required for remote access to the instrument via VNC, FTP or SAMBA.

SCPI command:
n.a.

Old Password (User Password)

Enters the currently used user password. The default password is "instrument".

Note: It is highly recommended to change the default user password before connecting the instrument to the network.

New Password (User Password)

Enters the new security password.

The security password may contain decimal characters only.

SCPI command:
n.a.

Confirm Password (User Password)
Enters the new password for conformation.

The new password is only valid after the "Change Password" button is pressed.

SCPI command:
n.a.

Change Password (User Password)
Changes the password accordingly.

SCPI command:
n.a.

Old Password (Security Password)
Enters the currently used security password. The default password is '123456'.

Note: It is highly recommended to change the default security password before connecting the instrument to the network.

The security password is required when changing the status of the USB and LAN interface.

SCPI command:
n.a.

New Password (Security Password)
Enters the new security password.

The security password may contain decimal characters only.

SCPI command:
n.a.

Confirm Password (Security Password)
Enters the new password for conformation.

The new password is only valid after the "Change Password" button is pressed.

SCPI command:
n.a.

Change Password (Security Password)
Changes the password accordingly.

SCPI command:
n.a.

USB Device
Enables/disables the USB interfaces.

The instrument does not recognize any device connected to the USB interface when the interface is disabled.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:
n.a.

LAN Connection
Enables/disables the LAN interfaces.

It is not possible to access the instrument via LAN while the LAN connection is disabled.

An enabled LAN Connection is a prerequisite for the remote control of the instrument via VNC, FTP or SAMBA.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:
n.a.

Annotation Frequency
Enables/disables the display of the currently used frequency in the header of the instrument.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:
n.a.

Annotation Amplitude
Enables/disables the display of the currently selected level in the header of the instrument.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:
n.a.

Display
Enables/disables the display.

If this parameter is disabled, the instrument cannot be operated manually via the user interface, i.e. display, front panel keys and external keyboard are disabled. Remote control of the insrument is enabled.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:
`:SYSTem:DLOCk` on page 433

Keyboard
Enables/disables an external keyboard and mouse connected to the instrument, the front pannel keys of the instrument, the rotary knob and the on-screen keyboard.

If this parameter is disabled, the instrument cannot be manually controlled but changes in the settings are shown on the display. Remote access and remote control are enabled.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

To enable the keyboard, type the security password on the external keyboard or use the `SYST:KLOC OFF` command over remote control.

SCPI command:
`:SYSTem:KLOCk` on page 437

Security Password
Enters the password that is required to enable or to disable the settings protected by a security password. Default is '123456'.

Note: It is highly recommended to change the default security password before connecting the instrument to the network.

All settings are only accepted after the "Accept" button is pressed.

SCPI command:
n.a.

Accept - Security
Accepts a new entry or selection and changes the settings accordingly.

SCPI command:
n.a.

Bluetooth Pin
Requires a USB Bluetooth adapter (recommended extra, see data sheet).

Enters the Bluetooth pin of an external Bluetooth device. The pin is required to enable remote control via an external Bluetooth device.

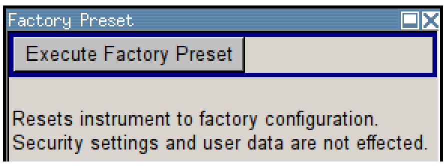
SCPI command:
n.a.

5.2.3.16 Save/Recall

The "Save/Recall" submenu can also be called up with the FILE key and is therefore described in the section of this key (see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 47).

5.2.3.17 Factory Preset

The "Factory Preset" dialog provides a function to reset the instrument's settings to their factory state. This function is activated by pressing the "Execute Factory Preset" button.



Factory Preset
Reset the instrument's settings to their factory state.

Note: Since Factory Preset resets the Remote Channel and network settings to the default values, executing Factory Preset via remote control terminates the connection to the instrument, if these settings had been configured to values different to the default ones!

The factory preset function resets nearly all instrument settings. In addition to the regular preset by means of the PRESET key, a "Factory Preset" resets also the following values:

- Reference frequency settings ("Ref Oscillator" menu)
- Power on settings ("Level/EMF" menu)
- Network settings including hostname ("Setup" menu)
- Remote Channel settings including GPIB address ("Setup" menu)
- Start/Stop Gui Update "(Setup" menu)
- Display and keyboard settings ("Setup" menu).

To maintain security, password settings and all settings protected by these passwords like disabled USB and LAN connections are not changed.

Not affected by the "Factory Preset" are also user data, lists or instrument settings files, created for example by means of the Save/Recall function.

SCPI command:
`:SYSTem:FPReset` on page 235

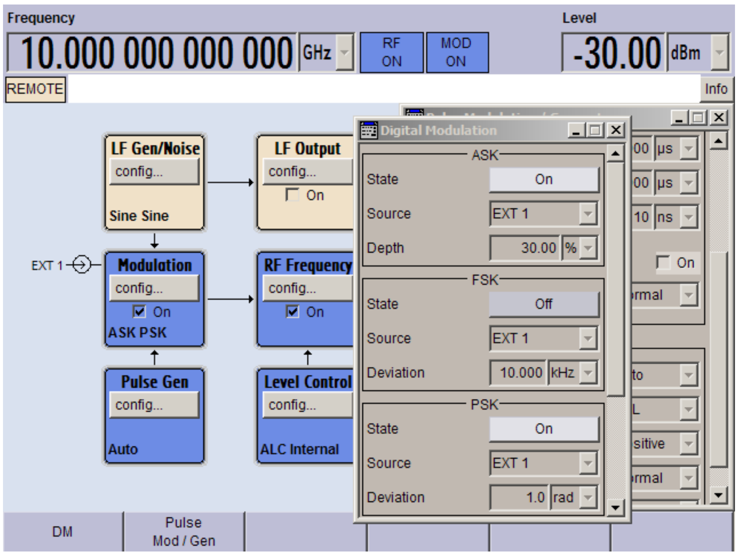
5.2.3.18 Help

The "Help" dialog offers comprehensive online help for the R&S Microwave Signal Generator. A desired topic can be selected via the table of contents (select "Manual") or the index (select "Index").

For context-sensitive information about a marked parameter, press the HELP key. For a description of the "Help" menu, refer to the section covering to the HELP key (see chapter 5.2.7, "Help System - Help Key", on page 46).

5.2.4 Switching to Manual Control - Local Key

In remote control mode a status message appears in the display header. The rest of the display remains unchanged and shows the current instrument status, i.e. the status which exists under the remote control settings. The instrument can be operated (e.g. menus can be opened). However, it is not possible to enter or change values.



The status message additionally indicates whether the LOCAL key is disabled or enabled (see also chapter 6.2.1, "Switching to Remote Control", on page 197).

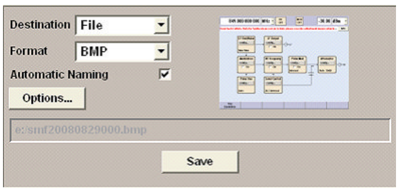
If the "REMOTE" status message is shown, the LOCAL key switches the instrument from remote control to manual control. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

If the "REM-LLO" status message is displayed, the instrument can be switched from remote control to manual control by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)`); the LOCAL key is disabled. The key is disabled by remote control with the command LLO.

When switching from remote to manual control, the display update suppression function, if active ("SETUP > GUI Update" is Off), is automatically deactivated ("SETUP > GUI Update" is On).

5.2.5 Generating a Hard Copy of the Display

The HCOPY key opens a window for configuring the hardcopy setting, like output file format, path and file name.



5.2.5.1 Hardcopy Dialog

Destination
Indicates that the hardcopy is stored in a file (see also "File Options" on page 45).

SCPI command:
`:HCOPy:DEVice` on page 242

Options
Opens the Hardcopy Options dialog for configuring the hardcopy parameters (see "File Options" on page 45.

SCPI command:
n.a.

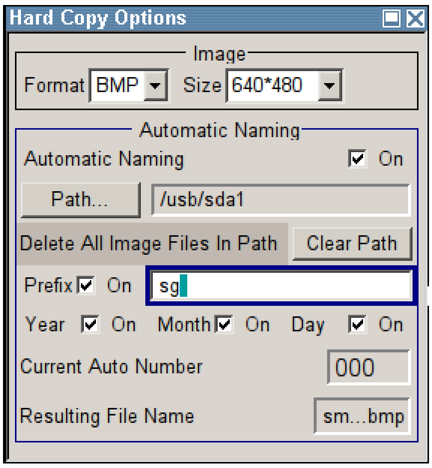
File
Some configuration parameters are already offered in the Hardcopy dialog. All configuration parameters are available in "File Options" on page 45.

Automatic Naming
Activates, deactivates automatic generation of the file name. Automatic naming is configured in the "Options…" submenu, see "File Options" on page 45.

File Info
Indicates the file name. The file name can be entered either manually via the file manager (button "File…") or generated automatically (Automatic naming checkbox). Automatic naming is configured in the "Options…" submenu.

SCPI command:
`:HCOPy:FILE[:NAME]` on page 243
`:HCOPy:FILE[:NAME]:AUTO:STATe` on page 247
`:HCOPy:FILE[:NAME]:AUTO:FILE` on page 244

5.2.5.2 Hardcopy Options



File Options

Dialog for setting the file parameters.

"Size" Defines the size of the bitmap in terms of pixels. The first value of the size setting defines the width, the second value the height of the image.

SCPI command:
:HCOPy:IMAGe:SIZE on page 247

"Format" Selects the image format. Several bitmap formats are available.

SCPI command:
:HCOPy:DEVice:LANGuage on page 242

"Automatic Naming" Determines the rules to create the file names and sets the directory the files are saved into.
As default the automatically generated file name is composed of:
`<Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`
Each component can be deactivated/activated separately to individually design the file name. The resulting file name is indicated.

"Path..." Automatic naming only
Opens the "Select Hard Copy Destination Path" dialog to select a path for storing the hardcopy.

Note: For selecting the destination path a file name must be entered as well. Otherwise the error message "The name of a list may not be empty" is displayed and the selection will be canceled.

Directory, path and file name are displayed in the infoline right to the "Path" button.

SCPI command:
:HCOPy:FILE[:NAME]:AUTO:DIRectory on page 244
:HCOPy:FILE[:NAME]:AUTO on page 243

"Clear Path" Deletes all image files with extensions `bmp`, `img`, `png`, `xpm` and `csv` in the directory set for automatic naming.
Before deleting the image files a warning message is displayed requiring the confirmation.

SCPI command:
:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar on page 244

"Prefix" Automatic naming only
Activates the usage of the prefix in the automatic file name. The prefix is entered in the field to the right of checkbox.

SCPI command:
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe on page 246

"Enter prefix" Automatic naming only
Enters the prefix for the automatically generated file name. The use of the prefix is activated in the checkbox to the left.

SCPI command:
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix on page 246

"Date - Year / Month / Day"
Automatic naming only
Defines the components of the automatically generated file name. The selectable parameters are year, month and day. If activated the current year, month or day used in the file name.

SCPI command:
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe` on page 247
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe` on page 245
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe` on page 245

"Current Auto Number"
Automatic naming only
Indicates the number which is used in the automatically generated file name.

Note: On initially switching on the device the number will be reset to the lowest possible value. Starting with number 0 the output directory will be scanned for already existing files. As long as files with the same name are existing the number will be increased by 1. The number will be automatically set to a number so that the resulting file name will be unique within the selected path. The current number will not be saved in the save recall file but will be temporarily stored within the database. On subsequent saves the number will be increased.

SCPI command:
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer` on page 246

"Resulting File Name"
Automatic naming only
Indicates the automatically generated file name.

SCPI command:
`:HCOPy:FILE[:NAME]:AUTO:FILE` on page 244

Save
Triggers the generation of a hardcopy.

SCPI command:
`:HCOPy[:EXECute]` on page 243

5.2.6 Messages - Info Key

The INFO key opens a window containing a detailed description of every message displayed in the info bar, see chapter 9, "Error Messages", on page 451.

5.2.7 Help System - Help Key

The HELP key opens a browser window containing a context-sensitive description of the highlighted parameter.

The context-sensitive page which is opened with the HELP key is part of a comprehensive help system. It is possible to move from this context-sensitive page to any page of the help system. The following navigation aids are available:

- Internal links in the text

They open pages which are directly linked to the described function. In this way it is possible, for example, to call up the description of the GPIB command for any particular function.

- Previous/Next links
  The Previous/Next links allow scroll through the help pages. The sequence of the described functions corresponds to their position in the menus.
- Back button
  The Back button calls up the page last viewed.
- Contents in the navigation panel
  The contents list is used to open the individual help pages. It has a hierarchical structure. The highlighted line indicates where the currently displayed page is within the contents list.
- Index in the navigation panel
  The index is used to call up all pages which contain the selected entry. The index has an alphabetical structure and also contains all GPIB commands.
- Find
  The find function allows you to look for freely selectable terms in all help pages. A list of the pages containing the entered term is displayed as the search result. The search can be limited to words in the page title to increase the number of hits.

The softkeys are used to determine the entry focus for front panel operation, to select the content of the navigation window and to change the font size. To determine the entry focus for front panel operation the Cursors UP/Down are used. The links are highlighted in blue, and can be selected and called up using the rotary knob.

5.2.8 Storing and Loading Instrument Data - File Key

The R&S Microwave Signal Generator allows complete instrument settings to be stored in files on the CompactFlash™ Card.

Defined and complex instrument settings can then be reproduced at any time by loading this data. If required, these settings can be loaded to various signal generators.

The corresponding menu is available under "Save/Recall" in the "Setup" menu or accessible by means of the FILE key. The instrument settings are saved in files which can be stored in data directories.

Additionally there are intermediate memories in which the current instrument setting can be stored and then called up again by just pressing a key. This provides fast switching between different instrument settings.

Only settings which differ from the preset values and configuration data for the operating elements (e.g. window positions) are stored. As a result the files remain relatively small. Furthermore, instrument settings can easily be transferred between different equipped signal generators since the files contain only relevant information. When loaded, the referenced settings are implemented and all non-referenced parameters are set to the associated preset values.

If list data is part of the instrument settings, e.g. a list of user correction data, a reference to this list is stored, not the list itself. The list is reactivated when the associated settings are loaded, but the list may have been modified or deleted in the meantime or may not be available on a different instrument. If the list has been modified, the new entries will be used. An error message appears if an attempt is made to access a non-existing list or to activate settings which are not supported by the instrument.

- Network settings and remote settings are not saved and restored.
- Lists are stored and loaded in the appropriate menus. For example, the user correction data list is created and stored in the "User Correction" menu.

When loading an instrument setting, it is possible to select whether the current frequency and level setting is to be retained or whether the stored settings are to be activated. It is possible to delete stored instrument settings. A file can be copied by loading it with "Recall" and then storing it under a new name.

Settings can be transferred easily between instruments with different equipment options and/or firmware versions because only the settings which differ from the preset values are affected. When settings are loaded, only those which are possible on the instrument are implemented. Error messages indicate the settings which cannot be implemented.

The stored file is transferred from one instrument to another using the memory stick.

General file management functions such as copying and moving data are available in the "File Manager" dialog.

5.2.8.1 File Menu

The settings available in the File menu "Save/Recall" depend on the operation selected under "Select Operation".

For more information, see section "File Management".

Select Operation

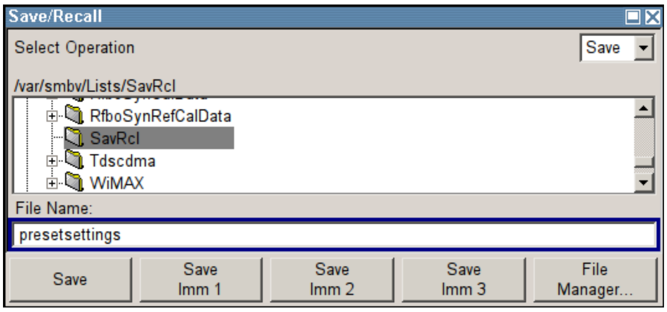
Selects the file function.

"Save…" Calls the menu for storing the current instrument setting (see chapter 5.2.8.2, "Storing Instrument Settings", on page 48).

"Recall..." Calls the menu for calling up a stored instrument setting (see chapter 5.2.8.3, "Loading Instrument Settings", on page 50).

5.2.8.2 Storing Instrument Settings

If "Save" is selected under "Select Operation", the File menu provides options for storing the current instrument setting in a file.



Recent data sets

Displays the files last used. The entire path is shown in plain text.

SCPI command:
n.a.

Directory

Selects the directory in which the file is to be stored.

The window opposite lists all settings files in this directory.

A new directory can be created in the "File Manager" dialog.

SCPI command:
`:MMEMory:CDIRectory` on page 252

File List

Displays the files which are in the selected directory.

If a file is highlighted, it is overwritten when the file is stored.

SCPI command:
`:MMEMory:CATalog` on page 250

File Name

Enter the file name of the file without file extension. This file is then created.

SCPI command:
n.a.

Save

Stores the current instrument settings under the specified path.

SCPI command:
`*SAV` on page 233
`:MMEMory:STORe:STATe` on page 256

Save Immediate x

Stores the current instrument setting in one of the three intermediate memories.

These instrument settings are retained until a different instrument setting is stored in the intermediate memory. When the instrument is switched off, the contents of the intermediate memories are retained.

SCPI command:
`*SAV` on page 233

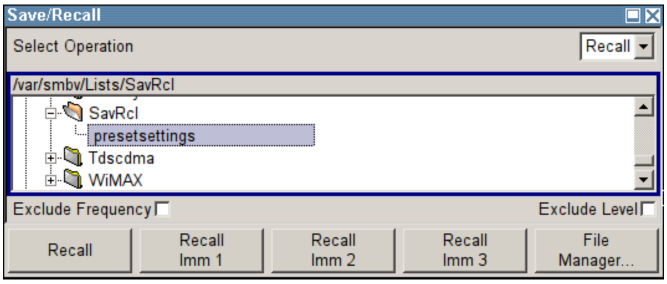
File Manager
Calls the "File Management" menu.

Directories can be created and files managed in this menu (see chapter 5.2.8.4, "File Manager", on page 51).

SCPI command:
n.a.

5.2.8.3 Loading Instrument Settings

If "Recall" is selected under "Select Operation", the "File" menu provides options for loading complete instrument settings. Here it is possible to select whether the current or stored frequency and level settings are to be used.



Recent data sets
Displays the files last used. The entire path is shown.

If the desired file is in the list, it can be selected.

SCPI command:
n.a.

Directory
Enter the directory in which the file with the instrument setting to be loaded is located.

The "Selected file" window lists all the files in this directory.

SCPI command:
`:MMEMory:CDIRectory` on page 252

File List
Selects the file with the desired instrument configuration.

SCPI command:
`:MMEMory:CATalog` on page 250

Exclude Frequency
The current frequency is retained when a stored instrument setting is loaded.

SCPI command:
`[:SOURce<hw>]:FREQuency[:CW|:FIXed]:RCL` on page 335

Exclude Level

The current level is retained when a stored instrument setting is loaded.

SCPI command:

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL on page 387

Recall

Load the selected configuration.

If an instrument setting in which a sweep was activated is stored, the sweep is started when the recall command is called.

If an instrument setting which accesses lists is stored, this list is also loaded.

If the list has been deleted in the meantime, an error message appears when the instrument setting is loaded. If the list has been overwritten in the meantime, the new entries will be used.

SCPI command:

:MMEMory:LOAD:STATe on page 254

*RCL on page 232

Recall Immediate x

Loads the selected configuration from one of the three intermediate memories.

If an instrument setting in which a sweep was activated is stored, the sweep is started when the recall command is called.

If an instrument setting which accesses lists is stored, this list is also loaded.

If the list has been deleted in the meantime, an error message appears when the instrument setting is loaded. If the list has been overwritten in the meantime, the new entries will be used.

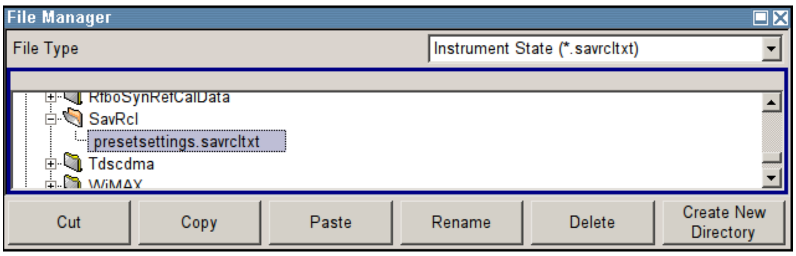
A message appears if no instrument configuration is stored in this memory.

SCPI command:

*RCL on page 232

5.2.8.4 File Manager

The "File Manager" dialog provides all the functions required for file management. Directories can be created, and files copied, deleted and moved between the directories on the devices (CompactFlash™ Card and memory stick). A USB stick is automatically recognized when connected to the instrument and the USB directory 'usb/ISB_DISK (data dir)' indicated in the file manager.



For more information, see section "File Management".

File Type

Selects the file types to be indicated. If a file type with a specific file extension is selected only files with this extension are indicated in the selected directory.

SCPI command:
n.a.

Directory and File Name

Selects the directory in which the file to be deleted or copied is located. The window lists all files in this directory. The file to be deleted or copied can be highlighted. The path is indicated above the directory window.

SCPI command:
`:MMEMory:CDIRectory` on page 252

Cut

Cuts the selected file. It can be pasted into a different directory using the "Paste" button.

SCPI command:
`:MMEMory:DELete` on page 254

Copy

Copies the selected file. It can be pasted into a different or the same directory using the "Paste" button. When pasting the file into the same directory file name `Copy of <file name>` is given automatically. When pasting the file into a different directory, the original file name is kept.

SCPI command:
`:MMEMory:COPY` on page 252

Paste

Pastes the file that has been copied or cut before.

SCPI command:
n.a.

Rename

Renames the selected file or directory. The new name can be entered in the "New File-name" dialog.

SCPI command:
`:MMEMory:MOVE` on page 255

Delete

Deletes the selected file. Before the file is deleted, a message appears prompting the user to confirm deletion of the file.

SCPI command:
`:MMEMory:DELete` on page 254

Create New Directory

Creates a new directory. The name of the new directory can be entered in the "New Directory" dialog.

Note: When the subdirectory is entered, it is possible to enter an absolute path name (e.g. `/var//USER/MEAS`) or the path relative to the current directory (e.g. `../MEAS`).

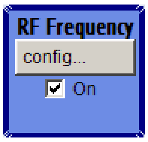
The directory is created as a subdirectory in the selected level.

SCPI command:
`:MMEMory:MDIRectory` on page 255

5.3 RF Signal - RF Frequency Block

5.3.1 Overview of RF Signal

Settings for the RF output signal are made under "RF Frequency". These settings can be accessed in the block diagram by way of the "RF Frequency" function block, or by means of the menu with the same name which is opened using the MENU key.



The function block is available for the basic unit R&S SMF without any additional equipment options.

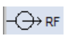
5.3.1.1 RF Output

To activate and deactivate the RF output signal, use one of the following alternatives:

- directly using the TOGGLE ON/OFF key (the function block must be highlighted beforehand)
- by means of the RF ON/OFF key (the current entry focus is irrelevant)
- by changing the state of the "RF Frequency" functional block (see "State RF" on page 53)
- by enabling/disabling the RF in the "Configure" menu of the "RF" block (see "RF Output State" on page 54).

The current state of the RF output (activated and deactivated) is indicated in the block diagram by means of the different block color and the status of the "On" checkbox.

The symbol for the signal output is displayed at the end of the block diagram, assigned to the attenuator block. The disconnected connection to the output is additionally shown when the output is deactivated.

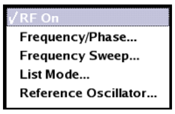


State RF
Activated/deactivates the RF output by changing the state of the "RF" functional block.

Alternatively, the RF ON/OFF key can be used.

SCPI command:
`:OUTPut<hw>[:STATe]` on page 260

RF Output State
Activated/deactivates the RF output by enabling/disabling the RF in the "Configure" dialog of the "RF" block.



SCPI command:
`:OUTPut<hw>[:STATe]` on page 260

5.3.1.2 Overview of the RF Signal Settings

The CW, Sweep and List modes are available for generating the RF signal.

- **CW**
  The RF signal is generated with the set frequency and level. This is the default mode.
- **Sweep**
  The RF signal is generated as a sweep with the set parameters.
  It is not possible to activate frequency, level and LF sweep simultaneously.
- **List Mode**
  The RF signal is generated on the basis of a list of predefined frequency and level values. The duration of the individual steps can be predefined.

Instruments connected downstream can be taken into consideration when setting the frequency and level by entering a frequency and/or level offset.

Automatic level control ("ALC") ensures maximum level accuracy.

User-specific lists which contain level correction values for any frequency range ("User Correction") can be created to, for example, compensate the cable attenuation in a test assembly setup.

The R&S Microwave Signal Generator generates the RF signal in unmodulated or analog form. The signal generator is equipped therefore with the following sources for analog modulations:

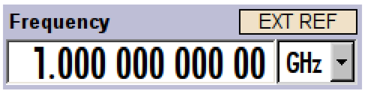
- two internal LF generators (option R&S SMF-B20)
- an internal pulse generator (option R&S SMF-K23)
- a noise generator (option R&S SMF-B20)
- the external modulation inputs EXT 1 and EXT 2 are available as the source for analog and/or digital modulations (option R&S SMF-B20).

An external trigger signal for the sweeps and the List mode can be provided at the TRIGGER input or AUX connector.

The input REF IN is used to input an external instrument reference, and the output REF OUT serves as the output of the reference frequency (internal or external).

5.3.2 RF Frequency Settings

The value of the RF frequency is displayed in the header of the instrument's display ("Freq"). This field provides the direct input of the RF frequency.



Be aware, that there is a difference between the displayed RF frequency in the header and the RF output frequency set in the "Frequency/Phase" dialog.

5.3.2.1 RF frequency vs. RF output frequency

The frequency entered and displayed in the frequency field in the header of the display takes any set frequency offset into consideration, e.g. an offset set for a downstream instrument. This means that with a frequency offset the frequency displayed in the header does not correspond to the frequency at the RF output, but rather to the frequency at the output of the downstream instrument.

A set frequency offset is indicated by the "FREQ OFFSET/MULTIPLIER" status message.

This instrument allows the desired frequency at the output of a downstream to be entered in the frequency field. The R&S Microwave Signal Generator changes the RF output frequency according to the entered offset.

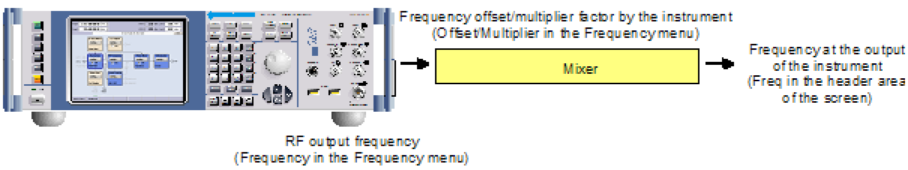
Similarly, the instrument adjusts the output frequency, when a multiplier factor is set.

However, the frequency entered and displayed in the "Frequency/Phase" dialog of the "RF Frequency" function block always corresponds to the RF output frequency. Any frequency offset/multiplier factor is not taken into consideration.

The frequency offset is entered in the "Frequency/Phase" dialog. Here it is also possible to set the frequency without taking the offset into consideration, to set the step width for the frequency entry using the rotary knob, and to set the phase for the RF output signal.

The correlation between the RF frequency, the RF output frequency and the frequency offset is as follows:

"Freq" (in header) = "RF output frequency" (Frequency in menu) + "Freq offset" (Offset in menu) + Multiplier factor (Multiplier in menu)



5.3.2.2 Configuring RF frequency

To change the RF frequency, press the FREQ key and enter the desired frequency. Changes to the RF frequency have an immediate effect (without confirmation with the ENTER key) on the output signal.

RF Freq
Enters the RF frequency, considering the frequency offset.

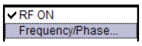
Note: The SCPI command sets the level of the "Freq" display, i.e. an entered frequency offset or multiplier factor is taken into consideration in the frequency value.

SCPI command:
`[:SOURce<hw>]:FREQuency[:CW|:FIXed]` on page 335

5.3.2.3 Frequency Menu

The instrument provides an acess to the frequency settings in the combined "Frequency/ Phase" dialog.

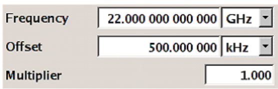
To open the"Frequency/Phase" dialog, select "RF Frequency > Configure > Frequency" or use the MENU key under "RF Frequency".



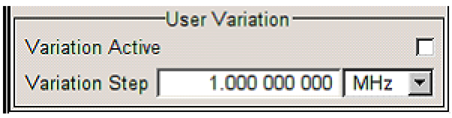
The "Frequency/Phase" dialog is divided into the several sections.

Frequency and offset of the RF output signal are set in the "Frequency Settings" section in the upper part of the group menu.

Also, the multiplier factor is entered here.



The step width which is used when setting the frequency using the rotary knob (with "Variation Active On") is set in the "User Variation" section.



The phase of the output signal can be changed in the "Phase Settings" section. The "Phase Settings" menu is described in chapter 5.3.3, "Phase Settings", on page 57.

Frequency Settings

The frequency, offset and multiplier factor are set in the top section of the menu.

Frequency - RF Signal
Sets the RF frequency of the RF output connector. The frequency entered and displayed here corresponds to the frequency at the RF output, i.e. any offset entry is not taken into consideration.

Note: The SCPI command `SOUR:FREQ` sets the frequency of the "FREQ" display, i.e. the frequency containing offset and multiplier.

SCPI command:
n.a.

Frequency Offset - RF Signal
Sets the frequency offset relative to the RF frequency. The frequency offset of a downstream instrument (e.g. a mixer) is entered.

The entry does not change the value of the RF frequency at the RF output. It only changes the RF frequency displayed in the display header. The value of the RF frequency in the header corresponds to the frequency at the output of the downstream instrument.

SCPI command:

`[:SOURce<hw>]:FREQuency:OFFSet` on page 337

Multiplier - RF Signal

Sets the multiplication factor for the RF frequency so that the frequency at the output of a downstream instrument (multiplier) is indicated in the frequency field of the display header.

The entry does not change the RF frequency at the RF output. It only changes the RF frequency displayed in the display header. The value of the RF frequency in the header corresponds to the frequency at the output of the downstream instrument (multiplier).

SCPI command:

`[:SOURce<hw>]:FREQuency:MULTiplier` on page 340

User Variation

If the frequency is set using the rotary knob, the step width is defined in the "User Variation" section.

Variation Active - RF Signal

Activates the user-defined step width used when varying the frequency value with the rotary knob.

"ON" The frequency value set with the rotary knob is varied using the user-defined step width which is entered under "Variation Step".

"OFF" The frequency value set with the rotary knob is varied in steps of one unit at the cursor position (standard operating mode).

SCPI command:

`[:SOURce<hw>]:FREQuency:STEP:MODE` on page 340

Variation Step - RF Signal

Sets the user-defined step width. This step width is used when entering the RF frequency using the rotary knob. Frequency variation with this step width must also be activated with "Variation Active".

SCPI command:

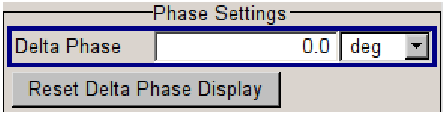
`[:SOURce<hw>]:FREQuency:STEP[:INCRement]` on page 339

5.3.3 Phase Settings

The phase of the RF output signal can be changed in the "Phase Settings" section of the "RF Frequency/Phase" menu.

5.3.3.1 Phase Menu

The phase of the RF output signal can be changed in the Phase Settings section. To open the "Frequency/Phase" dialog, select "RF Frequency> Configure > Frequency/ Phase" or use the MENU key under "RF Frequency".



Delta Phase - RF Signal
Sets the phase of the RF signal. The current phase of the signal is used as the reference. This function allows, for example, the phase of the output signal to be synchronized with the phase of a signal from a second signal generator.

SCPI command:
`[:SOURce<hw>]:PHASe` on page 380

Reset Delta Phase Display - RF Signal
Resets delta phase value. The set phase is adopted as the new current phase, i.e. the delta phase value is reset to 0.

SCPI command:
`[:SOURce<hw>]:PHASe:REFerence` on page 380

5.3.4 Sweep Mode

5.3.4.1 Overview

The R&S Microwave Signal Generator offers four different sweep types (RF frequency sweep, RF level sweep, LF frequency sweep, and LF level sweep) to be activated alternatively. Each type has 5 modes which differ with respect to the sweep cycle mode (continuous, individual and step-by-step) and triggering mode (automatic, internal and external).

Option R&S SMF-K4 enables analog ramp sweep mode. This mode corresponds to the analog sweep of classic sweep generators, except that the sweep is fully synchronized over the complete range. In conjunction with scalar network analyzers or suitable spectrum analyzers, realtime adjustment of microwave filterscan be performed, for example.

To mark important frequency ranges such as filter bandwidths or the position of attenuation poles, the R&S SMF has 10 user-selectable frequency markers which can be output as pulse markers at the marker output (TTL level) or alternatively modulated on the RF level as level markers (level reduction of 1 dB).

Sweeps and List mode can not be activated simultaneously, they deactivate each other.

Setting a sweep

A sweep is set in five basic steps which are shown below taking a frequency sweep as an example.

The LF frequency sweep is activated and configured in the "LF Gen./Noise" block.

1. Set the sweep range ("Start Freq" and "Stop Freq" or "Center Freq" and "Span").
2. Select linear or logarithmic sweep spacing ("Spacing").
3. Set the step width ("Step Lin/Log") and dwell time ("Dwell Time").
4. Activate the sweep ("Mode" to Auto, Single, Step or Extern Single, Extern Step).
5. Trigger the sweep, except for Auto mode ("Execute Single Sweep", Current Frequency or External Trigger Signal).

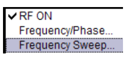
The different Sweep dialogs are activated as follows:

- The **RF frequency sweep** is activated in the "RF Frequency" block, see chapter 5.3.4.2, "RF Frequency Sweep", on page 59.
- The **RF level sweep** is activated in the "Level Control" block, see chapter 5.4.4, "RF Level Sweep", on page 84.
- The **LF frequency sweep** is activated and configured in the "LF Gen./Noise "block, seechapter 5.6.3, "LF Frequency Sweep", on page 163.
  Note: The "LF Gen./Noise" block is available with the option R&S SMF-B20.
- The **LF level sweep** is activated in the "LF Output" block, see chapter 5.7.2, "LF Level Sweep", on page 172.
  Note: The "LF Output" block is available with the option R&S SMF-B20.

It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 26).

5.3.4.2 RF Frequency Sweep

The dialog is used to activate and configure a sweep for the RF frequency.



To open the "Frequency Sweep" dialog, select "RF Frequency > Configure > Frequency Sweep" or use the menu tree of the MENU key under "RF Frequency".

In the top section of the menu, the RF sweep mode is activated and the sweep mode is selected.

The buttons are used to reset the RF sweep (all sweep modes) or to execute the RF sweep ("Single" mode).

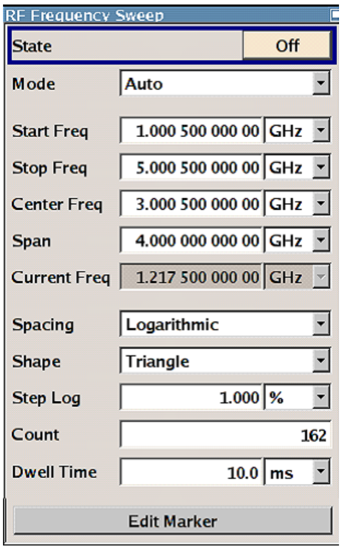
The sweep range, sweep spacing and dwell time are set in the bottom section.

The very fast ramp sweep can be activated in this section. The button "Edit Marker" opens the subdialog for configuring the sweep markers.

The sweep range of the RF sweep can be entered in two ways, either by entering the "Start" and "Stop" value or by entering the "Center" and "Span".

The two sets of parameters influence each other in the following way:

- "Start Freq" = "Center Freq" - "Span"/2
- "Stop Freq" = "Center Freq" + "Span"/2
- "Center Freq" = ("Start Freq" + STOP FREQ)/2
- "Span" = "Stop Freq" - "Start Freq"



RF Frequency Sweep Settings

State - Frequency Sweep

Activates/deactivates RF sweep mode.

Note: Activating the RF-Sweep mode automatically disables other sweep modes, and the list mode.

SCPI command:

`[:SOURce<hw>]:FREQuency:MODE` on page 337

Mode - Frequency Sweep

Selects the sweep instrument operating mode and the sweep mode.

"Auto" Sets an automatic repeated sweep cycle. If a different sweep mode was activated prior to the "Auto" mode, the cycle continues from the current sweep setting.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:SWE:FREQ:MODE AUTO
TRIG:FSW:SOUR AUTO
SOUR:FREQ:MODE SWE
```

"Single" Sets a single sweep cycle. The sweep is triggered by the "Execute Single Sweep" button.
If a different sweep mode was activated prior to the "Single" mode, the current sweep is stopped. The "Single" sweep always starts at the start frequency when triggered.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:SWE:FREQ:MODE AUTO
TRIG:FSW:SOUR SING
SOUR:FREQ:MODE SWE
SOUR:SWE:FREQ:EXEC
```

"Step" Sets a step-by-step sweep cycle.
If this mode is activated, the cursor moves to the value displayed for "Current Freq". Any variation to the "Current Freq" value triggers a sweep step. The step width is set below at entry field "Step Lin" or "Step Log".
If a different sweep mode was activated prior to the "Step" mode, the current sweep is stopped. The "Step" sweep starts at the current RF frequency when triggered.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:SWE:FREQ:MODE MAN
SOUR:FREQ:MODE SWE
SOUR:SWE:FREQ:SPAC LIN
SOUR:SWE:FREQ:STEP:LIN 0.5E4
SOUR:FREQ:MAN 1GHz
```

The value entered with command `SOUR:SWE:FREQ:STEP:LIN|LOG` sets the step width.

The value entered with command `SOUR:FREQ:MAN` has no effect, the command only triggers the next sweep step. However, the value has to be in the currently set sweep range (start to stop). In remote control only a step-by-step sweep from start to stop frequency is possible.

"Extern Single" Sets a single sweep cycle. The sweep is triggered by an external trigger signal.
If a different sweep mode was activated prior to the "Extern Single" mode, the current sweep is stopped. The "Extern Single" sweep always starts at the start frequency when triggered.
Refer to the description of the rear panel for information about the connectors for external trigger signal input (see section "Legend for Rear Panel View").
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

`SOUR:SWE:FREQ:MODE AUTO`

`TRIG:FSW:SOUR EXT`

`SOUR:FREQ:MODE SWE` (External trigger)

"Extern Step" Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under "Extern Single"). The step width is set below at entry field "Step Lin" or "Step Log".
If a different sweep mode was activated prior to the "Extern Step" mode, the current sweep is stopped. The "Extern Step" sweep always starts at the start frequency when triggered.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

`SOUR:SWE:FREQ:MODE STEP`

`SOUR:SWE:FREQ:SPAC LIN`

`SOUR:SWE:FREQ:STEP:LIN 1MHz`

`TRIG:FSW:SOUR EXT`

`SOUR:FREQ:MODE SWE` (External trigger)

"Extern Start/Stop" Sets an automaticly repeated sweep cycle that is started, stopped and restartet by subsequent external trigger events.
The first external trigger signal starts the sweep (Start).
The next external trigger signal stops the sweep at the current frequency (Stop).
The third external trigger signal starts the sweep at the start frequency (Start).
If a different sweep mode was activated prior to the "Extern Start/Stop" mode, the current sweep is stopped and the "Extern Start/Stop" sweep starts at the start frequency when triggered.
The "Reset" button resets the sweep to the start frequency.
Refer to the description of the rear panel for information about the connectors for external trigger signal input.
The external trigger signal is input at the rear of the instrument (BNC connector TRIGGER).

Example:

`SOUR:SWE:FREQ:MODE AUTO`

`TRIG:FSW:SOUR EAUT`

`SOUR:FREQ:MODE SWE` (External trigger)

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MODE` on page 414
`:TRIGger<hw>:FSWeep:SOURce` on page 443
`[:SOURce<hw>]:FREQuency:MODE` on page 337

Execute Single Sweep - Frequency Sweep
Triggers the sweep manually. A manual sweep can only be triggered if "Mode Single" is selected.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:EXECute` on page 412

Reset Sweep - Frequency Sweep
Resets the sweep. The start frequency is set and the next sweep starts from there.

SCPI command:
`[:SOURce<hw>]:SWEep:RESet[:ALL]` on page 423

Start Freq - Frequency Sweep
Sets the start frequency.

SCPI command:
`[:SOURce<hw>]:FREQuency:STARt` on page 338

Stop Freq - Frequency Sweep
Sets the stop frequency.

SCPI command:
`[:SOURce<hw>]:FREQuency:STOP` on page 339

Center Freq - Frequency Sweep
Sets the center frequency.

SCPI command:
`[:SOURce<hw>]:FREQuency:CENTer` on page 334

Span - Frequency Sweep
Sets the span.

SCPI command:
`[:SOURce<hw>]:FREQuency:SPAN` on page 338

Current Freq - Frequency Sweep
Displays the current frequency.

If "Step" is set, the frequency for the next frequency step of the sweep is entered here.

SCPI command:
`[:SOURce<hw>]:FREQuency:MANual` on page 336

Spacing - Frequency Sweep
Selects linear or logarithmic sweep spacing.

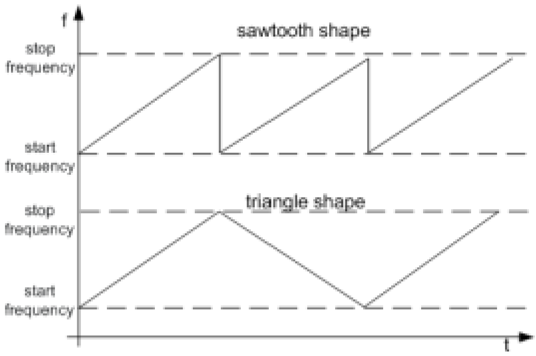
"Linear" With the linear sweep, the step width is a fixed frequency value which is added to the current frequency. The step width is entered below.

"Logarithmic" With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered below in %.

"Ramp" With the ramp sweep, a synthesized continuous analog frequency sweep is provided for the set sweep time. The sweep time is entered below.
Note: The ramp sweep is only available with option R&S SMF-K4.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:SPACing` on page 416

Shape - RF Frequency Sweep
Selects the cycle mode for a sweep sequence (shape).



"Sawtooth" One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

"Triangle" One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe` on page 415

Step Lin/Log - Frequency Sweep

Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

"Step Lin" or "Step Log" is displayed depending on whether "Spacing Lin" or "Log" is selected.

"Step Lin" With the linear sweep, the step width is a fixed frequency value which is added to the current frequency. The linear step width is entered in Hz.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]` on page 416

"Step Log" With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in %.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic` on page 417

Count - RF Frequency Sweep

Sets the number of sweep steps.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:POINts` on page 415

Sweep Time - RF Frequency Sweep

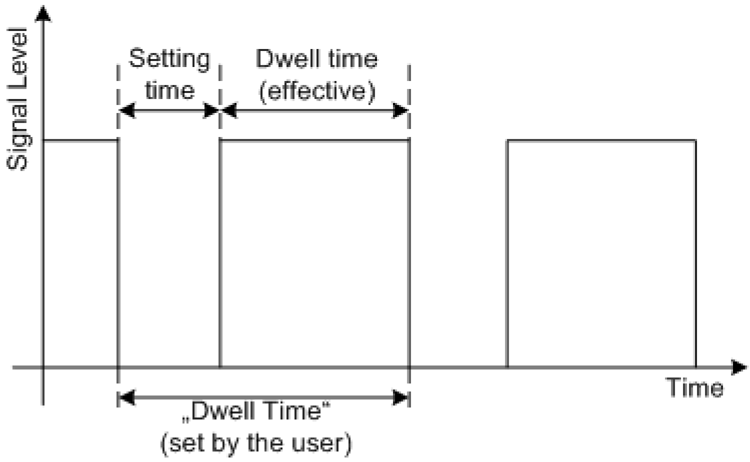
This feature is available for ramp spacing only.

Sets the sweep time for ramp sweeps. Ramp sweeps are selected above under "Spacing - Frequency Sweep" on page 64.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:TIME` on page 418

Dwell Time - Frequency Sweep

Sets the dwell time. The dwell time determines the duration of the individual sweep steps.



The "Dwell Time" set by the user is used as the step time of the sweep. The effective net dwell time is shorter, reduced by the setting time. This setting time may be greater than the time specified in the data sheet.

Note:
It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 26).

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:DWELl` on page 411

Trigger Slope - Frequency Sweep
Sets the polarity of the active slope of an applied instrument trigger. This setting affects the trigger input, i.e. the BNC connector at the rear of the instrument.

"Positive" The rising edge of the trigger signal is active.

"Negative" The falling edge of the trigger signal is active.

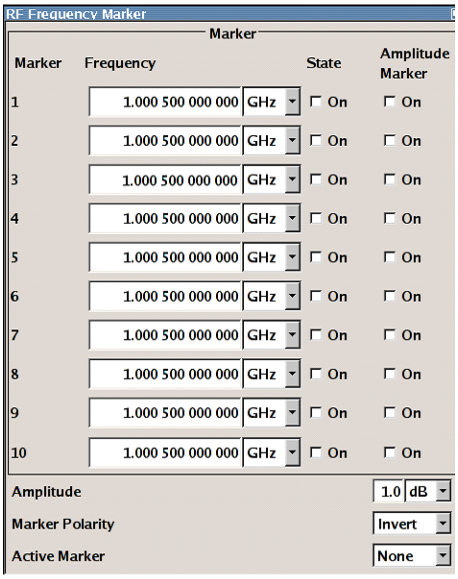
SCPI command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 341

Edit Marker - RF Frequency Sweep
Opens the "RF Frequency Marker" menu. This menu is used for setting and editing the markers. For a detailed description, see chapter 5.3.4.2.2, "RF Frequency Marker", on page 66.

SCPI command:
n.a.

RF Frequency Marker

The "RF Frequency Marker" dialog is called via the EDIT MARKER button in the "RF Frequency Sweep" dialog. Up to ten frequency markers can be defined. The level of the marker signal at the MARKER output changes according to the selected polarity when the frequency mark is reached. For each of these markers an amplitude marker can be activated in addition. If activated, the marker signal is attenuated by the set amplitude when the frequency mark is reached. Only one marker is output at the MARKER output at one time.



Marker - RF Frequency Marker
Displays the marker index. The active marker is selected by this index.

SCPI command:
n.a.

Frequency - RF Frequency Marker
Enters the frequency for the corresponding marker. If the marker is activated, the signal level at the MARKER output changes according to the set polarity on reaching the entered frequency.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FREQuency` on page 413

State - RF Frequency Marker
Switches on or off the selected marker. If on, the marker is output at the MARKER output on reaching the mark.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FSTate` on page 413

Amplitude Marker - RF Frequency Marker
Activates or deactivates the selected amplitude marker. If activated, the level is reduced by the amplitude entered under Amplitude - RF Frequency Marker on reaching the mark.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:PSTate` on page 413

Amplitude - RF Frequency Marker
Sets the amplitude marker attenuation. This value is valid for all markers.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:AMPLitude` on page 412

Marker Polarity - RF Frequency Marker
Selects the marker output polarity.

SCPI command:
`[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity` on page 418

Active Marker - RF Frequency Marker
Selects the active marker. The active marker is output with a higher voltage than all other markers.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:ACTive` on page 412

5.3.5 List Mode

Similar to a sweep, a series of previously defined frequency and level points is processed in List mode. In contrast to a sweep, however, a list with freely selectable value pairs (frequency and level) can be created. The value range for frequency and level covers the entire configurable value range of the instrument.

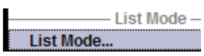
List mode and sweeps can not be activated simultaneously, they deactivate each other.

The lists can be created in the "List Editor". Each list is stored in its own file with the predefined file extension `*.lsw`. The name of the List file can be freely selected. The files are loaded from the "Lists..." file manager. Externally created tables with pairs of frequency and level values can be converted into List files using the import function. The external files must have the file extension `*.txt` or `*.csv`. These file formats are provided e.g. by the Microsoft®Excel program. The separators for table columns and for decimal floating-point numerals can be set. In addition, internally created List data can be exported into ASCII files using the export function.

The necessary hardware settings are calculated the first time a list is processed. With long dwell times, this calculation can be performed while the list is being processed; the entered dwell times are observed. With very short dwell times, calculation of the hardware settings increases the dwell time for the initial processing cycle; the entered value is only observed from the second processing cycle onwards. In this case a message appears to inform the user that there is a deviation between the current and set dwell times. No further calculations are required after the first run through a list. The current dwell times will definitely no longer deviate from the set dwell times.

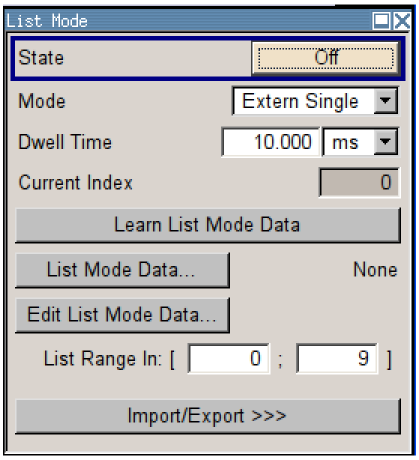
The list is processed from the beginning to the end of the list (modes "Auto", ("External") "Single", ("External") "Step").

5.3.5.1 List Mode Dialog



To open the "List Mode" menu, select "RF Frequency> Configure > List Mode" or use the MENU key under "RF Frequency".

The menu is used to activate/deactivate operating mode List, to create, select and activate the lists, and to select the trigger mode and the dwell time.



General Settings

State - List Mode

Activates/deactivates the List mode. The currently selected list is processed.

In case of a new or modified list, the necessary hardware settings are automatically determined on activation of the list mode. The data determined in this way is stored along with the list and is available whenever the list is used again.

This means that when activating the list mode, the system checks whether any hardware settings are present. If so, the list is started immediately, but if not they are automatically determined (the list is learnt).

A "Learn List Mode Data" button is available for deliberately activating list learning.

Note: Activating the list mode automatically deactivates all sweeps. During list mode the frequency and level indications do not display the currently set values.

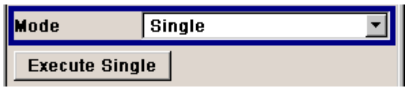
SCPI command:
`[:SOURce<hw>]:FREQuency:MODE` on page 337

Mode - List Mode

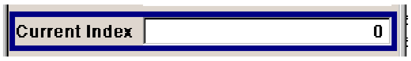
Selects the cycle mode of the List mode.

"Auto" Cycle from the beginning to the end of the list with automatic restart at the beginning. If a different mode was activated prior to the Auto mode, the cycle continues from the beginning of the list. The duration of a list step is determined by the set dwell time.
Button "Reset" restarts the list at the starting point.

"Single" Single cycle from the beginning to the end of the list. If "Single" is selected, the cycle is not started immediately. The "Execute Single" button appears under the "Mode" line. The cycle is started with this button.
The duration of a list step is determined by the set dwell time.
Button "Reset" restarts the list at the starting point.



"Step" Manual, step-by-step processing of the list. Activating "Step" stops the current list and the cursor moves to the value displayed for "Current Index". It is now possible to scroll up and down in the list in discrete steps by varying the index. The duration of a list step is determined by the time between two index entries.
Button "Reset" restarts the list at the starting point.



"Extern Single" Single cycle from the beginning to the end of the list as with "Single", but started by an external trigger.
The external trigger signal is input at the TRIGGER or AUX connector on the rear of the instrument.
Button "Reset" restarts the list at the starting point.

"Extern Step" Step-by-step cycle using the external trigger signal. Each trigger event starts a single step. The duration of a list step is determined by the time between two trigger events.
The external trigger signal is input at the TRIGGER or AUX connector on the rear of the instrument.
Button "Reset" restarts the list at the starting point.

SCPI command:
[:SOURce<hw>]:LIST:MODE on page 374
[:SOURce<hw>]:LIST:TRIGger:SOURce on page 376

Execute Single - List Mode

Triggers the list manually. This button is available only if mode "Single" is selected.

SCPI command:
[:SOURce<hw>]:LIST:TRIGger:EXECute on page 376

Reset - List Mode

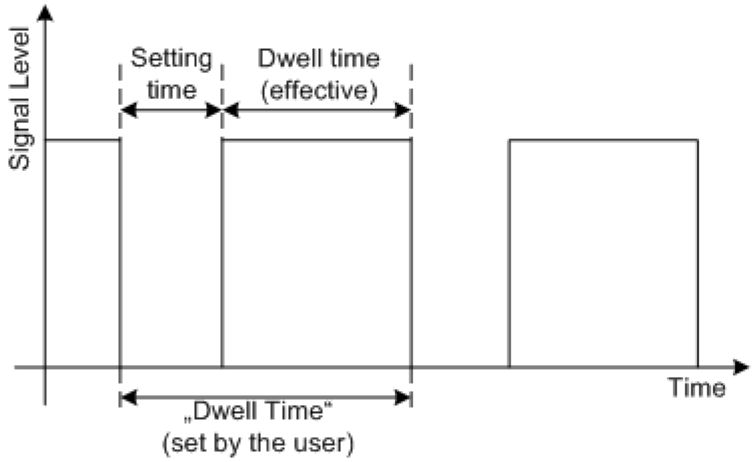
Resets the list to the starting point.

SCPI command:
[:SOURce<hw>]:LIST:RESet on page 375

Dwell Time - List Mode

Enters the dwell time. The dwell time determines the duration of a list step in list operating modes "Auto", "Single" and "Extern Single". In these modes a complete list is processed either once or continuously.

In list operating modes "Step" and "Extern Step", the set dwell time does not affect signal generation. In this case, the duration of a list step is determined by the time between two (internal or external) trigger events.



The "Dwell Time" set by the user is used as the step time of the list mode. The effective net dwell time is shorter, reduced by the setting time. This setting time may be greater than the time specified in the data sheet.

SCPI command:
`[:SOURce<hw>]:LIST:DWELl` on page 371

Current Index - List Mode
Sets the list index in "Step" mode.

SCPI command:
`[:SOURce<hw>]:LIST:INDex` on page 372

Learn List Mode Data... - List Mode
Starts the determination of the hardware setting for the selected list. The data determined in this way is stored along with the list.

It may be necessary to deliberately activate list learning in the event of greatly altered environmental conditions that require new hardware settings.

If this is not done, a previously learned hardware setting will continue to be used when list mode is switched on ("State = On"). If no setting is available, e.g. when the list is used for the first time, learning is automatically activated.

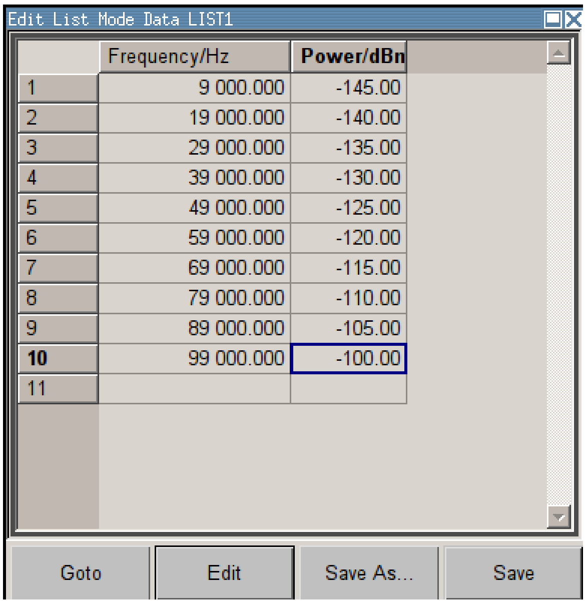
SCPI command:
`[:SOURce<hw>]:LIST:LEARn` on page 373

List Mode Data... - List Mode
Calls the "File Select" menu for selecting and creating a list or the "File Manager".

SCPI command:
[:SOURce<hw>]:LIST:SELect on page 376
[:SOURce<hw>]:LIST:DELete on page 366
[:SOURce<hw>]:LIST:DELete:ALL on page 367

Edit List Mode Data... - List Mode

Calls the editor for editing the selected list. A list consists of any number of frequency/level value pairs. The currently selected list is displayed.



"Frequency / Hz" Enter the frequency of the frequency/power value pair.

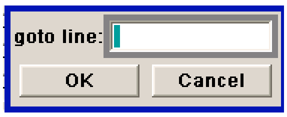
SCPI command:
[:SOURce<hw>]:LIST:FREQuency on page 371

"Power /dBm" Enter the level of the frequency/power value pair.

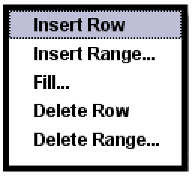
SCPI command:
[:SOURce<hw>]:LIST:POWer on page 374

"Goto" Selects row for editing.

If "Goto row" is selected, a window opens for entering the requested row.

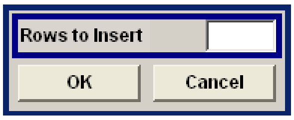


"Edit" Calls a selection of possible actions described below.



"Insert Row" Inserts a new row before the marked row.

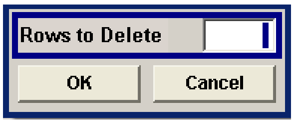
"Insert Range" Inserts new rows before the marked row. The number of rows to be inserted can be defined in an entry window.



"Fill...." Opens a sub menu for defining a set of list values to be automatically entered in the List Mode table (see chapter 5.3.5.2, "Filling the List Mode Data automatically", on page 76).

"Delete Row" Deletes the marked row.

"Delete Range..." Allows to delete any number of rows starting with the marked row. The number of rows to be deleted can be defined in an entry window.



"Save as" Open the file menu to save the list under a new name.
Each list is saved to the R&S Microwave Signal Generator Compact-Flash™ Card as a separate file with the file prefix `*.lsw`. The file name and the directory to which the file is saved are user-selectable.

"Save" The list is saved under its current name.

List Range In - List Mode

Defines an index range in the current list by setting the start and stop index. Only the values in the selected index range are processed in List mode, all other list entries are ignored.

SCPI command:
`[:SOURce<hw>]:LIST:INDex:STARt` on page 372
`[:SOURce<hw>]:LIST:INDex:STOP` on page 373

Trigger Slope - List Mode

Sets the polarity of the active slope of an applied instrument trigger. This setting affects the trigger input (BNC connector at the rear of the instrument).

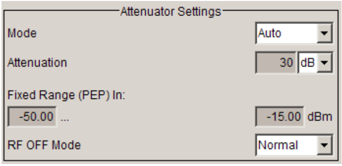
"Positive" The rising edge of the trigger signal is active.

"Negative" The falling edge of the trigger signal is active.

SCPI command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 341

Attenuator Settings

In the "Attenuator Settings" section, the attenuator mode is set.



Mode – Attenuator Settings
Sets the attenuator mode at the RF output.

"Auto" The mechanical attenuator switches in steps of 10 dB at fixed points.

"Fixed" The attenuator is fixed at the current position.

SCPI command:
:OUTPut<hw>:AMODe on page 258

Attenuation – Attenuation Settings
Setst the attenuation. To enter a value in this field, the attenuator mode "Fixed" has to be selected. If "Auto" is selected, this field is read-only.

SCPI command:
[:SOURce]:POWer:ATTenuation on page 385

Fixed Range in: - Attenuation Settings
Displays the level range in which the level is set without interruption for the attenuator mode Fixed setting.

SCPI command:
:OUTPut<hw>:AFIXed:RANGe:LOWer
on page 257 :OUTPut<hw>:AFIXed:RANGe:UPPer on page 258

RF OFF Mode - Attenuation Settings
Selects the mode of the mechanical attenuator, when the RF signal is switched off.

Note: This feature is only available when the instrument is equipped with one of the mechanical attenuator options, i.e. either option R&S SMF-B26 or R&S SMF-B27.

The setting of the RF OFF mode is not affected by an instrument preset (PRESET key), *RST and the "Save/Recall" function. This parameter is influenced only by the Factory Preset.

"Normal" The current attenuation remains when the RF signal is switched off and thus provides fast and wear-free switching.

"Attenuated" The attenuation is set to maximum when the RF signal is switched off. This setting is recommended for applications that require a high level of noise suppression.

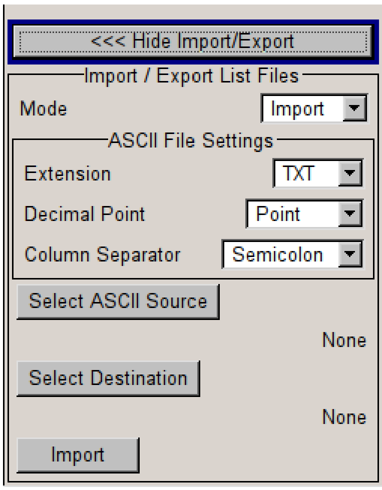
SCPI command:
[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE on page 385

Import/Export

Lists can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the "Import/Export" button.

Import/Export - List Mode

Expands the menu with the area for import and export of list mode files.



Externally edited Excel tables with frequency/level pairs can be imported as text or CSV-files and used for list mode.

On the other hand, internally created list mode lists can be exported as text or CSV-files.

Mode - List Mode

Selects if list mode lists should be imported or exported. The settings offered below depend on the selected mode.

SCPI command:

[:SOURce<hw>]:LIST:DEXChange:MODE on page 370

Extension - List Mode

Selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

SCPI command:

[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension on page 368

Decimal Point - List Mode

Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

SCPI command:

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 369

Column Separator- List Mode

Selects the separator between the frequency and level column of the ASCII table.

SCPI command:

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 368

Select ASCII Source / Destination - List Mode
Calls the "File Manager" for selecting the ASCII file to be imported into a list mode list (source) or the ASCII file the list mode list is exported (destination) in.

SCPI command:
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect` on page 368

Select Destination / Source - List Mode
Calls the "File Manager" for selecting the list mode list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

SCPI command:
`[:SOURce<hw>]:LIST:DEXChange:SELect` on page 370

Import / Export - List Mode
Starts the export or import of the selected file.

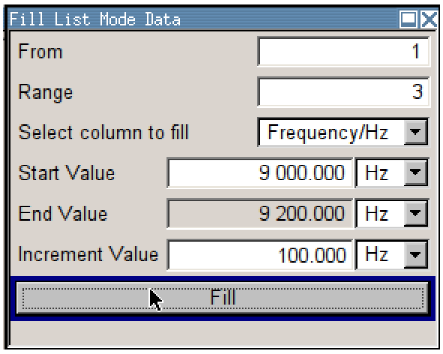
When import is selected, the ASCII file is imported as list mode list.

When export is selected, the list mode list is exported into the selected ASCII file.

SCPI command:
`[:SOURce<hw>]:LIST:DEXChange:EXECute` on page 370

5.3.5.2 Filling the List Mode Data automatically

The "Fill List Mode Data" menu enables you to automatically set the values in the List Mode table.



The start line and the number of rows to be filled are defined under "From" and "Range".

The column to be filled is selected under "Select column to fill". Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters.

The filling of the column with the selected value settings is started with button "Fill".

The list entries are only computed when the "Fill" button is pressed.

From
Sets the start value of the index range.

SCPI command:
n.a.

Range
Sets the range for filling the table.

SCPI command:
n.a.

Select column to fill
Selects either the frequency or the level column to be filled with the value defined below.

SCPI command:
n.a.

Start value
Sets the start value for the frequency or the level entries.

SCPI command:
n.a.

End value
Sets the end value for the frequency or the level entries.

SCPI command:
n.a.

With increment
Sets the increment for the frequency or the level entries.

SCPI command:
n.a.

Fill
Fills the selected column in the set range with values, starting with the start value and using the set increment.

SCPI command:
n.a.

5.3.6 Reference Oscillator

In the internal reference mode the internal reference signal is available at the REF OUT connector. The frequency of the internal reference signal is permanently set to 10 MHz.

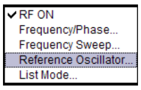
The frequency of the internal reference oscillator can be influenced by applying a tuning voltage at the **EFC** (External Frequency Control) input at the rear of the instrument (**Frequency Adjustment**; see data sheet for technical information).

External impairment is possible in both "Adjustment State" states (**On** or **Off**).

In the external reference mode, an external signal with selectable frequency and defined level must be input at the REF IN connector. This signal is output at the REF OUT connector. The "EXT REF" status message appears in the display header.

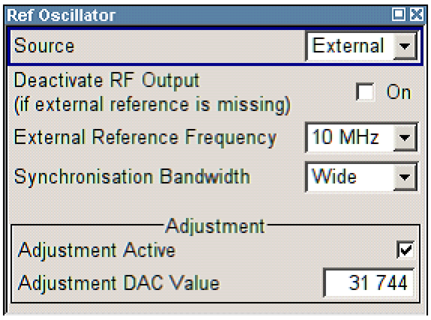
> The settings of the reference oscillator are not influenced by an instrument preset ("PRESET" key).

5.3.6.1 Reference Oscillator Dialog



To open the "Reference Oscillator" dialog, select "RF Frequency > Configure > Reference Oscillator" or use the MENU key under "RF Frequency".

The menu is used to select the source, to enter the frequency of an external reference signal and to adjust the reference frequency.



Source - Reference Oscillator

Selects the source of the reference frequency.

"Internal" The internal reference signal of 10 MHz is used, comprising either the calibrated or a user-defined adjustment value.

"External" An external reference signal is used. The frequency of the external reference signal must be selected under "External Reference Frequency".

SCPI command:

`[:SOURce]:ROSCillator:SOURce` on page 409

Deactivate RF Output - Reference Oscillator

Determines if the RF output is switched off in case of a missing external reference signal for selection external source.

If enabled, this setting ensures that no improper RF signal due to the missing external reference signal is output and used for measurements.

In addition to the error message "Ext Ref missing", the information "RF output deactivated" is indicated.

This setting is not influenced by a reset.

SCPI command:

`[:SOURce]:ROSCillator:EXTernal:RFOFf:STATe` on page 408

External Reference Frequency

Selects the frequency of the external reference signal. An external reference signal in the range of 1 MHz to 20 MHz can be used.

SCPI command:

`[:SOURce]:ROSCillator:EXTernal:FREQuency` on page 407

Synchronization Bandwidth - RF Signal

(Source External only)

Selects the synchronization bandwidth for an external reference signal. The wideband setting is provided for using very good reference sources of high spectral purity.

"Narrow" Synchronization bandwidth is 1 Hz.

"Wide" Synchronization bandwidth is 750 Hz.

SCPI command:

`[:SOURce]:ROSCillator:EXTernal:SBANdwidth` on page 408

Output - Reference Oscillator

Selects the output for the reference oscillator signal. The external output is only available in case that the external reference frequency is 10 MHz.

SCPI command:

EFC - Reference Oscillator

Activates/deactivates the electronic frequency control. EFC is performed by applying a tuning voltage at the "EFC" input at the rear of the instrument (Frequency Adjustment; see data sheet for technical information).

SCPI command:

Adjustment Active - Reference Oscillator

Selects adjustment mode.

"OFF" The calibrated adjustment value of the internal reference frequency is used. This value is determined at one of the R&S service shops during calibration.

"ON" A user-defined adjustment value is used. The value is entered under "Adjustment DAC Value".
This allows the frequency to be impaired freely, for example to simulate a frequency error.
The instrument is no longer in the calibrated state. However, the calibration value is not changed and the instrument resumes the calibrated state after switching the "Adjustment State" to Off.

SCPI command:

`[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]` on page 409

Adjustment DAC Value

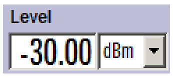
Enters a user-defined adjustment value for the internal reference frequency. This value is not used unless "Adjustment Active On" is selected.

SCPI command:

`[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue` on page 408

5.4 RF Level/EMF

5.4.1 Overview RF Level Settings



The value of the RF level is displayed in the level field in the header of the instrument's display and the simplest way to set the RF level is to set it directly in this field.

Be aware, that there is a difference between the RF level displayed in the header and the RF output level set in the "Level/EMF" dialog of the "RF" block.

5.4.1.1 RF level vs. RF output level

The level entered and displayed in the "Level" field takes the offset of any downstream attenuators/amplifiers into consideration by way of calculation. This means that with a level offset the level displayed in the header does not correspond to the level at the RF output, but rather to the level at the output of the downstream instrument.

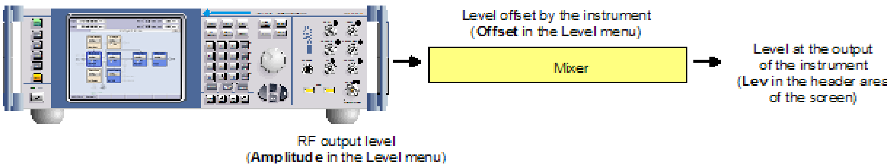
This allows the desired level at the output of downstream instruments to be entered. The R&S Microwave Signal Generator changes the RF output level according to the set offset.

However, the level entered and displayed in the "Level" menu of the "RF" function block always corresponds to the RF output level. Any level offset is not taken into consideration.

The level offset is entered in the "Level" menu. Here it is also possible to set the level without taking the offset into consideration, and to make other settings, such as level offset, attenuator mode, power-on state.

The correlation is as follows:

"Level" (in header) = "RF output level" (Level in menu) + "Level offset" (Offset in menu)



5.4.1.2 Setting the RF level

To change the RF level, press the LEVEL key and enter the desired level. Changes to the RF level have an immediate effect (without confirmation with the Enter key) on the output signal.

RF Level
Enters the RF level, considering the level offset.

dBm, dBuV, mV and uV can be used as the level units. The 4 unit keys are labeled with these units.

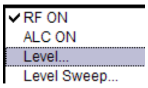
Note: The SCPI command sets the level of the "Level" display, i.e. an entered level offset is taken into consideration in the level value.

SCPI command:

`[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` on page 386

5.4.2 RF Level

The "Level" dialog is opened in the "Level Control" function block or using the MENU key under "Level Control".



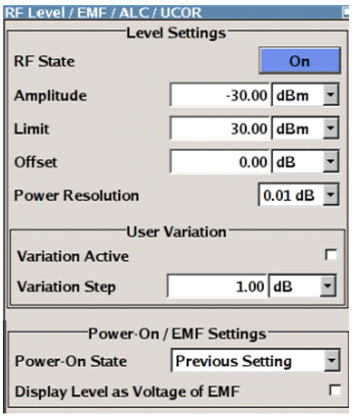
To open the "RF Level/EMF/ALC/UCOR" dialog, select "Level Control > Configure > Level" or use the MENU key under "Level Control".

The combined menu "RF Level / EMF / ALC / UCOR" is divided into the several sections.

The top sections of this dialog provide access to the level settings.

The offset-free level, level offset, level limit and power resolution are set in the top section of the dialog.

The step width which is used when setting the level using the rotary knob (with "Variation Active On") is set in the "User Variation" section.



The power-on behavior of the instrument and the level display in the display header are set in the "Power-On / EMF Settings" section (see chapter 5.4.3, "Power-On/EMF Settings", on page 83).

5.4.2.1 Level Settings

The offset-free level, level offset, level limit and power resolution are set in the top section of the dialog.

RF State – RF Level
Activates/deactivates the RF output.

SCPI command:
:OUTPut<hw>[:STATe] on page 260

Amplitude - RF Signal
Sets the RF level of the RF output connector.

The level entered and displayed here corresponds to the level at the RF output, i.e. any offset entry is not taken into consideration.

Note: The SCPI command SOUR:POW:LEV:IMM:AMPL sets the level of the "Level" display, i.e. the level containing offset.

SCPI command:
[:SOURce<hw>]:POWer:POWer on page 389

Limit - RF Signal
Sets the level limit.

The value specifies the upper limit of the level at the RF output connector. A message appears if an attempt is made to set a level above this limit and the level at the RF output is confined to the upper limit. However, the level indication is not influenced.

The value is not affected by an instrument preset (PRESET key), *RST and the "Save/Recall" function. This parameter is influenced only by the Factory Preset and its factory value is equal to the upper limit.

SCPI command:
[:SOURce<hw>]:POWer:LIMit[:AMPLitude] on page 387

Offset (Level) - RF Signal
Sets the level offset relative to the RF level.

The level offset of a downstream instrument (e.g. an attenuator or amplifier) is entered.

The entry does not change the value of the RF level at the RF output. It only changes the RF level displayed in the display header. The value of the RF level in the header corresponds to the level at the output of the downstream instrument.

SCPI command:
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet on page 386

Power Resolution - RF Level
Selects the resolution for the level settings.

Remote-control command:SOUR:POW:RES 0.01

SCPI command:
[:SOURce<hw>]:POWer:RESolution on page 390

5.4.2.2 User Variation

If the level is set using the rotary knob, the step width is defined in the "User Variation" section.

Variation Active - RF Level

Activates the user-defined step width used when varying the level value with the rotary knob.

"ON"	The level value set with the rotary knob is varied using the user-defined step width which is entered under "Variation Step".
"OFF"	The level value set with the rotary knob is varied in steps of one unit at the cursor position (standard operating mode).

SCPI command:

`[:SOURce<hw>]:POWer:STEP:MODE` on page 391

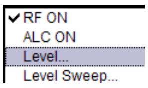
Variation Step - RF Level

Sets the user-defined step width for entering the RF level using the rotary knob. Level variation with this step width must also be activated with "Variation Active".

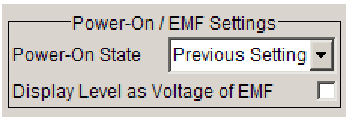
SCPI command:

`[:SOURce<hw>]:POWer:STEP[:INCRement]` on page 391

5.4.3 Power-On/EMF Settings



The power-on behavior of the R&S SMF and the level display in the display header are set in the "Power-On / EMF Settings" section of the "RF Level/EMF/ALC/UCOR" dialog. To open the dialog, select "Level Control > Configure > Level" or use the MENU key under "Level Control".



Power-On State - RF Signal

Selects the state which the RF output is to assume after the instrument is switched on.

"RF Off"	The output is deactivated when the instrument is switched on.
"Previous Setting"	When the instrument is switched on, the output assumes the same state as it had when the instrument was switched off.

SCPI command:

`:OUTPut<hw>[:STATe]:PON` on page 260

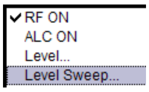
Display Level as Voltage of EMF - RF Level

Activates display of the signal level as voltage of the EMF (no-load voltage). If this setting is deactivated, the level is displayed as a voltage over a 50 Ohm load (preset state).

SCPI command:

n.a.

5.4.4 RF Level Sweep

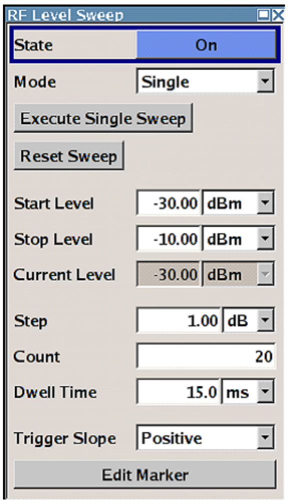


The "RF Level Sweep" dialog is used to activate and configure a sweep for the RF level. To open the dialog, select "Level Control > Configure > Level Sweep" or use the MENU key under "Level Control".

5.4.4.1 RF Level Sweep Settings

In the top section, the Level Sweep mode is activated and the sweep mode is selected. The buttons are used to reset the level sweep (all sweep modes) or to execute the level sweep ("Single" mode).

The sweep range, sweep spacing and dwell time are set in the bottom section.



State - Level Sweep

Activates Level Sweep mode.

Note: Activating the RF level sweep mode automatically disables other sweep modes, and the list mode.

SCPI command:

`[:SOURce<hw>]:POWer:MODE` on page 389

Mode - Level Sweep

Selects the level sweep instrument operating mode and the sweep mode.

"Auto" Sets an automatic repeated sweep cycle. If a different sweep mode was activated prior to the "Auto" mode, the cycle continues from the current sweep setting.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:SWE:POW:MODE AUTO
TRIG:PSW:SOUR AUTO
SOUR:POW:MODE SWE
```

"Single" Sets a single sweep cycle. The sweep is triggered by the "Execute Single Sweep" button.
If a different sweep mode was activated prior to the "Single" mode, the current sweep is stopped. The single sweep always starts at the start level.
The "Reset Sweep" button resets the sweep to the start level.

Example:

`SOUR:SWE:POW:MODE AUTO`

`TRIG:PSW:SOUR SING`

`SOUR:POW:MODE SWE`

`SOUR:SWE:POW:EXEC`

"Step" Sets a step-by-step sweep cycle.
If this mode is activated, the cursor moves to the value displayed for "Current Level". Each sweep step is triggered by a variation of the value in the "Current Level" entry window. The step width is set below at entry field "Step".
If this mode is activated, the cursor moves to the value displayed for "Current Level". If a different sweep mode was activated prior to the "Step" mode, the current sweep is stopped. The step sweep starts at the current level value.
The "Reset Sweep" button resets the sweep to the start level.

Example:

`SOUR:SWE:POW:MODE MAN`

`SOUR:SWE:POW:STEP 0.5`

`SOUR:POW:MODE SWE`

`SOUR:POW:MAN -16`

The value entered with command `SOUR:SWE:POW:STEP` sets the step width.

The value entered with command `SOUR:POW:MAN` has no effect, the command only triggers the next sweep step. However, the value has to be in the currently set sweep range (start to stop). In remote control only a step-by-step sweep from start to stop frequency is possible.

"Extern Single" Sets a single sweep cycle. The sweep is triggered by an external trigger signal.
If a different sweep mode was activated prior to the "Extern Single" mode, the current sweep is stopped. The "Extern Single" sweep always starts at the start level.
Refer to the description of the rear panel for information about the connectors for external trigger signal input (see section "Legend for Rear Panel View").
The "Reset Sweep" button resets the sweep to the start flevel.

Example:

`SOUR:SWE:POW:MODE AUTO`

`TRIG:PSW:SOUR EXT`

`SOUR:POW:MODE SWE` (External trigger)

"Extern Step" Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under "Extern Single"). The step width corresponds to the step width of the rotary knob.
If a different sweep mode was activated prior to the "Extern Step" mode, the current sweep is stopped. The "Extern Step" sweep always starts at the start level.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

`SOUR:SWE:POW:MODE STEP`

`SOUR:SWE:POW:STEP 0.5`

`TRIG:PSW:SOUR EXT`

`SOUR:POW:MODE SWE` (External trigger)

"Extern Start/Stop" Sets an automatically repeated sweep cycle that is started, stopped and restartet by subsequent external trigger events.
The first external trigger signal starts the sweep (Start).
The next external trigger signal stops the sweep at the current frequency (Stop).
The third external trigger signal starts the sweep at the start frequency (Start).
If a different sweep mode was activated prior to the "Extern Start/Stop" mode, the current sweep is stopped and the "Extern Start/Stop" sweep starts at the start frequency when triggered.
The "Reset" button resets the sweep to the start level.
The external trigger signal is input at the rear of the instrument (BNC connector TRIGGER).

Example:

`SOUR:SWE:POW:MODE AUTO`

`TRIG:PSW:SOUR EAUT`

`SOUR:POW:MODE SWE` (External trigger)

SCPI command:
`[:SOURce<hw>]:SWEep:POWer:MODE` on page 420
`:TRIGger<hw>:PSWeep:SOURce` on page 445.
`[:SOURce<hw>]:POWer:MODE` on page 389

Reset Sweep - Level Sweep
Resets the sweep. The start level is set and the next sweep starts from there.

SCPI command:
`[:SOURce<hw>]:SWEep:RESet[:ALL]` on page 423

Execute Single Sweep - Level Sweep
Triggers the sweep manually. A manual sweep can only be triggered if "Mode Single" is selected.

SCPI command:
`[:SOURce<hw>]:SWEep:POWer:EXECute` on page 419

Start Level - Level Sweep
Sets the start level.

SCPI command:
`[:SOURce<hw>]:POWer:STARt` on page 390

Stop Level - Level Sweep
Sets the stop level.

SCPI command:
`[:SOURce<hw>]:POWer:STOP` on page 391

Current Level - Level Sweep
Displays the current level.

If "Step" is set, the level for the next level step of the sweep is entered here.

SCPI command:
[:SOURce<hw>]:POWer:MANual on page 388

Shape - RF Level Sweep
Selects the cycle mode for a sweep sequence (shape).

"Sawtooth" One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

"Triangle" One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start level again.

SCPI command:
[:SOURce<hw>]:SWEep:POWer:SHAPe on page 422

Step - Level Sweep
Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

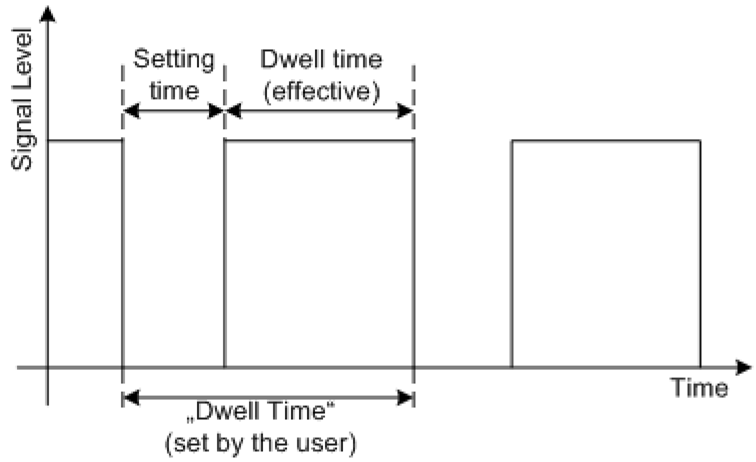
With the level sweep, the logarithmic step width is a constant fraction of the current level. This fraction is added to the current level. The logarithmic step width is entered in dB.

SCPI command:
[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] on page 422

Count - RF Level Sweep
Sets the number of sweep steps.

SCPI command:
[:SOURce<hw>]:SWEep:POWer:POINts on page 421

Dwell Time - Level Sweep
Enters the dwell time and determines the duration of the individual sweep steps.



The "Dwell Time" set by the user is used as the step time of the sweep. The effective net dwell time is shorter, reduced by the setting time. This setting time may be greater than the time specified in the data sheet.

Note:
It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 26).

SCPI command:
`[:SOURce<hw>]:SWEep:POWer:DWELl` on page 419

Trigger Slope - Level Sweep
External trigger only.

Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the trigger input , i.e. the BNC connector TRIGGER at the rear of the instrument.

"Positive" The rising edge of the trigger signal is active.

"Negative" The falling edge of the trigger signal is active.

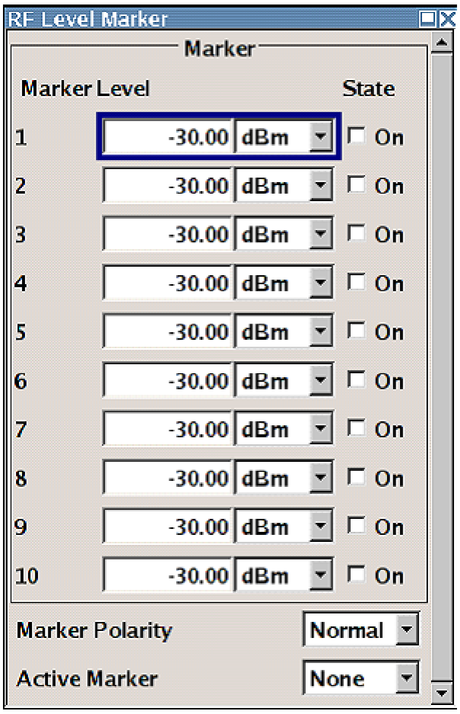
SCPI command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 341

Edit Marker - RF Level Sweep
Opens the "RF Level Marker" menu. This menu is used for setting and editing the markers. For a detailed description, see chapter 5.4.4.2, "RF Level Marker", on page 89.

SCPI command:
n.a.

5.4.4.2 RF Level Marker

The "RF Level Marker" dialog is called via the EDIT MARKER button in the "Level Sweep" dialog.



Marker - RF Level Marker

Displays the index of the marker.

SCPI command:

n.a.

Level - RF Level Marker

Enters the level for the corresponding marker. If the marker is activated, the signal level at the MARKER output changes according to the set polarity on reaching the entered level.

SCPI command:

`[:SOURce<hw>]:SWEep:POWer:MARKer<ch>:POWer` on page 420

State - RF Level Marker

Switches in or off the selected marker. If on, the marker is output at the MARKER output on reaching the mark.

SCPI command:

`[:SOURce<hw>]:SWEep:POWer:MARKer<ch>:STATe` on page 420

Marker Polarity - RF Level Marker

Selects the marker output polarity.

SCPI command:

`[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity` on page 418

Active Marker - RF Level Marker

Selects the active marker. The active marker is output with an higher voltage than all other markers.

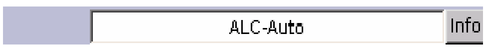
SCPI command:

`[:SOURce<hw>]:SWEep:POWer:MARKer:ACTive` on page 419

5.4.5 Automatic Level Control - ALC

Automatic level control (**A**utomatic **L**evel **C**ontrol) can be used with almost all applications, except for pulse modulation with very small pulse width.

The level control status is permanently displayed as a status message in the info line.



The standard operating status is level control "On". This provides the highest level accuracy.

Level control can be switched to "Sample&Hold" or "Off" for particular applications. The "Sample&Hold" state (level control Off) is recommended:

- if pulse modulation with very small pulse width is active
- if in CW mode the signal/intermodulation ratio is to be improved for multi-transmitter measurements.

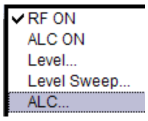
If "Sample&Hold" is selected, the level is recalibrated for every level and frequency setting. For this purpose, level control is activated briefly at a defined signal, the level adjuster is then held at the attained value and level control is activated.

If "On" and "Attenuator Mode Fixed" is selected, the level is recalibrated for every level and frequency setting.

For this purpose, level control is activated briefly at a defined signal, the level adjuster is then held at the attained value and level control is deactivated.

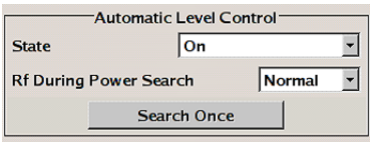
5.4.5.1 Automatic Level Control Settings

To open the "Automatic Level Control" dialog, select "Level Control > Configure > Automatic Level Control" or use the MENU key under "Level Control".



The combined dialog "RF Level / EMF / ALC / UCOR" is divided into the several sections and provides access to the "ALC" settings and to function "User Correction", see chapter 5.4.7, "User Correction", on page 134).

External level control via the EXT ALC intput is offered in addition to internal ALC (see chapter 5.4.5.2, "External Level Control", on page 92).



State - ALC

Activates/deactivates internal level control.

"Off (Sample & Hold)"	Internal level control is deactivated. The **Sample&Hold** state is recommended ● if pulse modulation with very small pulse width is active ● if in CW mode the signal/intermodulation ratio is to be improved for multi-transmitter measurements.
"On"	Internal level control is permanently activated. This provides the highest level accuracy.

SCPI command:
`[:SOURce<hw>]:POWer:ALC[:STATe]` on page 384

RF During Power Search - ALC

Activates the mode for power attenuator and for output during ALC power search.

"Normal"	During Power search, the RF output is active.
"Minimum"	The RF output is inactive during power search.

SCPI command:
`:OUTPut<hw>:ALC:SEARch:MODE` on page 258

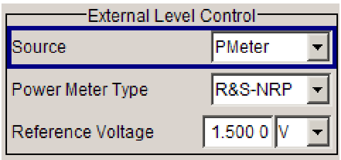
Search Once - ALC
Manually activates level control briefly to allow the level to be calibrated (the "Sample&Hold" setting must be selected).

SCPI command:
[:SOURce<hw>]:POWer:ALC:SONCe on page 383

5.4.5.2 External Level Control

With external level control, the level control is performed using an external DC signal applied at the EXT ALC input. The signal can be provided either by a diode detector or a power meter. A reference voltage has to be entered for the desired level at the RF output of the generator.

The "External Level Control" dialog is part of the **Level...** dialog and is opened in the LEVEL CONTROL function block or using the "MENU" key under "Level Control".



Source - External Level Control
Selects the source for level control.

"Internal" The internal detector is used. The settings under ALC are valid (see chapter 5.4.5, "Automatic Level Control - ALC", on page 90).

"Diode" A diode detector is connected to the EXT ALC input. The RF level is controlled by the external voltage provided by the detector. The reference voltage for the desired level at the RF output of the generator has to be entered below. See the specification of the detector for details.

"PMeter" A power meter can be connected to the EXT ALC input. The RF level is controlled by the external voltage provided by the power meter. The reference voltage for the desired level at the RF output of the generator has to be entered below. Please see the specification of the power meter for details.

SCPI command:
[:SOURce<hw>]:POWer:ALC:SOURce on page 384

Power Meter Type - External Level Control
Selects the power meter that is used for external level control. This feature is only available if PMeter is selected in the Source field.

SCPI command:
[:SOURce<hw>]:POWer:ALC:PMETer:TYPE on page 383

Reference Voltage - External Level Control
Sets the reference voltage for the desired level at the RF output of the generator. See the specification of the external source (diode detector or power meter) for details.

SCPI command:
`[:SOURce<hw>]:POWer:ALC:REFerence` on page 383

5.4.6 Power Sensors

Up to four R&S NRP power sensors can be connected to the generator. The SENSOR connector for the first R&S NRP power sensor is on the front panel, a second and third R&S NRP power sensor can be connected via the USB interfaces (front and rear panel, requires USB adapter R&S NRP-Z3 or R&S NRP-Z4). The connected R&S NRP power sensors are automatically detected and indicated in the "NRP-Z Power Viewer" dialog.

The signal generator supports the use of R&S NRP power sensors for measurement of the output signal of the RF signal path or any freely selectable source (see chapter 5.4.6.1, "NRP-Z Power Viewer", on page 93). In addition, it enables sweep measurements on DUTs (see chapter 5.4.6.2, "NRP-Z Power Analysis", on page 98). Pulse data analysis is possible with power sensor R&S NRP-Z81.

5.4.6.1 NRP-Z Power Viewer

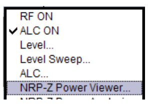
The output signals of the RF signal path (reference level is the set RF level) or any freely selectable source can be measured.

The average signal power is continuously measured by the R&S NRP power sensor(s) and indicated in the Power Sensors menu ("NRP-Z Power Viewer"). Permanent display of the measurement results in the block diagram can be activated.

The signal generator supports the use of R&S NRP power sensors for the acquisition of level correction data. The acquired level correction data is used to create and activate lists in which level correction values predefined by the user are freely assigned to RF frequencies. Correction is performed by the user-defined table values being added to the output level for the respective RF frequency (see chapter 5.4.7, "User Correction", on page 134).

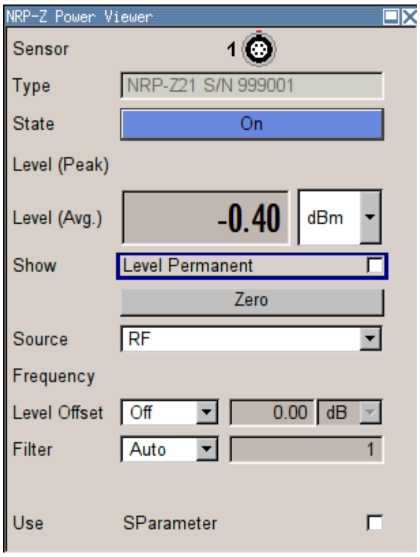
Refer to the R&S NRP power sensor manual for detailed information on the used power sensor.

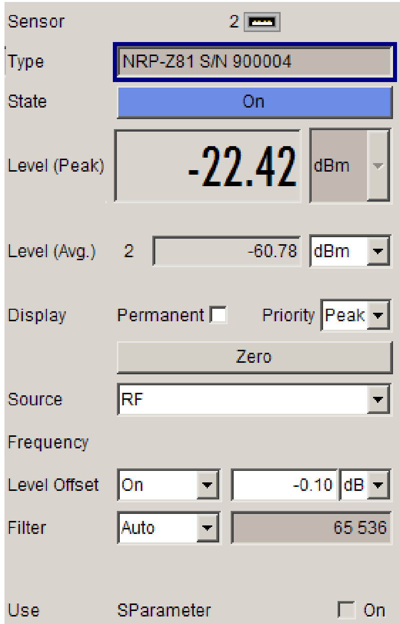
NRP-Z Power Viewer Settings



To open the "NRP-Z Power Viewer" dialog, select "Level Control > Configure > NRP-Z Power Viewer" or use the MENU key under "Level Control".

The sensor connected to the SENSOR port is always indicated as sensor 1, and the sensors connected to the USB interface are always indicated as sensor 2, 3 and 4.





Sensor - Power Sensors

Indicates the connector used for the detected sensors. The values listed below belong to the respective sensor.

The sensor is selected by suffix 1, 2, 3 or 4 in key word `SENSe` or `READ` of the command header. Suffix 1 denotes the sensor connected to SENSOR, suffix 2 the one at the first USB interface, and suffix 3 and 4 are assigned to the sensors at the following USB interfaces. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

In order to detect all connected sensors the state of all four connectors (i.e. SENsor1/SENSor2/SENSor3/SENSor4) must be checked.

Note: The software version of the connected power sensor can be retrieved by means of the remote control command `:SENS:POW:TYPE?`.
Use the "Setup > NRP-Z Info Update Setup" dialog to update the sensor software.

SCPI command:
`SENSe<ch>[:POWer]:STATus[:DEVice]` on page 274

Type - Power Sensors

Indicates the type and the serial number of the connected R&S NRP power sensor. The sensor type is automatically detected.

SCPI command:
`SENSe<ch>[:POWer]:TYPE` on page 303
`SENSe<ch>[:POWer]:SNUMber` on page 273

State - Power Sensors

Activates/deactivates level measurement by the power sensor.

The local state is set with the `INIT` command. Switching the local state off enhances the measurement performance.

In remote control, the sensors are set up using the SENSe commands. The remote measurement is triggered by the READ query which also provides the measurement results. The state is not influenced by these commands, measurements results can be retrieved with local State on or off.

The sensor is selected by suffix 1, 2, 3 or 4 in key word SENSe or READ of the command header. Suffix 1 denotes the sensor connected to SENSOR, suffix 2 the one at the first USB interface, and suffix 3 and 4 are assigned to the sensors at the following USB interfaces. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

In order to detect all connected sensors the state of all four connectors (i.e. SENsor1/SENSor2/SENSor3/SENSor4) must be checked.

To query the availability of a sensor at a given connector, use the command
SENSe<ch>[:POWer]:STATus[:DEVice] on page 274.

SCPI command:
INITiate<ch>[:POWer]:CONTinuous on page 266

Level (Peak) - Power Sensors
With certain power sensors only, e.g. R&S NRP-Z81.

Indicates the measured peak level value with the selected unit.

SCPI command:
READ<ch>[:POWer] on page 266

Level (Avg.) - Power Sensors
Indicates the measured level value with the selected unit.

SCPI command:
READ<ch>[:POWer] on page 266

Unit - Power Sensors
Selects the unit used for result display.

The power sensor provides the measured value in Watt.

In which unit the measured value is indicated is selected here and might be Watt, dBm or dBuV.

SCPI command:
SENSe<ch>:UNIT[:POWer] on page 304

Permanent Display State - Power Sensors
Activates the permanent indication of the power measurement result in the upper right corner of the block diagram. For each sensor, the type of sensor, the connector, the measurement source and - if set - the offset is indicated.

SCPI command:
SENSe<ch>[:POWer]:DISPlay:PERManent:STATe on page 269

Permanent Display Priority - Power Sensors

Selects whether the average or the peak power measurement result is indicated when permanent display is active.

SCPI command:

`SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority` on page 269

Zero - Power Sensors

Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor (see tips below). R&S power sensors automatically detect the presence of any significant input power. This aborts zeroing and generates an error message. Zeroing can take a few seconds, depending on the sensor model; refer to the documentation of your external power sensor for more information.

Tips for zeroing

Zeroing should be performed:

- During warm-up after switching on or connecting the instrument
- After a substantial change of the ambient temperature
- After fastening the power sensor module to an RF connector at high temperature
- After several hours of operation
- When very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
- Switch off the RF power source for zeroing; do not disconnect it from the power sensor. In this way you will maintain the thermal equilibrium, and zeroing will also compensate for the noise superimposed on the measured signal (e.g. from a broadband amplifier).

SCPI command:

`SENSe<ch>[:POWer]:ZERO` on page 303

Source - Power Sensors

Selects the source for measurement.

"RF" Measurement source is the RF signal of the generator. The RF frequency is used as the measurement frequency of the sensor and the corresponding correction factor is used.
In this mode the RF frequency of the generator is send to the sensor automatically if changed.

"User" Measurements source is any freely selectable source. The frequency is entered manually under frequency (e.g. for measurement of amplifier gain with 2 sensors).

SCPI command:

`SENSe<ch>[:POWer]:SOURce` on page 273

Frequency - Power Sensors

Source User only

Enters the frequency for measurement source "User".

SCPI command:

`SENSe<ch>[:POWer]:FREQuency` on page 272

Level Offset - Power Sensors

Activates and defines a level offset which is added to the measured value. This allows e.g. an attenuator in the signal path to be taken into account. The offset is always entered in dB, irrespective of the selected unit for result display.

SCPI command:

`SENSe<ch>[:POWer]:OFFSet:STATe` on page 273

`SENSe<ch>[:POWer]:OFFSet` on page 272

Filter Length - Power Sensors

Selects the filter length used for measurement. The filter length is the multiplier for the measurement time and thus directly influences it.

The averaging filter is used to reduce fluctuations in the measured result to the extent desired. Such fluctuations can be caused by inherent noise of the measuring instrument, modulation of the measurement signal or beats from the superposition of adjacent carriers. A more stable display has to be traded off against longer measurements. The measurement result is obtained from a two-stage averaging process.

Note: Longer measurements does not mean that it takes longer to display a new result, but rather that it takes longer for the result to settle when the power changes.

Measurements are continuously repeated in a predefined time window. The measurement result is obtained by averaging the measured values for the last 2N time windows. The number N is the filter length, the factor of 2 arises because the output signals from the microwave detector to suppress low-frequency noise are chopped at the same rate as the time windows, which means that an independent measured value can only be obtained from two consecutive values. As the filter length is the multiplier for the time window it directly influences the measurement time.

The filter length can be selected automatically or can be manually set to a fixed value. As a preliminary, you should always check if the auto mode is giving satisfactory results because you will always have to adjust an optimal, manual filter-length setting if the power is not constant.

Selection "Fixed Noise" is offered for reaching defined measurement accuracy.

"Auto" The filter length is automatically selected and adapted to the currently measured value. With very high signals the filter length and therefore the measurement time can be short. With very low signal levels the filter length and therefore the measurement time is increased in order to reduce noise. The used filter length is indicated in the field to the right.

"User" The filter length is set manually.
The filter length is entered in the entry window to the right. As the filter length works as a multiplier for the time window, this results in a constant measurement time. Values 1 and 2^n are settable.

Note: The time window varies depending on the used sensor. For most sensors it is fixed to 20 ms. For the R&S NRP-Z81 sensor it is 10 us. Therefore, the user filter length for the R&S NRP-Z81 has be about 1000 times larger than the filter length for other sensors in order to achieve the same filtering result.
The "Auto Once" button can be used to search for the optimum filter length for the current measurement conditions. The found filter length is indicated in the field to the right.

"Fixed Noise" The averaging factor is selected so that the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content.
The desired noise content is entered in the entry field to the right.
To avoid very long settling times when the power is low, the averaging factor can be limited with the "Timeout" parameter.

SCPI command:
SENSe<ch>[:POWer]:FILTer:TYPE on page 271
SENSe<ch>[:POWer]:FILTer:LENGth:AUTO on page 270
SENSe<ch>[:POWer]:FILTer:SONCe on page 271
SENSe<ch>[:POWer]:FILTer:LENGth[:USER] on page 270
SENSe<ch>[:POWer]:FILTer:NSRatio on page 270
SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe on page 271

Use SParameter - Power Sensors
Activates the use of the S-Parameters correction data of the connected power sensor. For sensor with attenuator this checkbox is automatically checked.

Please see the manual of the connected R&S NRP power sensor for a description on how to use the s-parameters table.

SCPI command:
SENSe<ch>[:POWer]:CORRection:SPDevice:STATe on page 269

Use Sensor for RF Lev. Control - Power Sensors
Enables/disables controlling of the RF level via the power sensor.

SCPI command:
n.a.

Target Level - Power Sensors
Sets the target RF level.

SCPI command:
n.a.

5.4.6.2 NRP-Z Power Analysis

The signal generator in combination with a connected R&S NRP probe enables sweep measurements on DUTs.

The measurement data of the sensors is displayed in traces in a measurement diagram. Four traces are available. The traces are automatically or manually assigned to the sensors. In addition to the data traces, a reference trace can be stored and recalled and/or the trace indication can be frozen temporarily (hold trace), thus enabling comparison of traces. Readout and comparison of particular values of the traces is possible by means of four markers.

Three measurement modes are offered:

- power versus frequency (frequency response)
- power versus power (power sweep, AM/AM)
  These two modes are generator driven, i.e., the generator provides the measurement signal.

- power versus time (power measurement in the time domain R&S NRP trace mode). This mode is signal driven, i.e. besides the generator signal also external signals can be analyzed. Time mode requires an additional trigger event, for which level, hysteresis and dropout time are freely selectable. The generator also features pulse data analysis in this mode, provided that R&S power sensor NRP-Z81 is connected.

The timing can be selected for normal and fast measurements for all modes.

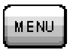
By the use of a separate frequency than the set generator frequency, measurement results retrieved at a different frequency can be displayed in the diagram (e.g. as provided at the output of the DUT).

Special functions of some hardkeys

In order to ease operation, several hardkeys are allocated special functions if the "NRP-Z Power Analysis" menus are active.

The REARRANGE key toggles between different views for the diagram, selectable in the "REARR list NRP-Z Analysis dialog", see "REARR list - Power Analysis" on page 108:

- standard, diagram and buttons are displayed,
- full display, diagram with marker list but no buttons are displayed,
- full display, diagram with pulse data list but no buttons are displayed, and
- full display only diagram is displayed.



The MENU and SETUP keys directly open a special power analysis menu. Either the complete menu tree or the setup menu tree is available in addition to the power analysis menu.

The ON /OFF key toggles between measurement start and stop.

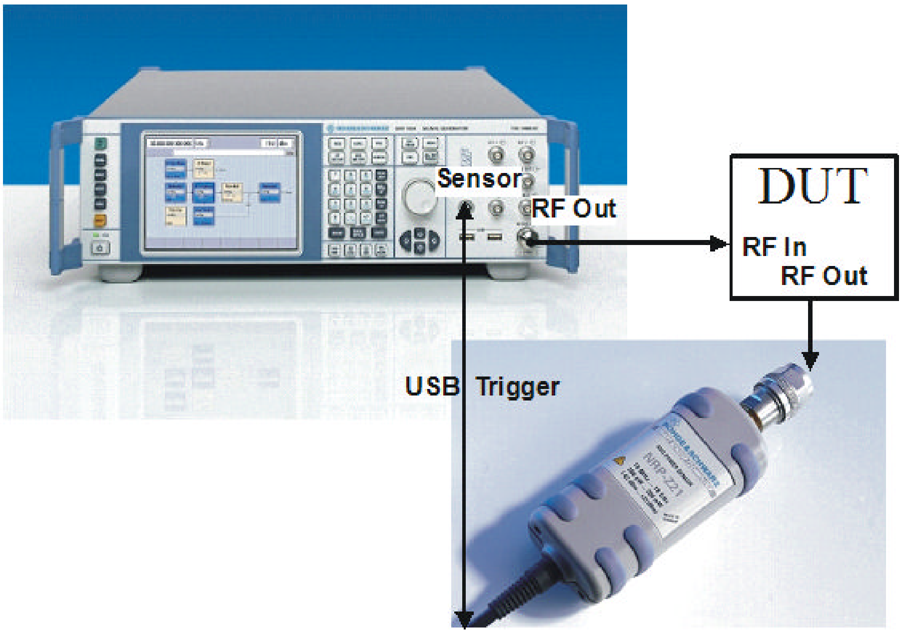
The BACKSPACE key resets the scaling of the Y-axis to suitable values after the use of auto scaling in the expanding mode. For this mode, the y scale might get to expanded because of temporarily high power values. The reset function resets the diagram in such a way that it matches smaller power values again.

If the auto scaling is turned off, a pressure on the BACKSPACE button switches into auto scaling expanding mode and resets Auto Scale.

Example Test Setup

As a power meter has no built-in selection, it is measuring all signal components from nearly DC to 40 GHz and higher. Therefore, the DUT's signal must be rather pure or subjected to external filtering (harmonics, spurious) before measured.

The test setup for the power analysis in the **power versus frequency or power versus power** is as follows:



1. Connect the DUT (e.g. bandpass) to the RF output of the instrument and the RF input of the R&S NRP-Zxx sensor (e.g. R&S NRP-Z21).
2. Connect the USB output of the R&S NRP-Zxx to the SENSOR connector of the instrument.
3. Open the "NRP-Z Analysis" diagram in the "Level" block of the generator
4. Setup the measurement and scale diagram in the "Configure…" dialog (e.g. fast measurement, 200 measurement points, range, x-axis and y-axis scale).
5. Trigger measurement by pushing the "Start" button in the "NRP-Z Power Analysis" diagram.
6. If required, perform the further settings:
   a) Set markers by means of the rotary knob. To access the markers activate the "NRP-Z Analysis Frequency / Marker" diagram view with the "Rearrange" key. The markers are moved by means of the cursor and the roll key to the desired trace position.
   Note: The "REARR list NRP-Z Analysis dialog" dialog provides a selection of views, between which is toggled (see).
   b) Store a hardcopy of the measurement results chapter 5.4.6.2.5, "Configure Diagram", on page 107("Save…" submenu).
   c) Apply user correction. "Ucor" is also available for NRP-Z measurements (see chapter 5.4.7, "User Correction", on page 134).

   The following graphs show the measurement results of a single measurement with the above example settings and an RF frequency from 1 to 6 GHz and level range from -65 dB to 5 dB.

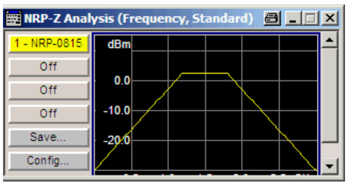


Fig. 5-1: Standard display, diagram and buttons are displayed

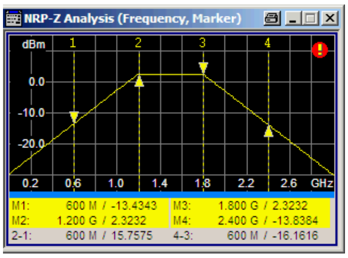


Fig. 5-2: Full display, diagram with marker and marker list are displayed

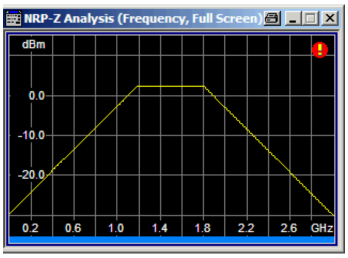
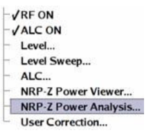


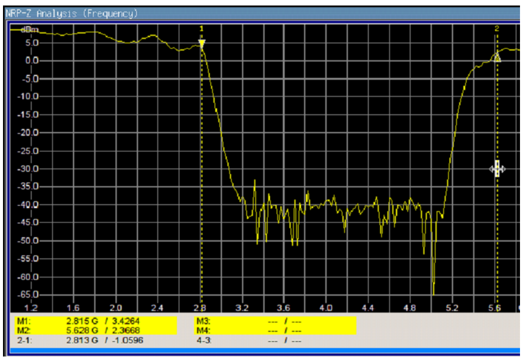
Fig. 5-3: Fullscreen view, only the diagram is displayed

Measurement Diagram



To open the "NRP-Z Power Analysis" diagram, select "Level Control > Configure > NRP-Z Power Analysis" or use the MENU key under "Level Control".

The dialog comprises the measurement diagram with start button and provides access to the dialogs for setting up the measurement and sensor parameters, for configuring the diagram and trace indication, and for storing hardcopies of the measurement results.



The diagram display depends on the diagram view which can be toggled by means of the "Rearrange" key.

Note: The "REARR list NRP-Z Analysis dialog" dialog provides a selection of views, between which is toggled (see "REARR list - Power Analysis" on page 108).

Markers and the marker list are available in the "NRP-Z Analysis Frequency / Marker" view which is shown in the graph above (see also chapter 5.4.6.2.11, "Define Markers ", on page 129). The markers are moved by means of the roll key. One click activates the marker cursor, the second click attaches the cursor to the selected marker which now can be moved to the desired position. Two clicks on the ESC key set the focus back to the diagram.

The list below the diagram shows the numerical readout of the marker values.

The x-axis of the measurement diagram is freely scalable in the frequency or power range of the generator, the power range for the y-axis is +100 dBm to -200 dBm. In addition, a separate frequency range for x-axis scaling in power versus frequency mode can be used. The available time range for power versus time measurements is -1s to +2s.

It is possible to select single or continuous measurement mode in the "Config…" menu. Single starts a single measurement after the trigger, continuous causes a restart of the measurement after each pass. The measurement is triggered by pushing the "Start" button. In continuous mode, the "Start" button is replaced by a "Stop" button after the trigger which can be used to cancel the measurement. A progress bar indicates the current status of the measurement.

In time mode additional triggering is required which is configured in the trigger dialog.

Changing to trace source **Hold** freezes the current trace indication in the diagram.

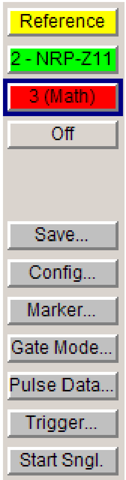
Some front panel keys are assigned special functions if the power analysis is active (see overview of features and operation in section chapter 5.4.6.2, "NRP-Z Power Analysis", on page 98):

Marker and Pulse Data Indication - Power Analysis
The marker and pulse data value indication below the measurement diagram is only available for certain views of the diagram. The "Rearrange" key or the key combination <STR+A> toggles between the different digram views (see chapter 5.4.6.2, "NRP-Z Power Analysis", on page 98). The marker indication in the measurement diagram is activated in the marker dialog, see chapter 5.4.6.2.11, "Define Markers ", on page 129.

Tip: In the remote control mode, it can be defined if the markers in the measurement diagram and the marker list/pulse data below the diagram are also indicated in the hardcopy file.

SCPI command:
`:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe]` on page 308
`:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe]` on page 309

Buttons



The dialog comprises at the left side of the diagram butttons for sensor assignment, for configuring the diagram, accessing dialogs for setting up the measurement and for activating.

Trace Buttons - Power Analysis
The four buttons in the upper left corner of the measurement diagram indicate the sensor assignment to the respective trace. They open the settings dialogs for the traces, see chapter 5.4.6.2.10, "Setup Trace", on page 126.

Save… - Power Analysis
Opens the dialog to store a screenshot of the current measurement diagram, see chapter 5.4.6.2.12, "Save Hardcopy", on page 130.

Config… - Power Analysis
Opens the dialog to configure the power analysis measurement, see

- chapter 5.4.6.2.4, "Configure Measurement", on page 104

Marker… - Power Analysis
Opens the dialog to activate the marker indication, see chapter 5.4.6.2.11, "Define Markers ", on page 129.

Gate Mode… - Power Analysis
Only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Opens the dialog to configure the gate settings for pulse data analysis, see chapter 5.4.6.2.6, "Configure Gate Mode", on page 110.

Pulse Data… - Power Analysis
Only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Opens a dialog to configure the pulse data analysis, see section chapter 5.4.6.2.8, "Configure Pulse Data NRP-Z", on page 115.

Trigger… - Power Analysis
Only for measurement mode time.

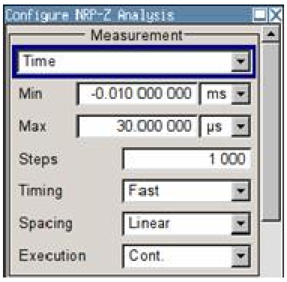
Opens a dialog to set the trigger for time measurement mode, see chapter 5.4.6.2.9, "Configure Trigger", on page 124.

Start - Power Analysis
Triggers the measurements with the R&S NRP-Zxx power sensors. The measurement results are indicated in the measurement diagram. A progress bar indicates the current status of the measurement.

SCPI command:
`SENSe[:POWer]:SWEep:INITiate` on page 289
`*OPC?`
`:TRACe<ch>[:POWer]:SWEep:DATA:POINts` on page 306
`:TRACe<ch>[:POWer]:SWEep:DATA:XVALues` on page 306
`:TRACe<ch>[:POWer]:SWEep:DATA:YVALues` on page 307

Configure Measurement

To open the "Configure NRP-Z Analysis" dialog, press the "Config..." button. The dialog is divided into several sections. In the measurement section, the mode is selected, the start and stop values for the sweep are set, and additional parameter settings are made.



Measurement Mode - Power Analysis
Selects the measurement mode.

"Frequency" Power versus frequency measurement (frequency response).

"Power" Power versus power measurement (power sweep, AM/AM).

"Time" Power versus time measurement (envelope power measurement as a function of time, NRP trace mode). This is done by sampling power over a time interval and then assigning the internal power values that have been determined to a number of points.
Gated measurements and pulse data analysis (R&S NRP-Z81 only) are available in this mode.

SCPI command:
`SENSe[:POWer]:SWEep:MODE` on page 289

Min - Power Analysis
Enters the minimum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the generator and the used power sensor.

The range for the start time is -1s to +1s. Value 0 defines the trigger point. By choosing a negative time value, the trace can be shifted in the diagram.

It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

If this value is changed for a finished single measurement, only the scaling of the X-axis is changed. This allows to zoom the trace. However, for subsequent measurements the measurement range is changed according to the new setting.

If this value is changed during a continuous measurement, only the scaling of the X-axis is changed for measurement cycles that still were triggered before the change. For subsequent measurement cycles the measurement range is changed according to the new setting.

SCPI command:

`SENSe[:POWer]:SWEep:FREQuency:STARt` on page 277

`SENSe[:POWer]:SWEep:POWer:STARt` on page 293

`SENSe[:POWer]:SWEep:TIME:STARt` on page 300

Max - Power Analysis

Enters the maximum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the instrument and the used power sensor.

The range for the stop time is 0 s to 2 s. Value 0 defines the trigger point.

It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

If this value is changed for a finished single measurement, only the scaling of the X-axis is changed. This allows to zoom the trace. However, for subsequent measurements the measurement range is changed according to the new setting.

If this value is changed during a continuous measurement, only the scaling of the X-axis is changed for measurement cycles that still were triggered before the change. For subsequent measurement cycles the measurement range is changed according to the new setting.

SCPI command:

`SENSe[:POWer]:SWEep:FREQuency:STOP` on page 278

`SENSe[:POWer]:SWEep:POWer:STOP` on page 293

`SENSe[:POWer]:SWEep:TIME:STOP` on page 301

Steps - Power Analysis

Enters the number of steps for the sweep. The number of measured points is steps + 1. The number of steps is one of the parameters that define the measurement speed. The higher the number of step, the longer the measurement takes (frequency and power mode).

SCPI command:

`SENSe[:POWer]:SWEep:FREQuency:STEPs` on page 277

`SENSe[:POWer]:SWEep:POWer:STEPs` on page 293

`SENSe[:POWer]:SWEep:TIME:STEPs` on page 301

Timing - Power Analysis

Frequency and power mode only.

Selects the timing mode of the measurement in frequency and power mode. This parameter is not available in time mode.

"Fast" Fast measurement with an integration time of 2 ms for each measurement step.

"Normal" A longer but more precise measurement (integration time is 20 ms/step).

SCPI command:

`SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE]` on page 278

`SENSe[:POWer]:SWEep:POWer:TIMing[:MODE]` on page 294

Average - Power Analysis

Time mode only

Selects the averaging factor in time mode. This parameter is not available in frequency and power mode.

The factor determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing. If factor 1 is selected no averaging is performed.

SCPI command:

`:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt]` on page 297

Spacing - Power Analysis

Sets the mode for calculating the sweep steps.

In power versus frequency mode, selection between linear and logarithmic spacing is possible.

"Linear"
- Power versus frequency
  In a linear sweep, the frequency is swept in equidistant steps over the continuous frequency range. The x-axis is a linear frequency axis.
- Power versus power
  The sweeps are performed at constant frequency but with variable generator power that is swept in linear, equidistant steps over a continuous range. The x-axis is a dB-linear power axis.
- Power versus time
  The sweeps are performed at constant frequency and stimulus power. The measurement is repeated over a specified period of time at constant time intervals.

"Logarithmic" Power versus frequency
In a logarithmic sweep, the frequency is swept in equidistant steps on a logarithmic scale. The x-axis is a logarithmic frequency axis.

SCPI command:

`SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE]` on page 277

`SENSe[:POWer]:SWEep:POWer:SPACing[:MODE]` on page 293

`SENSe[:POWer]:SWEep:TIME:SPACing[:MODE]` on page 300

Execution - Power Analysis

Selects single or continuous mode in power analysis.

The measurement is started in the diagram using the "Start" button. During measurement, the "Start" button is replaced by a "Stop" button which can be used to abort the measurement. The progress bar indicates the current status of the measurement.

Note: For time mode an additional trigger is required (see chapter 5.4.6.2.9, "Configure Trigger", on page 124).

"Single" Selects single measurement.

"Cont." Selects continuous measurements.

SCPI command:

`SENSe[:POWer]:SWEep:RMODe` on page 296

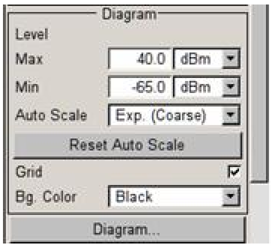
`SENSe[:POWer]:SWEep:FREQuency:RMODe` on page 275

`SENSe[:POWer]:SWEep:POWer:RMODe` on page 290

`SENSe[:POWer]:SWEep:TIME:RMODe` on page 296

Configure Diagram

The "Configure NRP-Z Analysis" dialog is divided into several sections. In the diagram area the scaling of the y-axis and the appearance of the diagram are set.



Min - Max Y-Axis - Power Analysis

Selects the minimum and maximum value of the y-axis.

SCPI command:

`SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum` on page 279

`SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum` on page 280

`SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum` on page 295

`SENSe[:POWer]:SWEep:POWer:YSCale:MINimum` on page 296

`SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum` on page 302

`SENSe[:POWer]:SWEep:TIME:YSCale:MINimum` on page 303

Auto Scale - Power Analysis

Activates/deactivates autoscaling of the Y axis of the diagram. The Auto Scale function adjusts the scale divisions so that the entire trace fits into the diagram area.

"Off" Auto scale is deactivated. If switching from activated to deactivated Auto scaling, the scaling is maintained.

"Exp. (Course/ Fine)" Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

"Flt. (Coarse/ Fine)"	Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

SCPI command:
SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO on page 278
SENSe[:POWer]:SWEep:POWer:YSCale:AUTO on page 294
SENSe[:POWer]:SWEep:TIME:YSCale:AUTO on page 301

Reset Auto Scale - Power Analysis
Resets the scaling of the Y-axis to suitable values after the use of auto scaling in the expanding mode. For this mode, the y scale might get too expanded because of temporarily high power values. The reset function resets the diagram in such a way that it matches smaller power values again.

SCPI command:
SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet on page 279
SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet on page 295
SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet on page 302

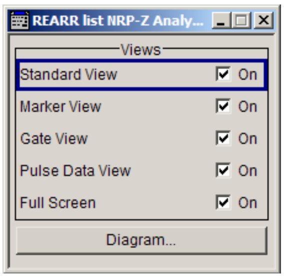
Grid - Power Analysis
Activates/deactivates the indication of a grid in the diagram area.

SCPI command:
:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe on page 265

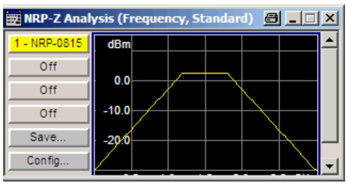
Bg Color - Power Analysis
Selects the background color of the diagram, black or white. The background color is also effective for the hardcopy of the diagram.

SCPI command:
:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor on page 265

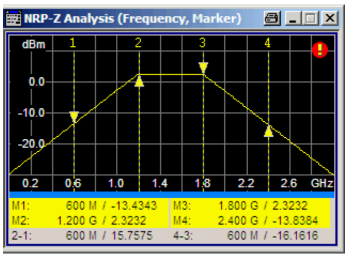
REARR list - Power Analysis
The "REARR list..." button in the middle section opens the dialog for selection of diagram views. This function provides to activate only the required "Views" on the checkboxes to the right. REARRR or STRG+<A> toggle between all views that are activated in this dialog.



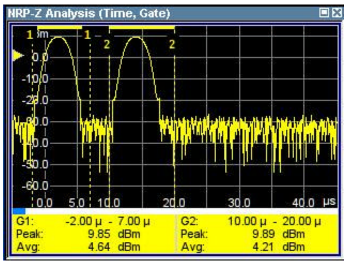
The following views (zoom levels) are available:
- Standard view, diagram and buttons but no lists are displayed



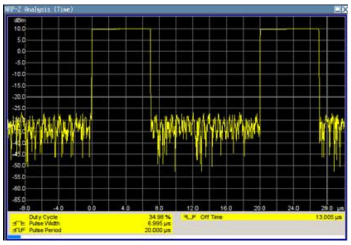
- Marker view, full display, diagram with marker list, but no buttons are displayed



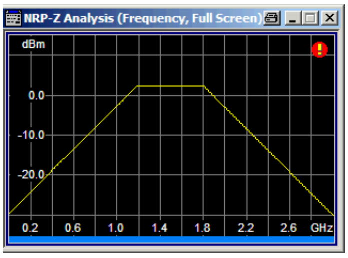
- Gate view, full display, diagram with gate data but no buttons are displayed



- Pulse data view, full display, diagram with pulse data list but no buttons are displayed



- Full Screen, full display only diagram is displayed



Note: The toggle function always switches sequentially between the activated views. Disabling a view that is currently shown, the instrument automatically switches to the next active view.

At least one view must be active, i.e. the final active view cannot be switched off.

SCPI command:

:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe] on page 310

:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe] on page 308

:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] on page 308

:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe] on page 309

:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe] on page 308

Pressing the "Diagram..." button returns to the "NRP-Z Analysis" diagram.

Gate Mode - Power Analysis

The "Gate Mode…" button opens the submenu for the gate mode settings (see chapter 5.4.6.2.6, "Configure Gate Mode", on page 110).

Diagram.. - Power Analysis

Returns to the "NRP-Z Analysis" diagram.

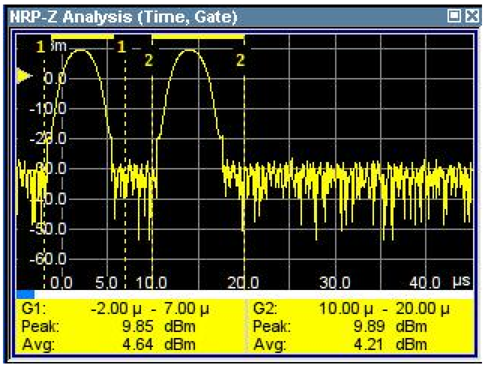
Configure Gate Mode

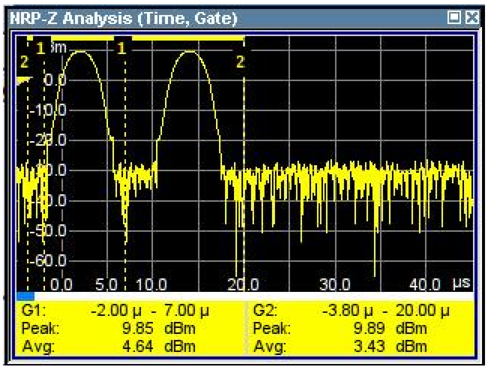
The "Configure NRP-Z Analysis" dialog is divided into several sections. The "Gate Mode…" button in the middle section opens the dialog for the gate mode settings.

For time measurement mode only.

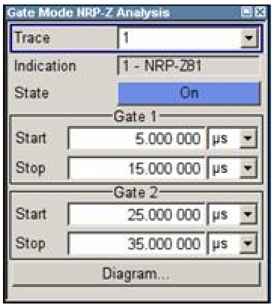
Time gated measurements of peak and average power are possible for many sensors. Two user-configurable gates can be assigned to one of the traces. Both gates are active at the same time. The values are calculated from the trace data, the time resolution is determined by the resolution of the sensor. An external trigger signal or signal triggering is required for synchronization.

The following graph shows two measurement examples, one with separated gates, and another one with overlapping gates.





The start and stop time of the gates are indicated as gate markers, a bar between the start and stop marker shows the gate length. The indication state of the gate borders and measurement values is only available for certain diagram views which are switched with the "Rearrange" key. The "REARR list NRP-Z Analysis dialog" dialog provides a selection of views, between which is toggled (see"REARR list - Power Analysis" on page 108).



In the remote control mode, commands for setting the indication state differ from the commands for reading the measurement values.

- **Command that defines the indication state for the diagram and for hardcopy:**
  `:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe]` on page 308
- **Commands that query the measured values:**
  `:CALCulate[:POWer]:SWEep:TIME:GATE<ch>AVERage` on page 262 queries the measured average power.
  `:CALCulate[:POWer]:SWEep:TIME:GATE<ch>MAXimum` on page 262 queries the measured peak power.

Trace - Gate

Selects the trace to which the gates are assigned. The sensor assignment to the respective trace is performed in the measurement diagram (trace buttons). The two gates are assigned to the same trace.

SCPI command:

`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED` on page 262

Indication - Gate

Indicates the type of the R&S SMF NRP power sensor assigned to the selected trace. This field is automatically updated if the sensor is connected or disconnected. Additionally, this sensor is indicated on the trace button in the measurement diagram.

Note: Gate settings are available in time measurement mode only.

SCPI command:
n.a.

State - Gate

Enables time gated measurement. The measurement is started with the "Start" button in the main measurement diagram. Both gates are active at one time.

The gate borders and the measurement values (average and peak power) are indicated in/below the measurement diagram. The indication is only available for certain diagram views which are switched with the "Rearrange" key.

SCPI command:
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe on page 263
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>AVERage on page 262
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>MAXimum on page 262
:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] on page 308

Start / Stop - Gate

Sets the start and the stop times for the respective gate.

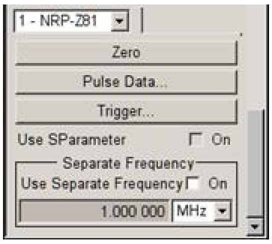
SCPI command:
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>STARt on page 263

Diagram... - Power Analysis

Returns to the "NRP-Z Analysis" Diagram.

Configure Sensors

The "Configure NRP-Z Analysis" dialog is divided into several sections. In the power sensor area the specific parameters for the selected sensor are set. This part of the dialog might differ from the following description depending on the sensor used. Refer to the manual of the power sensor in this case.



The "Pulse Data..." button is displayed only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Power Sensor - Power Analysis
Selects the power sensor to be set if more than one sensor is connected to the instrument.

SCPI command:
n.a.
In remote control the sensor is selected via the numeric suffix in the sense key word of the command, e.g. `SENSe2:POWer:SWEep:...`.

Zero - Power Analysis
Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor (see tips below). R&S power sensors automatically detect the presence of any significant input power. This aborts zeroing and generates an error message. Zeroing can take a few seconds, depending on the sensor model; refer to the documentation of your external power sensor for more information.

Tips for zeroing

Zeroing should be performed:
- During warm-up after switching on or connecting the instrument
- After a substantial change of the ambient temperature
- After fastening the power sensor module to an RF connector at high temperature
- After several hours of operation
- When very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
- Switch off the RF power source for zeroing; do not disconnect it from the power sensor. In this way you will maintain the thermal equilibrium, and zeroing will also compensate for the noise superimposed on the measured signal (e.g. from a broadband amplifier).

SCPI command:
`SENSe<ch>[:POWer]:ZERO` on page 303

Pulse Data... - Power Analysis
Only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Opens the "Pulse Data NRP-Z-Analysis" dialog for configuring the parameters for pulse data analysis (see chapter 5.4.6.2.8, "Configure Pulse Data NRP-Z", on page 115.

SCPI command:
n.a.

Trigger... - Power Analysis
Only for measurement mode time.

Opens a settings dialog to set the trigger for time measurement mode, see chapter 5.4.6.2.9, "Configure Trigger", on page 124.

Use S-Parameter - Power Analysis
Activates the use of the s-parameters correction data of the connected power sensor. For sensors with attenuator this checkbox is automatically checked.

Refer also to the manual of the connected R&S NRP power sensor for a description on how to use the s-parameters table.

SCPI command:

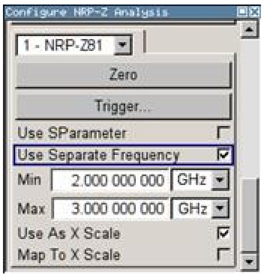
SENSe<ch>[:POWer]:CORRection:SPDevice:STATe on page 269

Use Separate Frequency- Power Analysis

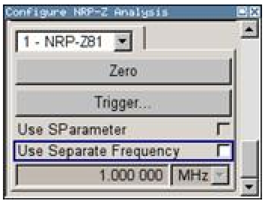
This setting is offered for measurements with DUTs that change the measurement frequency (e.g. modulators), thus changing the input frequency of the sensor.

The dialog differs depending on the measurement modes:

- Power versus frequency measurement
  Activates the use of a different frequency range other than the set signal generator frequency range for the measurement. The separate minimum and maximum frequency values are entered below.
  The x-scale of the diagram can be adjusted to the separate frequency range with functions "Use as X Scale" and "Map to X Scale".



- Power versus power measurement / Power versus time measurement
  Activates the use of a different frequency other than the set signal generator frequency for the measurement. The separate frequency value is entered in the entry window below.



SCPI command:

SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe]
on page 275

SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe
on page 291

SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency on page 290

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe on page 298

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency on page 298

Min Frequency - Power Analysis

Power versus frequency measurement active Use Separate Frequency only.

Enters the minimum frequency of the measurement.

SCPI command:

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt
on page 276

Max Frequency - Power Analysis
Power versus frequency measurement active Use Separate Frequency only.

Enters the maximum frequency of the measurement.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP` on page 276

Use as X Scale - Power Analysis
Measurement Mode Frequency only.

Activates the use of the separate frequency min and max values for the scaling of the x-axis. Thus, the trace for this sensor is visible in the diagram , especially for frequency ranges that differ substantially from the generator settings.

If more than one sensor is active and uses separate frequency, this options is only available for one sensor. To indicate the traces of the other sensors, function "Map to X Scale" has to be used.

SCPI command:
n.a.

Map to X Scale - Power Analysis
Mode Frequency and active Use Separate Frequency only.

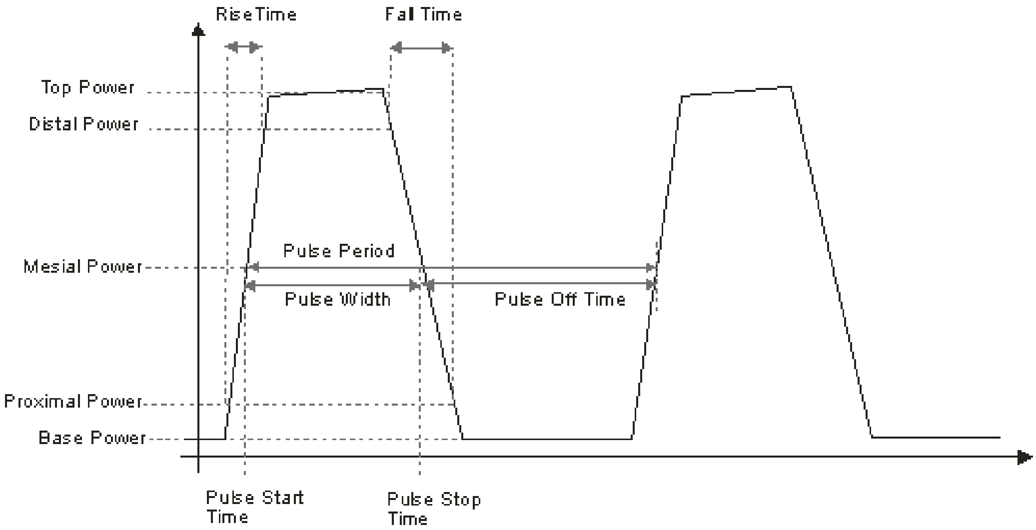
Maps the trace of a sensor that uses separate frequency to the current scaling of the diagram. Usually the scale is determined by the set frequency range of the generator. If more than one sensor is active and uses separate frequency the scale can also be determined by the separate frequency range of one of the other sensors.

SCPI command:
n.a.

Configure Pulse Data NRP-Z

For time measurement mode and power sensor R&S NRP-Z81 only.

The power sensors R&S NRP-Z81 enable pulse data analysis in measurement mode time. All important pulse parameters are measured after setting the threshold levels. The following graph shows most of these parameters:



The sensor calculates the pulse parameters from each measurement. The sensor delivers the results to the R&S signal generator.

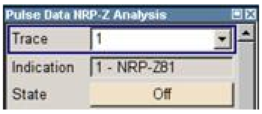
The "Pulse Data" button opens the submenu to configure and enable pulse data analysis:

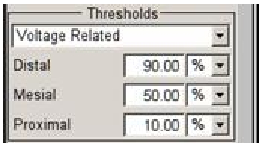
- The "Pulse Data NRP-Z- Analysis" dialog is divided into several sections. In the upper section the trace is selected and the pulse data analysis enabled. For information on traces and the measurement data on traces refer to chapter 5.4.6.2.10, "Setup Trace", on page 126.
- The "Thresholds" section covers the thresholds for detecting time values of a pulsed signal. Thresholds are used to calculate the time parameters. The thresholds can either be related to power or voltage. For information on parameters and terms refer to "Voltage / Power Related - Pulse Data Analysis" on page 118, "Mesial - Pulse Data Analysis" on page 119 and "Proximal - Pulse Data Analysis" on page 119.
- The "Notifications" section covers Duty Cycle, Pulse Width, Pulse Period and Pulse Off Time (see "Notifications - Pulse Data Analysis" on page 119.
- The "Transition Times" section covers Rise Time, Pulse Start Time, Overshoot for the rising or falling edges, Fall Time and Pulse Stop Time (see "Transition Times - Pulse Data Analysis" on page 120).
- The "Signal Power" section covers Minimal Power, Peak Power and Average Power (see "Signal Power - Pulse Data Analysis" on page 122).
- The "Pulse Power" section covers Top Power and Base Power, and Mesial Proximal and Distal Power (see "Pulse Power - Pulse Data Analysis" on page 123).

The indication state of the parameters also affects the hardcopy function. Storing the measurement diagram as hardcopy includes the parameters selected in this dialog. For information on storing measurement data refer to chapter 5.4.6.2.12, "Save Hardcopy", on page 130.

A total of 6 parameters can be indicated at one time. Structured hierarchically, trace 1 features top priority and trace 4 is addressed with the lowest weighting. This means that only the first 6 checked parameters are indicated, starting with the settings of trace 1.

The pulse data is only visible for certain zoom levels of the diagram. The REAR-RANGE key or the key combination <STR+A> on an external keyboard toggles between the different zoom levels.





In the remote control mode, commands for setting the indication state differ from the commands for reading the values of the corresponding pulse data parameters.

In the description of the checkboxes, the different remote control commands are listed as shown in the example below:

- Commands that define the indication state for the diagram and for hardcopy:
  `:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe]` on page 310
  activates indication of the measured duty cycle.
  `:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:ANNotation[:STATe]` on page 311
  activates indication the measured top level.
- Commands that query the measured values:
  `:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle` on page 309
  queries the measured duty cycle.
  `:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP`
  on page 309
  queries the measured top level.

Trace - Pulse Data Analysis

Selects the trace for which the pulse data analysis is performed. The sensor assignment to the respective trace is performed in the measurement diagram (trace buttons).

SCPI command:
n.a.
In remote control, the trace is selected by the suffix of keyword `TRACe`.

Indication - Pulse Data Analysis

Indicates the type of R&S NRP power sensor assigned to the selected trace. This field is automatically updated if the sensor is connected or disconnected. Additionally, this sensor is indicated on the trace button in the measurement diagram.

Note: Pulse measurement is available for R&S NRP-Z 81 power sensors in time measurement mode.

SCPI command:
n.a.

State - Pulse Data Analysis

Enables pulse data analysis. The measurement is started with the "Start" button in the main measurement diagram.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe` on page 291

Voltage / Power Related - Pulse Data Analysis

Selects how the threshold parameters are calculated, either voltage related or power related. The voltage-related parameters represent the normal case, as the usual representation when defining the pulse parameters (rise/fall time, pulse width) is U(t). To achieve a display with equivalent power-related values, the voltage-related threshold values must be converted (squared) (see example in table below).

	Distal	**Mesial**	**Proximal**
Voltage related:	90%	50%	10%
Power related:	81%	25%	1 %
log. Scale (e.g.): (approx., difference between top- base power > 30 dB)	-0.9dB	-6dB	-20dB

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE`
on page 291
`:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE` on page 311

Distal - Pulse Data Analysis

Sets the upper reference level in terms of percentage of the overall pulse level (power or voltage related). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:HREFerence` on page 292
`:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence`
on page 312

Mesial - Pulse Data Analysis
Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define the pulse width (τ) and pulse period.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:REFerence` on page 292
`:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence` on page 312

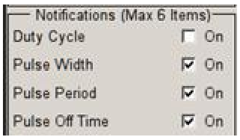
Proximal - Pulse Data Analysis
Sets the lower reference level in terms of percentage of the overall pulse level (power or voltage related).

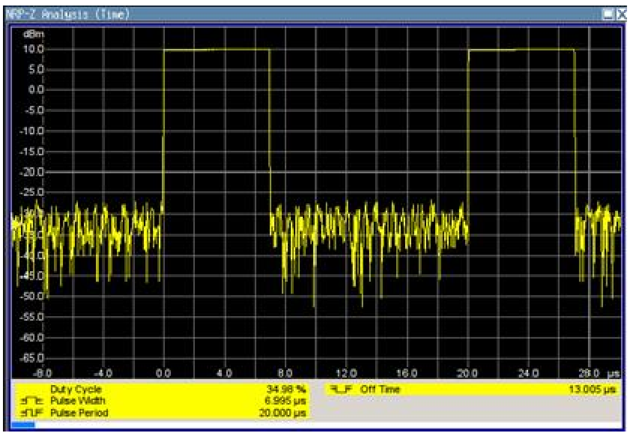
The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:LREFerence` on page 292
`:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence` on page 312

Notifications - Pulse Data Analysis
Selects the pulse parameters to be indicated below the measurement diagram (medium zoom level only).

Note: The "Rearrange" key or the key combination <STR+A> toggle between the zoom levels of the diagram.





"Duty Cycle" Indicates the ratio between the pulse duration (τ) and the pulse period (T) of the measured pulse signal in per cent:
Duty Cycle = (pulse duration / pulse period) * 100

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe] on page 310
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle on page 309

"Pulse Width" Indicates the pulse duration of the pulse data measurement in seconds.

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay:ANNotation[:STATe] on page 310
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation on page 309

"Pulse Period" Indicates the time the pulse signal needs to complete one cycle.

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:ANNotation[:STATe] on page 310
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod on page 309

"Pulse Off Time" Determines the time the pulse signal is low, i.e. as long as the signal level is below the proximal value.

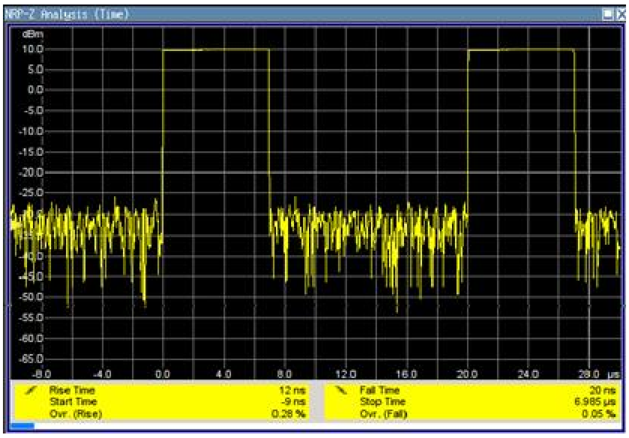
SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation on page 309

Transition Times - Pulse Data Analysis

Selects the transition parameters of the pulse signal to be indicated below the measurement diagram (medium zoom level only).

The R&S NRP-Z sensor searches for the first rising edge and the first falling edge in the trace.

Note: The "Rearrange" key or the key combination <STR+A> toggle between the zoom levels of the diagram.



"Rise Time / Fall Time" Display the time the signal requires from crossing low reference until it reaches high reference level and vice versa.

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation on page 309
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation on page 309

"Pulse Start Time / Pulse Stop Time" Display the time when the pulse signal crosses the medial reference level.

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence on page 309
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence on page 309

"Overshoot (Rising Edge / Falling Edge)"

Display the maximum value of the pulse signal following a rising transition and the minimum value of the signal after a falling transition, respectively.

Overshoot values are given in per cent of the pulse amplitude as shown below:

- Overshoot(pos) = 100* (maximum - top level) / (top level - base level)
- Overshoot(neg) = 100* (base level - minimum) / (top level - base level)

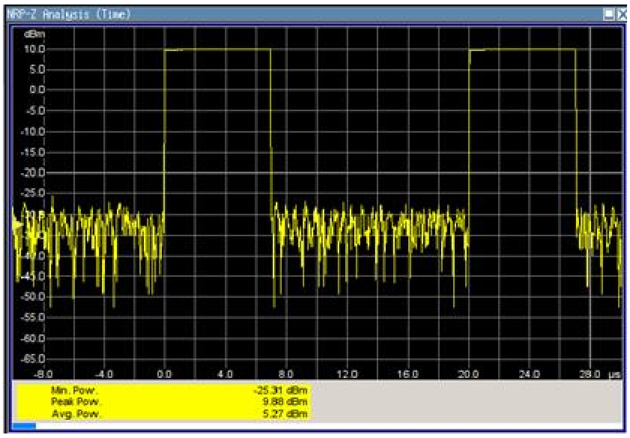
SCPI command:

:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot on page 309
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot on page 309

Signal Power - Pulse Data Analysis

Selects the power parameters of the pulse signal to be indicated below the measurement diagram (medium zoom level only).

Note: The REARRANGE key or the key combination <STR+A> toggle between the zoom levels of the diagram.

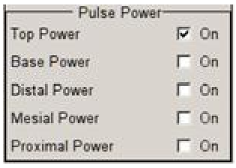


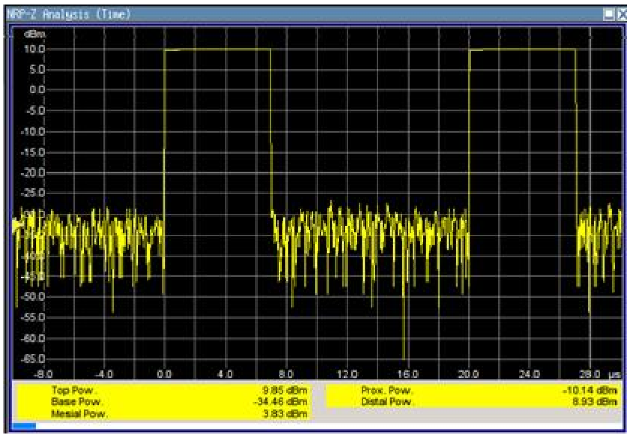
"Minimal / Peak / Average Power" display the minimum, the maximum and the average power of the pulse signal in dBm.

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum on page 309
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum on page 309
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:ANNotation[:STATe] on page 310
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage on page 309

Pulse Power - Pulse Data Analysis
Selects which pulse power parameters are indicated in the diagram (pulse data view only).

Note: The "Rearrange" key or the key combination "<STR+a>" toggles between the zoom levels of the diagram.





"Top / Base Power" Iindicate the pulse top and base level of the analyzed signal in dBm.

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP on page 309
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE on page 309

"Distal / Mesial /Proximal Power" Display the absolute power values of the medial, low and high reference level in dBm.

SCPI command:
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence on page 309
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay:ANNotation[:STATe] on page 311
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence on page 309

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis" Diagram.

Configure Trigger

The "Trigger…" button opens the "Trigger NRP-Z Analysis" dialog. The button is only active for time measurement mode. For this mode, the measurement start has to be known to the sensor as the measurement is controlled by the sensor.

Power Sensor - Power Analysis
Selects the power sensor to be set if more than one sensor is connected to the instrument.

SCPI command:
n.a.
In remote control the sensor is selected via the numeric suffix in the sense key word of the command, e.g. SENSe2:POWer:SWEep:....

Mode - Power Analysis
Selects if the measurement is free running, or starts only after an internal or external trigger event.

SCPI command:
SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce on page 300

Level - Power Analysis
Sets the trigger threshold. This setting is also possible by means of the trigger marker on the left side of the diagram.

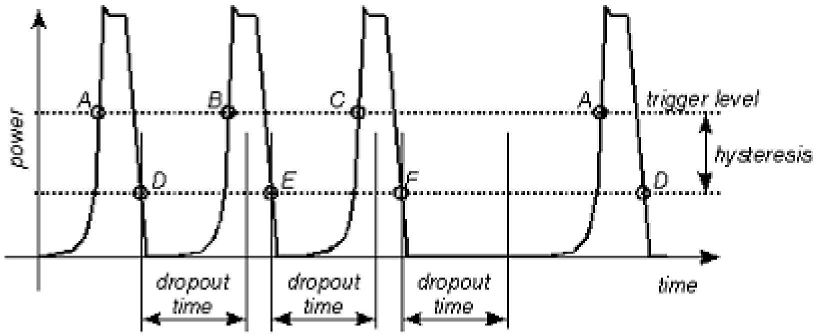
SCPI command:
SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel on page 299

Hysteresis - Power Analysis
Sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis`
on page 299

Drop out Time - Power Analysis
Determines the minimum time for which the signal must be below (above) the power level defined by "Level" and "Hysteresis" before triggering can occur again. This prevents the trigger system from being activated too early if the trigger threshold is briefly underranged or exceeded.

The dropout time parameter is useful when dealing with, for example, GSM signals with several active slots. When performing a measurement in sync with the signal, a trigger event is to be produced at A, but not at B or C. As the RF power between the slots is below the threshold defined by "Level" and "Hysteresis", the trigger hysteresis alone cannot prevent triggering at B or at C. This is why the dropout time parameter is selected to be greater than the time elapsed between points E and B and between F and C, but less than the time elapsed between G and A. This ensures that triggering will take place at A.



As the mechanism associated with the dropout time parameter is reactivated whenever the trigger threshold is crossed, unambiguous triggering can also be obtained for many complex signals. By contrast, all triggering is suppressed during the hold-off time. For the example described, this would mean that although stable triggering conditions could be obtained with a suitable hold-off time (regular triggering at the same point), it would not be possible to set exclusive triggering at A.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe` on page 299

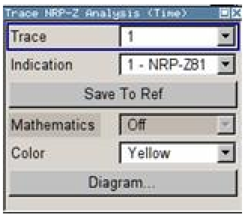
Auto Set - Power Analysis
Sets the trigger level, the hysteresis and the drop out time to default values.

SCPI command:
`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO` on page 298

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis" Diagram.

Setup Trace

Traces are used to display measurement results in the diagram area. The measurement data can be current (sensor trace) or stored trace data, either in a file (reference trace) or in a temporary memory (hold trace). Up to four traces can be indicated at one time. On connection, the sensors are automatically detected and assigned to a trace. By default, connected sensors are assigned to the traces in ascending order, i.e. sensor 1 to trace 1, sensor 2 to trace 2 and so on. If the default trace is already used, the sensor has to be assigned manually in the trace dialog.



The reference trace or hold trace enable comparison of traces. The reference trace or the hold trace are assigned to one of the traces and the sensor measurement to be compared to another trace.

Example

The current single measurement of sensor 2 which is assigned to trace 2 shall be used as reference trace.

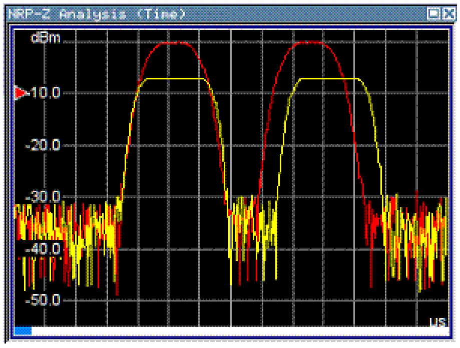
1. Select "Trace 2" with "Indication 2" = NRP-Zx and press the "Save To Ref" button.
2. Select "Trace 1" and "Indication Ref.".
3. Press the "Diagram" button, two identical traces are now indicated.
4. Push the "Start single" button and a new measurement cycle with sensor 2 is triggered. The resulting measurement trace can be compared to the former measurement which is visible as reference trace.

Trace - Power Analysis
Selects the index of the trace. The source for the trace data is selected below. The trace color for each of the four possible traces is preset but can be changed.

SCPI command:
n.a.
In remote control, the trace is selected by the suffix of keyword `TRACe`.

Indication - Power Analysis
Selects the source for the trace data.

The selection is indicated on the trace button in the measurement diagram.



Red = reference or hold trace
Yellow = current measurement trace

"Off" No source is selected, the trace is not indicated.

SCPI command:
:TRACe<ch>[:POWer]:SWEep:STATe on page 313

"2 - NRP-Zxx" The current measurement results of the selected power sensor are the source for the trace data. The index at the beginning of the sensor name indicates the used connector, e.g. 2 indicates that the sensor is connected via a USB interface. The data are either continuously updated (continuous measurement) or represent a single measurement cycle (single measurement).

SCPI command:
:TRACe<ch>[:POWer]:SWEep:STATe on page 313
:TRACe<ch>[:POWer]:SWEep:FEED on page 307

"Ref" Selects the reference trace. The reference trace represents the state of the sensor trace at the moment when it was stored. The reference trace is a static trace that was stored in a file and can be recalled.
It is possible to store one reference trace at a time.

SCPI command:
:TRACe<ch>[:POWer]:SWEep:COPY on page 306
:TRACe<ch>[:POWer]:SWEep:FEED on page 307
:TRACe<ch>[:POWer]:SWEep:STATe on page 313

"Hold" Freezes the current trace data. The hold trace is a temporary trace that is available until the NRP power analysis is finished. Freezing the trace of a sensor on one trace and displaying the measurement values of the same sensor on a other trace allows fast comparison between measurements.

SCPI command:
n.a.
(this feature is available for manual control only)

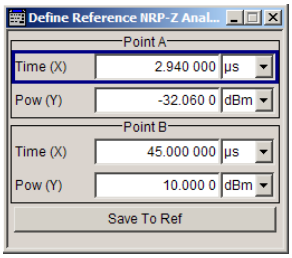
Save to Ref - Trace Power Analysis

Saves the selected trace as reference trace. One reference trace is available at a time.

SCPI command:
:TRACe<ch>[:POWer]:SWEep:COPY on page 306

Define Reference - Trace Power Analysis

Opens a dialog for defining a linear reference curve.



Define the reference curve by entering the coordinates of "Point A" and "Point B".

The reference curve is determined by two value pairs in the cartesian coordinates of the "NRP-Z Analysis" diagram. Depending on the measurement mode, the following values are required:

- Freq (X) / Pow (Y) in "Frequency" mode
  Determine the parameters of the frequency reference curve.
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues` on page 275
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues` on page 275
- Pow (X) / Pow (Y) in "Power" mode
  Enter the X and Y axis values of the points A and B.
  `:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues` on page 290
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY` on page 297
- Time (X) / Pow (Y) in "Time" mode
  Enter the time values for the x axis and the corresponding y axis power values.
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues` on page 297
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues` on page 298
- "Save To Ref"
  Saves the selected trace as reference trace. One reference trace is available at a time.
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY` on page 274
  `:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues` on page 290
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY` on page 297

The reference curve consists of a certain number of coordinate points, calculated by the number of steps + 1. The first coordinate point starts at Min, and Max is the last. "Step", "Min" and "Max" are determined in the configuration dialog, see chapter 5.4.6.2.4, "Configure Measurement", on page 104.

Mathematics - Trace Power Analysis

Activates / deactivates the trace mathematics mode. This feature enables to subtract the measurement values of two traces. Additionally, a math result can also be assigned to an operand for further calculation.

Math configuration includes the selection of two operands for math measurement for a maximum of four channels. The math operation follows the formula:

$T<ch>_{result} = T<ch>_{Operand1} - T<ch>_{Operand2}$

The result ("T<ch>$_{result}$") is assigned to the currently active "Trace" (see above), and any of the traces, math results or the reference are available for "T<ch> $_{Operand1/2}$".

If switched on, the resulting curve is shown in the diagram.

The scaling of the Y axis changes according to the displayed type of curve.

SCPI command:

`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe` on page 263
`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract` on page 263
`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe` on page 264
`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract` on page 264
`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe` on page 264
`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract` on page 265

Color - Trace Power Analysis

Selects the color of the trace.

SCPI command:

`:TRACe<ch>[:POWer]:SWEep:COLor` on page 305

Diagram.. - Power Analysis

Returns to the "NRP-Z Analysis" Diagram.

Define Markers

Readout and comparison of particular values of the traces is possible by means of four markers. The markers can be edited either in the diagram or in the "Marker" dialog that is called with the SETUP key in the "NRP-Z Analysis" diagram.

In the "Marker" dialog, the marker can be made visible ("Visible") and assigned to a certain trace ("Trace"). The exact position still has to be defined in the diagram.

Markers and the marker list are available in the medium zoom level which is shown in the graph below. To access the markers activate the "NRP-Z Analysis (Time, Marker)" view with the "Rearrange" key. The markers are moved by means of the cursor and the roll key to the desired trace position. One click activates the marker cursor, the second click attaches the cursor to the selected marker which now can be moved to the desired position. Two clicks on the ESC key set the focus back to the diagram. The position of a active markers are indicated in the marker list.

Marker - Power Analysis

Selects the marker to be configured.

SCPI command:

n.a.

Visible - Power Analysis
Selects if the marker and the marker list is visible in the diagram.

SCPI command:
n.a.

Trace - Power Analysis
Selects the trace to which the marker is assigned.

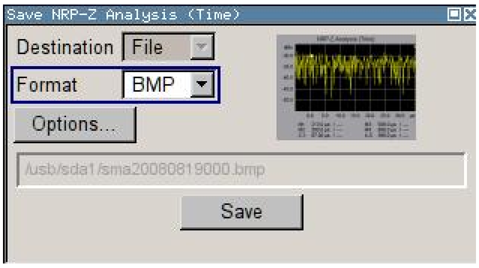
SCPI command:
n.a.

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis" diagram.

SCPI command:
n.a.

Save Hardcopy

The "Save …" button in the "Power Analysis" diagram opens a dialog to store a screen-shot of the current measurement diagram. The current screen shot is stored as indicated, i.e. with or without marker indication. The different diagram views are toggled with the "Rearrange" key or the key combination <STR+A> on an external keyboard (see over-view of features and operation in chapter 5.4.6.2, "NRP-Z Power Analysis", on page 98.



Destination - Power Analysis
Indicates that the hardcopy is stored in a file.

SCPI command:
SENSe[:POWer]:SWEep:HCOPy:DEVice on page 281

Format - Power Analysis
Selects the file format.

Several bitmap graphic format are offered. In addition, format `*.csv` is available which stores the measurement values as ASCII data. The csv settings are performed in the "Options…" submenu.

SCPI command:
SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage on page 282

File name - Power Analysis
Indicates the file name.

The file name can be entered either manually via the file manager (button "File…") or generated automatically. Automatic naming is activated and configured in the "Options…" subdialog

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]` on page 284

`SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe` on page 288

`SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE` on page 285

Save Hardcopy - Power Analysis

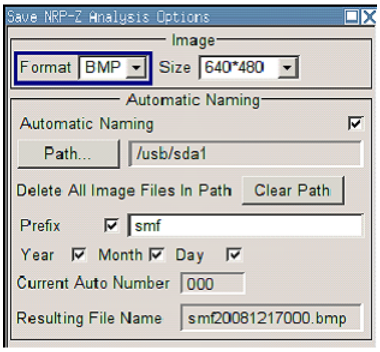
Stores the current measurement diagram as hardcopy in a graphic file format or the trace data in a csv-file, depending on the selected file format.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy[:EXECute]` on page 284

Save Options - Power Analysis

Opens a submenu to enter the screenshot format and size and also to activate and select the automatic naming settings.



"Format" Selects the hardcopy format. In addition to several bitmap formats, format "*.csv" is available which stores the measurement values as ASCII data.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage` on page 282

"Size" Defines the size of the bitmap in terms of pixels. The first value of the size setting defines the width, the second value the height of the image.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:DEVice:SIZE` on page 283

"Automatic Naming" Selects that file names are created by rules if checked. The filename includes at least number and optionally additional information which is determined below.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe` on page 288

"Path" Sets the directory the files are saved into. The "Clear Path" button deletes all image files with extensions "bmp", "img", "png", "xpm" and "csv" in the directory set for automatic naming.

SCPI command:
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory on page 285
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar on page 285

"Prefix, Year, Month, Day" "Prefix, Year, Month, Day" are included in the file name if checked and automatic naming is selected. The Auto Number used for file name creation and the resulting file name are indicated below.

SCPI command:
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe on page 287
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix on page 287
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe on page 286
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY on page 286
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe on page 287
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh on page 286
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe on page 288
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR on page 288

"Current Auto Number" Automatic naming only
Indicates the number which is used in the automatically generated file name.

SCPI command:
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer on page 287

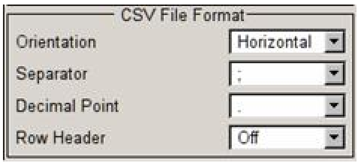
"Resulting File Name" Automatic naming only
Indicates the automatically generated file name.

SCPI command:
SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE on page 285

SCPI command:
SENSe[:POWer]:SWEep:HCOPy[:EXECute] on page 284

CSV Options Hardcopy- Power Analysis
If file format *.csv is selected, the trace data is saved as an ASCII file with separated values. Additional settings are available in the hardcopy options submenu.

CSV files can be imported into the program MS Excel and then processed further. The value separator and the decimal point have to be adjusted according to the used language version to ensure correct import.



"Orientation" Defines the orientation of the X/Y value pairs:

- **Horizontal:**
  X/Y values of trace 1 in rows 1 and 2,
  X/Y values of trace 2 in rows 3 and 4,
  X/Y values of trace 3 in rows 5 and 6

Example:

Trace1,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

Trace1,Y[dBm]: -20.09; -19.17; -18.19; -15.43; ...

Trace2,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

Trace2,Y[dBm]: -19.09; -18.17; -17.19; -14.43; ...

Trace3,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

Trace3,Y[dBm]: -21.09; -20.17; -19.19; -16.43; ...

- **Vertical:**
  X/Y values of trace 1 in column 1 and 2,
  X/Y values of trace 2 in column 3 and 4,
  X/Y values of trace 2 in column 5 and 6

Example:

Trace1,X[Hz]; Trace1,Y[dBm]; Trace2,X[Hz]; Trace2,Y[dBm]; Trace3,X[Hz]; Trace3,Y[dBm];

10000.0;-20.09;10000.0; -20.09;10000.0;20.09;

10010.0;-19.17;10010.0;-19.17;10010.0; -19.17;

10020.0;-18.19;10020.0;18.19;10020.0;-18.19;

10030.0; -15.43;10030.0; -15.43;10030.0;-15.43;…..

SCPI command:
`SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation`
on page 283

"Separator" Defines which character should be used to separate the values, either tabulator, semicolon, comma or blank.

SCPI command:
`SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator`
on page 283

"Decimal Point" Defines which character should be used as the decimal point of the values, either dot or comma.

SCPI command:
`SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint` on page 282

"Row Header" Defines whether each row (or column depending on the orientation) should be preceded by a header containing information about the trace, i.e. the index of the trace and the type of value (frequency or power or time).

Example:

Trace=2;Source=detecting..;X[Hz]";"Trace=2;Source=detecting..;Y[dBm]"

SCPI command:
`SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer` on page 282

5.4.7 User Correction

The "User Correction" function is used to create and activate lists in which level correction values predefined by the user are freely assigned to RF frequencies. Correction is performed by the user-defined table values being added to the output level for the respective RF frequency.

With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

The lists are created in the "List Editor". Each list is stored in its own file with the predefined file extension `*. uco`. The name of the User Correction file can be freely selected. The files are loaded from the "Lists..." file manager. Externally created tables with pairs of frequency and level values can be converted into User Correction files using the import function. The external files must have the file extension `*.txt` or `*.csv`. These file formats are provided e.g. by the Microsoft Excel program. The separators for table columns and for decimal floating-point numerals can be set. In addition, internally created User Correction data can be exported into ASCII files using the export function.

The amplitude can also be linearized automatically by means of an R&S NRP power sensor connected to one of the generator output signals. With the aid of the "Fill with Sensor" function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables. The User Correction list with the correction values acquired by the sensor is generated in the "Edit User Correction List" menu. The correction values can be acquired any time irrespective of the modulation settings of the generator.

If user correction is activated, the "UCOR" display (User Correction) is shown in the header together with the "Level" display. The RF output level is the sum of both values.

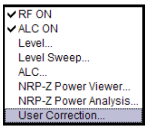
"Level" + "UCOR" = Output level

If the offset setting is used at the same time, the "Level" display value is the difference between the values entered for "Level" and "Offset" in the Level menu.

"Level" - "Offset" = Level display value

If activated, user correction is effective in all operating modes.

5.4.7.1 User Correction Menu

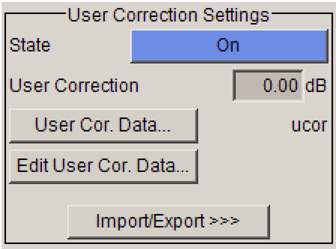


To open the "User Correction" menu, select "Level Control > Configure > User Correction" or use the MENU key under "Level Control".

The combined menu "RF Level/EMF/ALC/UCOR" is divided into the several sections.

User Correction Settings

The "User Correction" settings are set in the most lower section of the combined dialog; this section is used to activate/deactivate user correction, and to create, select and activate the lists.



State - User Correction

Activates/deactivates user correction.

The "UCOR" status message appears in the frequency and level display.

SCPI command:

[:SOURce<hw>]:CORRection[:STATe] on page 328

User Correction Value - User Correction

Indicates the current value for level correction.

SCPI command:

[:SOURce<hw>]:CORRection:VALue on page 328

User Correction – User Correction

Indicates the current value for user correction.

SCPI command:

[:SOURce<hw>]:CORRection:PMETer:TYPE on page 327

Measure – User Correction

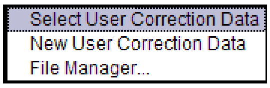
Triggers the external measurement of the user correction of the level according to the user defined frequencies.

SCPI command:

[:SOURce<hw>]:CORRection:MEASure on page 327

User Cor. Data - User Correction

Calls the "File Select" menu for selecting and creating a list or the "File Manager".



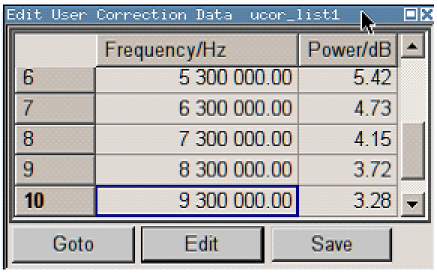
SCPI command:
[:SOURce]:CORRection:CSET:DELete on page 322
[:SOURce<hw>]:CORRection:CSET[:SELect] on page 327

Edit User Cor. Data - User Correction
Calls the editor for editing the selected user correction list.

A list consists of any number of frequency/level value pairs. The currently selected list is displayed.

Each list is saved as a separate file with extension `*.uco`. The file name and the directory to which the file is saved are user-selectable.

Note: Save list only after filling both columns (frequency and level), otherwise the entries are lost.

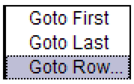


"Frequency / Hz" Enters the frequency to which the level correction value applies.

Note: The "Fill..." function allows to automatically enter any number of frequencies with freely selectable range and increment.
Using the "Fill With Sensor" function of the "Edit" sub menu requires only the entry of the frequency values. The level values are automatically acquired by the connected power sensor.

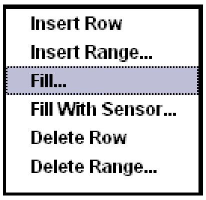
"Power/dB" Enters the level correction value to which the specified frequency applies. The values can be entered manually or automatically with the "Fill With Sensor" function (available in the "Edit" sub menu).

"Goto" Selects row for editing.



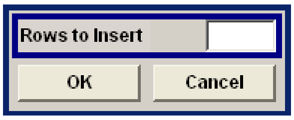
If Goto row is selected, a window opens for entering the requested row.

"Edit" Calls a selection of possible actions described below.



"Insert Row" Insert a new row before the marked row.

"Insert Range" Insert new rows before the marked row. The number of rows to be inserted can be defined in an entry window.

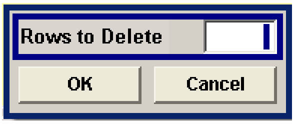


"Fill...." Opens a sub menu for defining a set of list values to be automatically entered in the ucor list (see chapter 5.4.7.2, "Filling the Correction List automatically", on page 139).

"Fill With Sensor" Calls the menu to activate the filling of the user correction list with level values acquired by the selected power sensor (see chapter 5.4.7.3, "Filling the Correction List with Power Sensor Measurement Data", on page 140).

"Delete Row" Deletes the marked row.

"Delete Range..." Allows to delete any number of rows starting with the marked row. The number of rows to be deleted can be defined in an entry window.



"Save as" Open the file menu to save the list under a new name.

Note: Save list only after filling both columns (frequency and level), otherwise the entries are lost.

Each list is saved to the R&S Microwave Signal Generator CompactFlash™ Card as a separate file with the file prefix `*.uco`. The file name and the directory to which the file is saved are user-selectable.

"Save" The list is saved under its current name.

SCPI command:

`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 327
`[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency` on page 321
`[:SOURce<hw>]:CORRection:CSET:DATA:POWer` on page 321

Import/Export

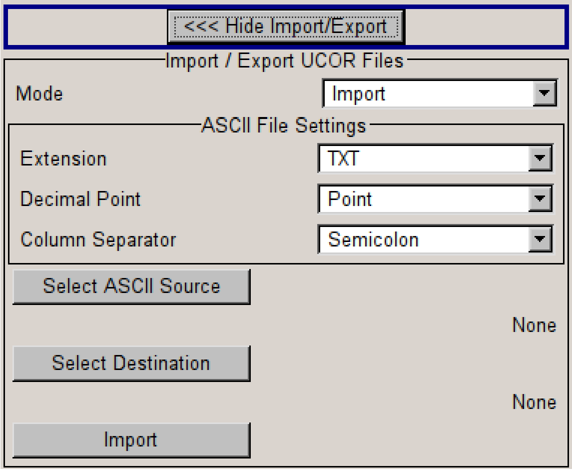
User correction list can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the "Import/Export" button.

Import/Export - User Correction

Expands the menu with the area for import and export of user correction files.

Externally edited Excel tables with any number of frequency/level value pairs can be imported as text or CSV-files and used for user correction.

On the other hand, internally created user correction list can be exported as text or CSV-files.



Mode - User Correction

Selects if user correction lists should be imported or exported. The settings offered depend on the selected mode.

SCPI command:

`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 326

Extension - User Correction

Selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

SCPI command:

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension` on page 323

Decimal Point - User Correction

Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

SCPI command:

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal`
on page 325

Column Separator- User Correction

Selects the separator between the frequency and level column of the ASCII table the user correction list is exported to or imported from.

SCPI command:

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn`
on page 324

Select ASCII Source / Destination - User Correction
Calls the "File Manager" for selecting the ASCII file to be imported into a user correction list (source) or the ASCII file the user correction list is exported (destination) in.

SCPI command:
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 324

Destination / Source - User Correction
Calls the "File Manager" for selecting the user correction list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

SCPI command:
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 326

Import / Export - User Correction
Starts the export or import of the selected file.

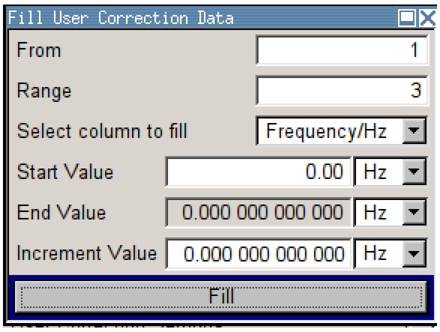
When import is selected, the ASCII file is imported as user correction list.

When export is selected, the user correction list is exported into the selected ASCII file.

SCPI command:
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 325

5.4.7.2 Filling the Correction List automatically

The "Fill Table" menu enables you to automatically set the level correction values.



The start line and the number of rows to be filled are defined under "From" and "Range."

The column to be filled is selected under "Select column to fill". Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters. The filling of the column with the selected value settings is started with button "Fill".

The correction list entries are only computed when the "Fill" button is pressed.

From
Sets the start value of the index range.

SCPI command:
n.a.

Range
Sets the range for filling the table.

SCPI command:
n.a.

Select column to fill
Selects either the frequency or the level column to be filled with the value defined below.

SCPI command:
n.a.

Start value
Sets the start value for the frequency or the level entries.

SCPI command:
n.a.

End value
Displays the end value for the frequency or the level entries.

SCPI command:
n.a.

With increment
Sets the increment for the frequency or the level entries.

SCPI command:
n.a.

Fill
Fills the selected column in the set range with values, starting with the start value and using the set increment.

SCPI command:
n.a.

5.4.7.3 Filling the Correction List with Power Sensor Measurement Data

The level correction values for the user correction list can be acquired by means of R&S NRP power sensors. The R&S NRP sensors are connected to either the SENSOR connector or to one of the USB interfaces. Configuration of the connection is performed in the "Power Sensor" menu (see chapter 5.4.6.1, "NRP-Z Power Viewer", on page 93). The filling of the ucor list with measurement data is performed in the ucor list editor (see "Edit User Cor. Data - User Correction" on page 136).

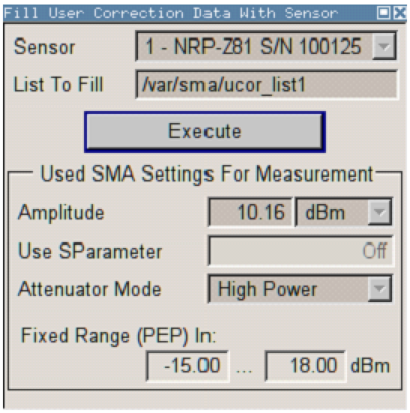
In the editor, the frequencies for which the correction values are to be acquired are entered in the frequency column (either manually or by means of the "Fill..." menu).

Do not save the list at this point, because the frequency entries are lost as long as there are no entries for the level column also. In the following these entries are automatically acquired by the connected power sensor.

All level correction values for the given frequency values are measured using the Power Sensor and automatically filled in the selected list after the "Execute" button is pressed. The list is automatically stored and recalled again after filling.

Fill User Correction Data with Sensor Settings

The "Fill with Sensor" button of the "Edit User Correction Data" menu opens the associated menu.



The menu indicates the relevant generator settings.

Fill User Correction Data with Sensor
All settings are read-only, except the "Sensor". In case more than one sensor is connected to the instrument, the sensor can be selected in the "Sensor" field of menu.

The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

SCPI command:
`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe`
on page 322

5.5 Modulations

5.5.1 Overview

The R&S SMF provides amplitude modulation (analog and digital), frequency modulation (analog and digital), phase modulation (analog and digital), pulse modulation and chirp modulation. In addition, the RF signal can be modulated with a wide variety of internal modulations waveforms, e.g. sine waves, triangle/rectangular/trapeze signals, and noise.

Amplitude modulation (AM), frequency modulation (FM), phase modulation (PhiM), and digital modulation require option R&S SMF-B20. This option also provides two LF generators and a noise generator for internal modulation.

Narrow pulse modulation is provided by option R&S SMF-K3.

Extended pulse modulation features are provided by option R&S SMF-K23, Pulse Generator. Option R&S SMF-K27, Pulse Train, enables generation of pulse trains.

Settings for the modulation are made in separate modulation menus. These menus can be accessed in the block diagram by way of the "Modulation" function block, or by means of the menu with the same name which is opened using the MENU key.

5.5.1.1 Enabling/Disabling Analog Modulations using the MOD On/Off Key

The MOD ON/OFF key switches the modulations on and off.

MOD ON/OFF
Press the MOD ON/OFF key to enable/disable analog modulations.

Pressing the key again restores the status that was active before the last switch-off. "MOD OFF" is displayed in the info line of the header next to the "Level" field.

SCPI command:
`[:SOURce<hw>]:MODulation[:ALL]:STATe` on page 377

5.5.1.2 Modulation Sources

The following modulations use internal and external modulation sources:

- Amplitude modulation
- Pulse modulation
- Frequency modulation
- Phase modulation

Internal Modulation Sources

Two LF generators, a noise generator and a pulse generator are available as internal modulation sources for a fully equipped instrument.

The LF generators supply signals with selectable shapes (see chapter 5.6, "LF Gen./Noise", on page 159). The pulse generator provides single and double pulse modulation with selectable pulse widths and periods or a user-definable pulse train (see chapter 5.8, "Pulse Generator", on page 179).

The noise generator supplies white noise with selectable bandwidth and level distribution.

The LF generators and the noise generator require option R&S SMF-B20. The pulse generator requires option R&S SMF-K23.

External Modulation Sources

The modulation inputs EXT 1, EXT 2, and PULSE IN at the front of the instrument are provided as the external modulation source for amplitude, frequency, phase, digital, and pulse modulation.

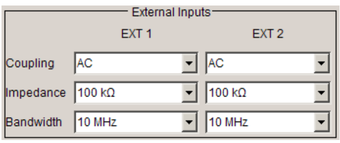
The external inputs EXT 1 and EXT 2 require option R&S SMF-B20.

The external modulation signal at the input must have a voltage of U_S = 1 V (U_{EFF} = 0.707 V) in order to achieve the displayed modulation depth and range. The input voltage should not exceed 1.1 Vs, otherwise modulation distortions might occur. With external pulse modulation, the switching point is max. 2.4 V and the voltage at the input should not exceed 5 V. The maximum modulation frequency is 10 MHz for frequency and phase modulation.

External Analog Modulation Sources

The external analog modulation inputs are configured in the dialogs of the selected modulation mode (amplitude modulation, frequency modulation, or phase modulation).

The following settings are valid for all analog modulation modes. Therefore, these settings are performed in all dialogs accordingly.



Coupling – External Inputs
Selects the coupling mode (AC or DC) for external feed via the EXT 1 and/or EXT 2 input.

SCPI command:
`[:SOURce<hw>]:INPut:MODext:COUPling<ch>` on page 341

Impedance – External Inputs
Selects the impedance for external feed via the EXT 1 and/or EXT 2 input. Selection 50 Ohm, 600 Ohm, and 100 kOhm are available.

SCPI command:
`[:SOURce<hw>]:INPut:MODext:IMPedance<ch>` on page 341

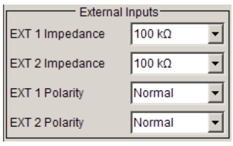
Bandwidth – External Inputs
Selects the bandwith for the external feed via the EXT 1 and/or EXT 2 input. Selection 200 kHZ und 10 MHz are available.

SCPI command:
`[:SOURce]:LFOutput<ch>:BANDwidth` on page 344

External Digital Modulation Sources

The external digital modulation inputs are configured in the "Digital Modulation" dialog.

The settings are valid for all digital modulation modes (ASK, FSK, PSK).



EXT 1/2 Impedance – External Inputs
Selects the impedance for external feed via the EXT 1 and/or EXT 2 input. Selection 50 Ohm, 600 Ohm, and 100 kOhm are available.

SCPI command:
`[:SOURce<hw>]:INPut:MODext:IMPedance<ch>` on page 341

Polarity – External Inputs
Sets the polarity of the external modulation signal.

"Normal" The RF level is **ON** while the level is **HIGH**.

"Inverse" The RF level is **ON** while the level is **LOW**.

SCPI command:
`[:SOURce<hw>]:DM:EXTernal:POLarity<ch>` on page 330

Simultaneous Operation of Several Modulations or Other Operating Modes

The table shows the modulations and operating modes which can be activated simultaneously (+) or which deactivate each other (-).

	AM	ASK	FM	FSK	PhiM	PSK	PuM
Amplitude modulation (AM)	/	+	+	+	+	+	+
ASK	-	/	+	+	+	+	-
Frequency modulation (FM)	+	+	/	-	-	-	+
FSK	+	+	-	/	-	+	+
Phase modulation (PhiM)	+	+	-	-	/	-	+
PSK	+	+	-	-	-	/	+
Pulse modulation (PuM)	+	-	+	-	+	+	/

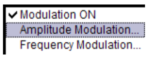
5.5.2 Amplitude Modulation (AM)

An internal and/or external source can be selected for amplitude modulation. Two LF modulation generators and a noise generator are available as the internal source for a fully equipped instrument. Two-tone AM is possible by simultaneously switching on the external and internal or both internal sources.

Two external input connectors for external feed of analog modulation signals are located on the front panel of the instrument.

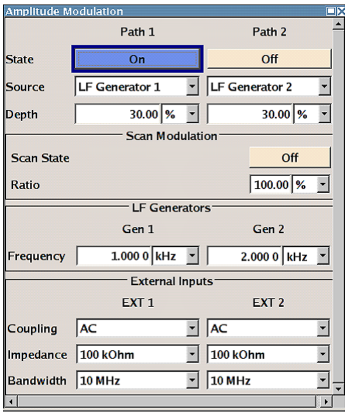
The AM modulation depth is limited by the maximum peak envelope power (PEP).

5.5.2.1 Amplitude Modulation Menu



To open the "Amplitude Modulation" menu, select "Modulation > Configure > Amplitude Modulation" or use the MENU key under "Modulation".

In the upper section of the menu, the amplitude modulation is activated and configured. Additionally, the scan state and the ratio can be set. In the "External Inputs" section, the external inputs are configured. These settings affect all modulations which use the same external modulation sources. For a detailed description, see chapter 5.5.1.2.3, "External Analog Modulation Sources", on page 143. The "LF Frequency" field displays the LF frequency as adjusted in the "LF Generator" menu. This value can be also be changed.



State
Activates/deactivates AM modulation.

SCPI command:
`[:SOURce<hw>]:AM<ch>:STATe` on page 315

Source
Selects the source for the AM signal.

"LF Generator 1/2"	Selects the internal LF generator (either 1 or 2) as the source for AM modulation.
"Ext 1/2"	Selects the external source (either EXT 1 or EXT 2) as the source for amplitude modulation.
"Noise Generator"	Selects the internal noise generator.

SCPI command:
`[:SOURce<hw>]:AM<ch>:SOURce` on page 315

AM Depth
Sets the modulation depth in percent.

Note: This function is available when scanning state is off.
With two-tone modulation, observe that the set modulation depth is valid for both signals and the sum modulation depth is determined by doubling the set modulation depth. This results in overmodulation if the maximal value for modulation depth is exceeded (see data sheet).

SCPI command:
`[:SOURce<hw>]:AM<ch>[:DEPTh]` on page 314

AM Sensitivity
Sets the input sensitivity of the EXT 1/2 input in db/V.

Note: This function is available when scanning state is on.

SCPI command:
`[:SOURce<hw>]:AM<ch>:SENSitivity` on page 315

Scan State – Amplitude Modulation
Activates/deactivates the logarithmic amplitude modulation.

SCPI command:
`[:SOURce<hw>]:AM:SCAN:STATe` on page 315

Ratio – Amplitude Modulation
Sets the path1/path 2 ratio.

SCPI command:
`[:SOURce<hw>]:AM:RATio` on page 314

LF Frequency Gen.1/2
Sets the frequency of LF generator 1/2. This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 344

5.5.3 Frequency Modulation (FM)

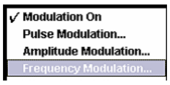
Frequency modulation requires option R&S SMF-B20 (AM/FM/PhiM/Log AM Modulator).

An internal and/or external source can be selected for frequency modulation. Two LF modulation generators and a noise generator are available as internal sources for a fully equipped instrument. Two-tone FM is possible by simultaneously switching on the external and internal source.

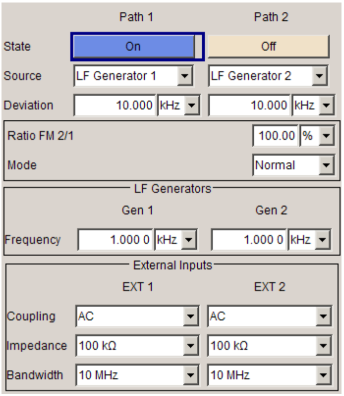
Two external input connectors for external feed of analog modulation signals are located on the front panel of the instrument.

It is not possible to use analog frequency modulation simultaneously with digital frequency modulation or with analog or digital phase modulation.

5.5.3.1 Frequency Modulation Settings



To open the "Frequency Modulation" menu, select "Modulation > Configure > Frequency Modulation" or use the MENU key under "Modulation".



In the upper section of the menu, the frequency modulation is activated and configured. Then, the frequency ratio FM path2/path1 and the modulation mode are selected. The "LF Generators" section sets the frequencies of the LF generators 1/2. This setting affects all analog modulations which use the LF generator as the internal modulation source.

In the "External Inputs" section, the external inputs are configured. These settings affect all modulations which use the same external modulation sources. For a detailed description, see section chapter 5.5.1.2.3, "External Analog Modulation Sources", on page 143.

State

Activates/deactivates FM modulation.

Activation of FM deactivates phase modulation.

SCPI command:
[:SOURce<hw>]:FM<ch>:STATe on page 334

Source - Frequency Modulation

Selects the source for the FM signal.

"LF Generator 1/2" Selects the internal LF generator (either 1 or 2) as the source for frequency modulation.

"EXT 1/2" Selects the external input (either EXT 1 or EXT 2) as the source for frequency modulation.

"Noise Generator" Selects the internal noise generator as source for frequency modulation.

SCPI command:
[:SOURce<hw>]:FM<ch>:SOURce on page 333

FM Deviation
Sets the modulation deviation in Hz.

The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message is displayed.

The deviation of the internal source must not exceed the deviation of the external source.

SCPI command:
`[:SOURce<hw>]:FM<ch>[:DEViation]` on page 332

Ratio FM 2/1 – Frequency Modulation
Sets the deviation of path2/deviation of path 1 ratio.

For example, if the ratio is set to 50%, the deviation of path 2 will become 5 kHz if the deviation of path 1 is set to 10 kHz.

SCPI command:
`[:SOURce<hw>]:FM:RATio` on page 333

Mode - Frequency Modulation
Selects the mode for the frequency modulation.

"Normal" The maximum range for modulation bandwidth and FM deviation is available.

"Low Noise" Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

SCPI command:
`[:SOURce<hw>]:FM:MODE` on page 332

LF Frequency Gen.1/2
Sets the frequency of LF generator 1/2. This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 344

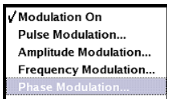
5.5.4 Phase Modulation (PhiM)

Frequency modulation requires option R&S SMF-B20 (AM/FM/PhiM/Log AM Modulator).

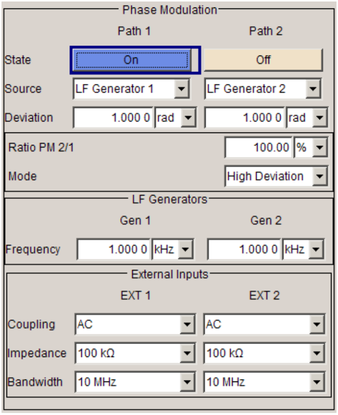
An internal and/or external source can be selected for phase modulation. Two LF modulation generators and a noise source are available as internal sources for a fully equipped instrument.

Two-tone PhiM is possible by simultaneously switching on the external and internal or both internal sources. Two external input connectors for external feed of analog modulation signals are located on the front panel of the instrument.

5.5.4.1 Phase Modulation Menu



To open the "Phase Modulation" menu, select "Modulation > Configure > Phase Modulation" or use the MENU key under "Modulation".



For a fully equipped instrument two LF generators and a noise generator are available as internal sources.

In the upper section of the menu, the phase modulation is activated and configured. Then, the phase modulation ratio and the modulation mode are selected. The "LF Generators" section covers the frequency fields of the two LF generators (1/2). This setting affects all analog modulations which use the LF generator as the internal modulation source.

In the "External Inputs" section, the external inputs are configured. These settings affect all modulations which use the same external modulation sources. For a detailed description, see section chapter 5.5.1.2.3, "External Analog Modulation Sources", on page 143.

State

Activates/deactivates PhiM modulation.

Activation of PhiM deactivates frequency modulation.

SCPI command:

`[:SOURce<hw>]:PM<ch>:STATe` on page 382

Source – Phase Modulation

Selects the source for the phase modulation signal.

"LF Generator 1/2"	Selects the internal LF generator (either 1 or 2) as the source for phase modulation.
"EXT 1/2"	Selects the external input (either EXT 1 or EXT 2) as the source for phase modulation.
"Noise Generator"	Selects the internal noise generator as source for phase modulation.

SCPI command:

`[:SOURce<hw>]:PM<ch>:SOURce` on page 382

Deviation - Phase Modulation
Sets the modulation depth in RAD or degrees.

The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message is displayed.

SCPI command:
`[:SOURce]:PM<ch>[:DEViation]` on page 381

Ratio PM 2/1 – Phase Modulation
Sets the deviation of path 2/deviation of path 1 ratio.

For example, if the ratio is set to 50%, the deviation of path 2 will become 5 kHZ if the deviation of path 1 is set to 10 kHz.

SCPI command:
`[:SOURce<hw>]:PM:RATio` on page 381

PhiM Mode
Selects the mode for the phase modulation.

"High Bandwidth"	The maximum range for modulation bandwidth is available. However, phase noise is increased for low frequencies. The range for PhiM deviation is limited. This mode is recommended for high modulation frequencies.
"High Deviation"	The maximum range for PhiM deviation is available. Phase noise is improved for low frequencies compared to the default mode. The range for modulation frequency is limited (see data sheet). This mode is recommended for low modulation frequencies and/or high PhiM deviation.
"Low Noise"	Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and PM deviation is reduced (see data sheet).

SCPI command:
`[:SOURce<hw>]:PM:MODE` on page 381

LF Frequency Gen.1/2
Sets the frequency of LF generator 1/2. This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 344

5.5.5 Digital Modulation

An internal and/or external source can be selected for digital modulation. The internal pulse generator source is available as internal source for a fully equipped instrument.

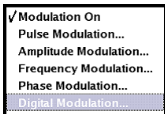
Two external input connectors for external feed of digital modulation signals are located on the front panel of the instrument.

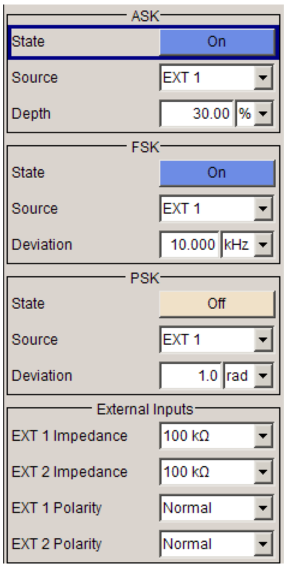
This modulation mode requires option R&S SMF-B20.

Activating a digital modulation mode can deactivate another digital or analog modulation modes. For an overview about the operating modes which operate simultaneously, see chapter 5.5.1.2.5, "Simultaneous Operation of Several Modulations or Other Operating Modes", on page 144.

5.5.5.1 Digital Modulation Menu

To open the "Phase Modulation" menu, select "Modulation > Configure > Phase Modulation" or use the MENU key under "Modulation".





The combined dialog provides selection between the following modulation modes:

- In the "ASK" section, the modulation signal of type ASK (amplitude shift keying) is configured.
- In the "FSK" section, the modulation signal of type FSk (frequency shift keying) is configured.
- In the "PSK" section, the modulation signal of type PSK (phase shift keying) is configured.
- In the "External Inputs" section, the impedance and polarity of the external inputs EXT 1 and/or EXT 2 are configured. These settings affect all modulations which use the same external modulation sources. For a detailed description, see chapter 5.5.1.2.3, "External Analog Modulation Sources", on page 143.

State – ASK

Activates/deactivates ASK modulation.

SCPI command:

`[:SOURce<hw>]:DM:ASK:STATe` on page 329

Source – ASK

Selects the source for the ASK modulation signal.

"EXT 1/2"	Selects the external inputs (either EXT 1 or EXT 2) as the source for ASK modulation.
"Pulse Generator"	Selects the internal pulse generator as source for ASK modulation.
"Random"	Selects random pulses generated by the noise generator as the source for ASK modulation.

SCPI command:
[:SOURce<hw>]:DM:ASK:SOURce on page 329

Depth – ASK
Sets the modulation depth for ASK modulation.

SCPI command:
[:SOURce<hw>]:DM:ASK:DEPTh on page 329

State – FSK
Activates/deactivates FSK modulation.

SCPI command:
[:SOURce<hw>]:DM:FSK:STATe on page 331

Source – FSK
Selects the source for the FSK modulation signal.

"EXT 1/2"	Selects the external inputs (either EXT 1 or EXT 2) as the source for FSK modulation.
"Pulse Generator"	Selects the internal pulse generator as source for FSK modulation.
"Random"	Selects random pulses generated by the noise generator as the source for FSK modulation.

SCPI command:
[:SOURce<hw>]:DM:FSK:SOURce on page 330

Deviation – FSK
Sets the frequency deviation for FSK modulation.

SCPI command:
[:SOURce<hw>]:DM:FSK:DEViation on page 330

State – PSK
Activates/deactivates PSK modulation.

SCPI command:
[:SOURce<hw>]:DM:PSK:STATe on page 332

Source – PSK
Selects the source for the PSK modulation signal.

"EXT 1/2"	Selects the external inputs (either EXT 1 or EXT 2) as the source for PSK modulation.

"Pulse Generator"	Selects the internal pulse generator as source for PSK modulation.
"Random"	Selects random pulses generated by the noise generator as the source for PSK modulation.

SCPI command:
`[:SOURce<hw>]:DM:PSK:SOURce` on page 331

Deviation – PSK
Sets the frequency deviation for PSK modulation.

SCPI command:
`[:SOURce<hw>]:DM:PSK:DEViation` on page 331

5.5.6 Pulse Modulation (PM)

External and internal pulse modulation is available for the basic unit of the R&S SMF equipped with the pulse modulation options.

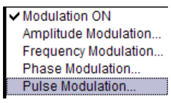
The external signal is input via the PULSE IN connector at the front of the instrument. The connector can be used as trigger input for internal pulse modulation. The external pulse signal is output at the VIDEO connector at the back of the instrument.

Narrow pulse modulation is provided by option R&S SMF-K3. Internal pulse modulation with extended features, e.g. generation of double pulse, requires option R&S SMF-K23, Pulse Generator. The generation of a pulse train requires option R&S SMF-K27.

The pulse signal is output at the PULSE OUT connector at the front of the instrument.

It is not possible to use pulse modulation simultaneously with digital amplitude modulation or with digital frequency modulation.

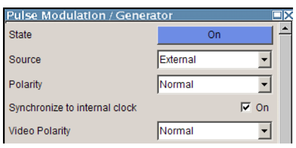
5.5.6.1 Pulse Modulation Settings



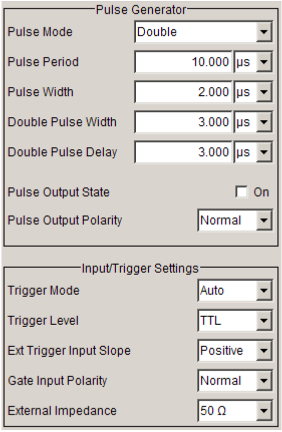
To open the "Pulse Modulation" menu, select "Modulation > Configure > Pulse Modulation", or select "Pulse Mod > Configure > Pulse Modulation", or use the MENU key under "Modulation".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu.

The menu differs according to the selected internal or external modulation source.



In case of modulation source pulse generator, the settings for the pulse characteristics and the trigger are offered in the "Pulse Generator" section of the "Pulse Modulation" dialog. Option R&S SMF-K23 offers extended features, e.g. generation of double pulse or selection of trigger mode. For description of the pulse generator dialog, see chapter 5.8, "Pulse Generator", on page 179.



Option R&S SMF-K27 enables the generation of pulse trains. For description of the pulse train dialog, see chapter 5.8.2, "Pulse Train Generation", on page 183.

In the "Input/Trigger Settings" section, the external input and trigger are configured.

State

Activates/deactivates pulse modulation.

If modulation source Pulse Generator is selected (requires option R&S SMF-K23), the pulse generator is switched on/off, in addition.

When the internal modulation source (pulse generator) is selected, the pulse generator is switched on automatically and the video/sync signal is output at the PULSE VIDEO output at the rear of the instrument. Signal output can be switched off in the "Pulse Generator" dialog (see chapter 5.8, "Pulse Generator", on page 179).

SCPI command:

`[:SOURce<hw>]:PULM:STATe` on page 396

Source

Selects the source for the pulse modulation signal.

"Pulse Generator"	Selects the Pulse Generator as modulation source. The internal pulse generator signal is provided at the PULSE OUT output. • Without option R&S SMF-K23: The internally generated rectangular signal is used for the pulse modulation. The frequency of the internal signal can be set in the LF Output menu. • With option R&S SMF-K23: If option R&S SMF-K23 is installed, the characteristics of the generated pulse can be set in a wide range, and double pulse generation is possible. The settings are made in the "Pulse Generator" section of the menu.

"External" Selects the external source.
The external modulation signal is input via the PULSE IN connector.

"Random" Selects random pulses generated by the noise generator as the source for pulse modulation.

SCPI command:
`[:SOURce<hw>]:PULM:SOURce` on page 396

Polarity
(External Source only)

Selects the polarity of the modulation signal.

"Normal" The RF signal is **On** while the level is high at the modulation input.

"Inverted" The RF level is ON while the level is LOW at the modulation input.

SCPI command:
`[:SOURce<hw>]:PULM:POLarity` on page 395

Synchronize to internal clock - Pulse Modulation
(External Source only)

When enabled, the external modulation signal is synchronized to the internal 200 MHz reference before it is passed to the pulse modulator. Since most instrument capabilities are timed by the same reference, the edges of the modulation signal can be synchronized e.g. to RF or to pulse modulator outputs if instrument is set up accordingly.

When disabled, the signal is passed asynchronously to the modulator.

SCPI command:
`[:SOURce<hw>]:PULM:SYNC` on page 396

Video Polarity - Pulse Modulation
Selects the polarity of the pulse video output.

"Normal" The video signal level is HIGH while the RF level is ON.

"Inverse" The video signal level is LOW while the RF level is ON.

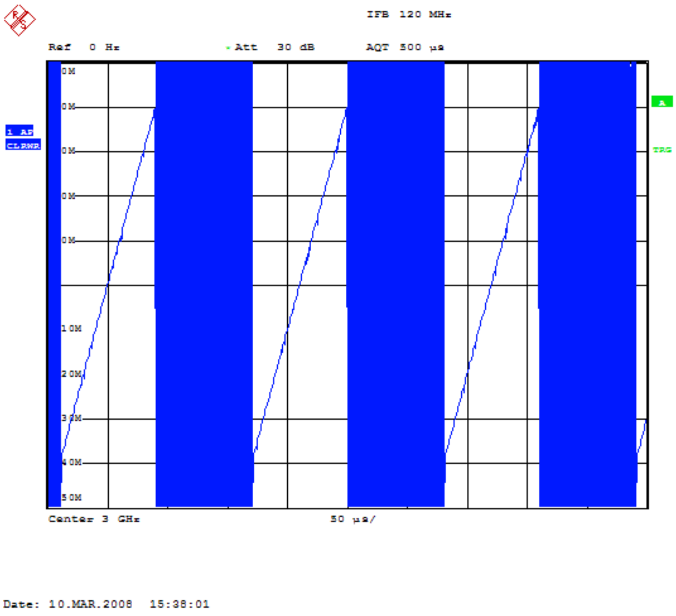
SCPI command:
`[:SOURce<hw>]:PULM:OUTPut:VIDeo:POLarity` on page 394

5.5.7 Chirp Modulation

Chirp modulation is used in radar technique to achieve pulse compression. Pulse compression increases the sensitivity and resolution of radar systems by modifying transmitted pulses to improve their auto-correlation properties. To chirp the radar signal is one way of accomplishing this. A chirp is a signal in which the frequency increases or decreases over time.

The R&S SMF always uses chirp modulation together with pulse modulation. The modulation signals for FM and Pulse modulator are generated and synchronized internally. The internal pulse generator is used as the modulation source for the pulse modulator and the internal LF generator as source for the frequency modulation. Normal FM mode is used. Using external modulation signals is not possible for chirp modulation.

The following graph shows the FM demodulated signal of chirped pulses with a chirp bandwidth of 80 MHz and a pulse width of 80 us. Chirp direction is up.



Chirp modulation is available for the basic unit (R&S SMF + frequency option R&S SMF-B10x) equipped with option R&S SMF-B20 (AM/FM/PHIM/LOG AM Modulator), R&S SMF-K3 (Narrow Pulse Modulator) and R&S SMF-K23 (Pulse Generator).

The PULSE IN connector at the rear of the instrument this connector can be used as external trigger or gate signal input.

The polarity and input impedance of the connector can be selected.

The pulse signal is output at the PULSE OUT connector at the rear of the instrument, the sync signal at the SYNC output.

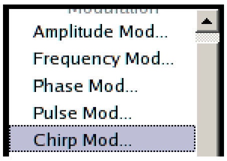
The FM modulation signal can be output at the LF connector.

All other analog modulations are deactivated during chirp modulation!

When chirp modulation is activated, any active analog modulation is automatically switched off.

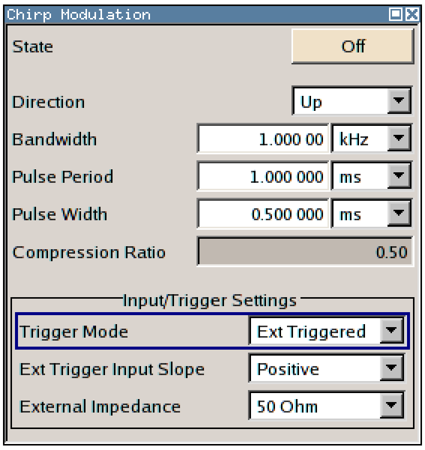
The Sample&Hold measurement for the ALC is performed at the chirp center frequency. Therefore, the frequency response of the RF path may result in level errors for the FM modulated carrier especially with high chirp bandwidths.

5.5.7.1 Chirp Modulation Settings



The "Chirp modulation" dialog is opened in the "Modulation" function block or using the MENU key under "Modulation".

In the upper section of the menu, the modulation is configured and switched on. The configuration of the trigger source is performed in the lower section of the menu.



State - Chirp Modulation
Activates/deactivates chirp modulation

Note: Any active modulation is automatically switched off when chirp modulation is activated.

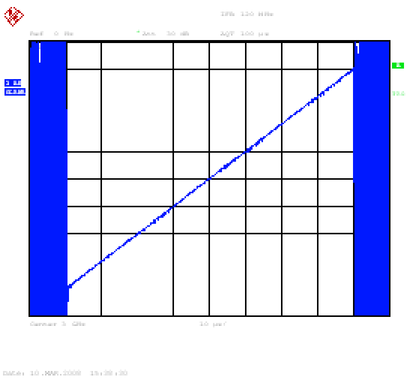
The pulse generator signal is provided at the "PULSE OUT" output, the sync signal at the "SYNC" output.

These outputs are automatically switched on/off according to the chirp modulation state. The FM modulation signal can be output at the LF connector.

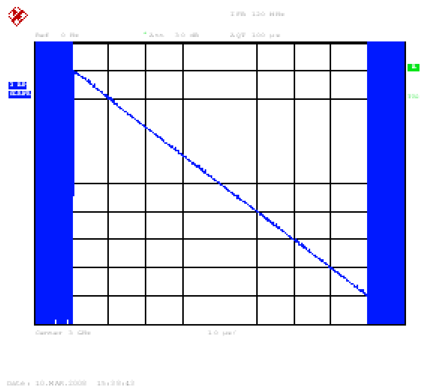
SCPI command:
[:SOURce<hw>]:CHIRp:STATe on page 317

Direction - Chirp Modulation
Selects the direction of the chirp modulation.

"Up" The chirp starts with the lower frequency.



"Down" The chirp starts with the higher frequency.



SCPI command:

Bandwidth - Chirp Modulation
Sets the modulation bandwidth in Hz.

The bandwidth denotes the difference between the maximum and minimum frequency, e.g. a bandwidth of 10 MHz at a center frequency of 1 GHz leads to a frequency modulation between 995 MHz and 1005 MHz.

The maximum bandwidth depends on the currently set RF frequency (see data sheet). It is possible to enter a bandwidth that is too high for a certain RF frequency or to vary the RF frequency to a range in which the bandwidth can no longer be set. In this case the maximum possible bandwidth is set and an error message is displayed.

SCPI command:
`[:SOURce<hw>]:CHIRp:BANDwidth` on page 316

Pulse Period - Chirp Modulation
Sets the period of the generated chirp. Option R&S SMF-K23 provides a resolution of 20 ns.

SCPI command:
`[:SOURce<hw>]:CHIRp:PULSe:PERiod` on page 317

Pulse Width - Chirp Modulation
Sets the width of the generated chirp. The pulse width must be at least 1 us less than the set pulse period. Option R&S SMF-K23 provides a resolution of 20 ns.

SCPI command:
`[:SOURce<hw>]:CHIRp:PULSe:WIDTh` on page 317

Compression Ratio - Chirp Modulation
Indicates the pulse compression ratio, i.e. the product of pulse width [s] and bandwidth [Hz]. Pulse compression increases the range resolution as well as the signal to noise ratio of pulsed signals.

SCPI command:
`[:SOURce<hw>]:CHIRp:COMPression:RATio` on page 316

Trigger Mode - Chirp Modulation
Selects the trigger mode for chirp modulation signals.

Note: An external trigger signal is supplied via the PULSE IN connector.

"Auto" The chirp modulation signals are generated continuously.

"Ext Single" The chirp modulation signals are triggered by an external trigger event.

"Ext Gated" The chirp modulation signals are gated by an external gate signal.

SCPI command:
`[:SOURce<hw>]:CHIRp:TRIGger:MODE` on page 319

Trigger Level – Chirp Modulation
Selects the external trigger level (threshold TTL, 0.5 V or -2.5 V).

SCPI command:
`[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:LEVel` on page 318

External Trigger Input Slope - Chirp Modulation
(External Trigger only)

Sets the polarity of the active slope of an applied trigger signal.

Note: An external trigger signal is supplied via the PULSE IN connector.

"Positive" The chirp modulation signals are triggered on the positive slope of the external trigger signal.

"Negative" The chirp modulation signals are triggered on the negative slope of the external trigger signal.

SCPI command:
`[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:SLOPe` on page 319

Gate Input Polarity - Chirp Modulation
Selects the polarity of the Gate signal.

Note: An external gate signal is supplied via the PULSE IN connector.

"Positive" The chirp modulation signals are generated while the gate signal is high.

"Negative" The chirp modulation signals are generated while the gate signal is low.

SCPI command:
`[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:GATE:POLarity` on page 318

External Impedance - Chirp Modulation
Selects the input impedance for the external trigger and gate signal input (10 kOhm or 50 Ohm).

SCPI command:
`[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:IMPedance` on page 318

5.6 LF Gen./Noise

The "LF Gen./Noise" block provides two internal LF generators which can be used as internal modulation sources for analog modulations (amplitude modulation, frequency modulation, phase modulation) and a noise generator. The LF/Noise generators can also be used as the signal source for the LF output at the front of the instrument.

The internal LF/Noise generators require option R&S SMF-B20.

Both LF generators providing sinusoidal signals in the frequency range 0.1 Hz to 10 MHz with selectable signal shapes e.g. sine waves, triangle/ pulse/ trapezoid signals.

The LF frequency settings for the LF generator can be made in the LF Gen./Noise menu, LF Output menu, and analog modulation menus.

A change to the frequency of the LF generator automatically has an effect on modulation if the LF generator is selected as the modulation source. For example, a change to the frequency of the first LF generator automatically has an effect on the amplitude modulation if the first LF generator is selected as the AM modulation source (i.e. LF Generator 1 is selected as Source). On the other hand, changing the frequency in the Amplitude Modulation menu has an effect to the LF output signal.

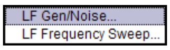
The LF frequency sweep mode is activated in the LF Frequency Sweep menu. The LF level sweep is activated in the LF Level Sweep menu of the "LF Output" block.

The Noise generator supplies noise with selectable bandwidth and level distribution.

The LF frequency sweep mode is activated in the "LF Frequency Sweep" dialog of the "LF Gen./Noise" block (see chapter 5.6.3, "LF Frequency Sweep", on page 163). The LF level sweep is activated in the "LF Level Sweep" dialog of the "LF Output" block (see chapter 5.7.2, "LF Level Sweep", on page 172).

5.6.1 LF Generator Settings

The "LF Generator/Noise" is used to perform the settings regarding the LF and noise generation.

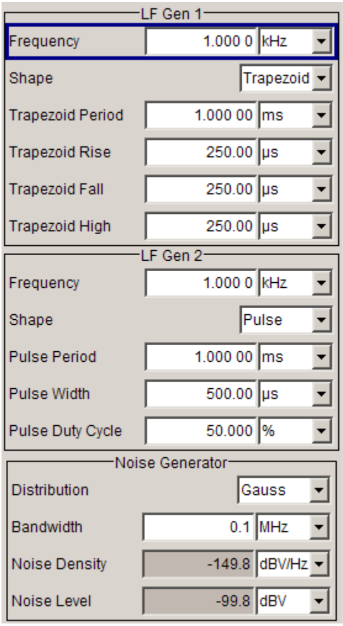


To open the "LF Generator/Noise" dialog, select "LF Gen./Noise > Configure > LF Gen./Noise" or use the MENU key under "LF Gen./Noise".

The LF Gen. 1/2 sections provide frequency and waveform shape settings for the two LF generators. In the "Noise Generator section", the settings for the noise source are provided.

The LF Gen. 1 section provides frequency and waveform shape settings for the first LF generator.

According to LF Gen. 1, the settings for the second LF generator are made in the LF Gen. 2 section.



Frequency – LF Generator

Sets the frequency of LF generator 1/2. This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:

`[:SOURce]:LFOutput<ch>:FREQuency` on page 344

Shape - LF Generator

Selects the waveform shape of the LF signal.

SCPI command:

`[:SOURce]:LFOutput<ch>:SHAPe` on page 358

Pulse Period – LF Generator

(This feature is available for shape mode Pulse only)

Sets the period of the generated pulseshape. The period determines the repetition frequency of the internal signal.

SCPI command:

`[:SOURce]:LFOutput<ch>:SHAPe:PULSe:PERiod` on page 359

Pulse Width – LF Generator

(This feature is available for shape mode Pulse only)

Sets the width of the generated pulse. The width determines the pulse length.

SCPI command:

`[:SOURce]:LFOutput<ch>:SHAPe:PULSe:WIDTh` on page 359

Pulse Duty Cycle – LF Generator

(This feature is available for shape mode Pulse only)

Sets the duty cycle for the shape pulse.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:PULSe:DCYCle on page 359

Triangle Period – LF Generator
(This feature is available for shape mode Triangle only)

Sets the period of the generated triangle shape. The period determines the repetition frequency of the internal signal.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:TRIangle:PERiod on page 361

Triangle Rise – LF Generator
(This feature is available for shape mode Triangle only)

Sets the triangle shape rise time.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:TRIangle:RISE on page 361

Trapezoid Period – LF Generator
(This feature is available for shape mode Trapezoid only)

Sets the period of the generated trapezoid shape. The period determines the repetition frequency of the internal signal.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:PERiod on page 360

Trapezoid Rise – LF Generator
(This feature is available for shape mode Trapezoid only)

Sets the trapeze shape rise time.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:RISE on page 360

Trapezoid Fall – LF Generator
(This feature is available for shape mode Trapezoid only)

Sets the fall time for the trapeze shape of the LF generator.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:FALL on page 359

Trapezoid High – LF Generator
(This feature is available for shape mode Trapezoid only)

Sets the high time for the trapeze shape of the LF generator.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:HIGH on page 360

5.6.2 Noise Settings

The parameters for the level distribution and the bandwidth for the noise source are provided in the "Noise Generator" section of the dialog. The settings affect all analog modulations which use the noise generator as the internal modulation source.

Distribution - Noise
Selects the noise power density distribution of the noise.

"Gaussian" The noise power density has a Gaussian distribution.

"Equal" The noise power density has an even distribution.

SCPI command:
`[:SOURce<hw>]:NOISe:DISTribution` on page 378

Bandwidth - Noise
Enters the noise bandwidth. Distinct bandwidth settings between 100 kHz and 10 MHz in 100 kHz steps (range 100 .. 1 MHz), 1 MHz (range 1 MHz .. 5 MHz) and 5 MHz (5 MHz … 10 MHz) are possible.

The noise signal is generated within the set frequency bandwidth. The noise level in the frequency band is indicated at Noise level (System Bandwidth).

SCPI command:
`[:SOURce<hw>]:NOISe:BWIDth` on page 378

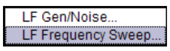
Noise Density - Noise
Indicates the level of the noise signal for a bandwith of 1 Hz.

SCPI command:
`[:SOURce<hw>]:NOISe:LEVel:RELative` on page 378

Noise Level - Noise
Indicates the level of the noise signal per Hz in the total bandwidth.

SCPI command:
`[:SOURce<hw>]:NOISe:LEVel[:ABSolute]` on page 378

5.6.3 LF Frequency Sweep

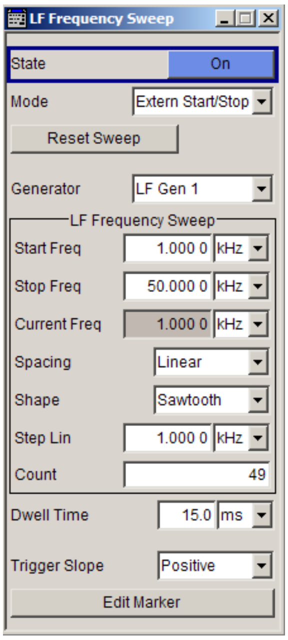


The "LF Frequency Sweep" dialog is used to activate and configure a sweep for the LF frequency. To open the dialog, select "LF Gen./Noise > Configure > LF Frequency Sweep" or use the MENU key under "LF Gen./Noise".

In the top section, the LF Sweep mode is activated and the sweep mode is selected. The buttons are used to reset the LF sweep (all sweep modes) or to execute the LF sweep ("Single" mode).

The sweep range, sweep spacing and dwell time are set in the bottom of the section.

Additionally, the trigger slope can be set.



State - LF Sweep
Activates LF Sweep mode.

Note: Activating the LF frequency sweep automatically deactivates the List mode, RF frequency sweep, RF level sweep, and LF level sweep.

SCPI command:
`[:SOURce]:LFOutput:FREQuency:MODE` on page 345

Mode - LF Sweep
Selects the Sweep instrument operating mode and Sweep mode.

"Auto" Sets are automatic repeated sweep cycle. If a different sweep mode was activated prior to the "Auto" mode, the cycle continues from the current sweep setting.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:LFO:SWE:FREQ:MODE AUTO
TRIG0:SWE:SOUR AUTO
SOUR:LFO:FREQ:MODE SWE
```

"Single" Sets a single sweep cycle. The sweep is triggered by the "Execute Single Sweep" button.
If a different sweep mode was activated prior to the "Single" mode, the current sweep is stopped. The "Single" sweep always starts at the start frequency.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR SING`

`SOUR:LFO:FREQ:MODE SWE`

`SOUR:LFO:SWE:FREQ:EXEC`

"Step" Sets a step-by-step sweep cycle. Each sweep step is triggered by a variation of the value in the "Current Freq" entry window.
If this mode is activated, the cursor moves to the value displayed for "Current Freq". If a different sweep mode was activated prior to the "Step" mode, the current sweep is stopped. The "Step" sweep starts at the current LF frequency.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

`SOUR:LFO:SWE:FREQ:MODE MAN`

`SOUR:LFO:FREQ:MODE SWE`

`SOUR:LFO:SWE:FREQ:SPAC LIN`

`SOUR:LFO:SWE:FREQ:STEP:LIN 1E34`

`SOUR:LFO:FREQ:MAN 12 kHz`

The value entered with command `SOUR:LFO:SWE:FREQ:STEP:LIN|LOG` sets the step width.

The value entered with command `SOUR:LFO:FREQ:MAN` has no effect, the command only sets the next sweep step. In remote control only a step-by-step sweep from start to stop frequency is possible

"Extern Single" Sets a single sweep cycle. The sweep is triggered by an external trigger signal.
If a different sweep mode was activated prior to the "Extern Single" mode, the current sweep is stopped. The "Extern Single" sweep always starts at the start frequency.
The external trigger signal is input at the rear of the instrument (BNC connector TRIGGER or AUX connector).
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR EXT`

`SOUR:LFO:FREQ:MODE SWE` (External trigger)

"Extern Step" Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under "Extern Single"). The step width corresponds to the step width set for the rotary knob.
If a different sweep mode was activated prior to the "Extern Step" mode, the current sweep is stopped. The "Extern Step" sweep always starts at the LF start frequency.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR EXT`

`SOUR:LFO:FREQ:MODE SWE` (External trigger)

"Extern Start/Stop" Sets an automatically repeated sweep cycle that is started, stopped and restartet by subsequent external trigger events.
The first external trigger signal starts the sweep (Start).
The next external trigger signal stops the sweep at the current frequency (Stop).
The third external trigger signal starts the sweep at the start frequency (Start).
If a different sweep mode was activated prior to the "Extern Start/Stop" mode, the current sweep is stopped and the "Extern Start/Stop" sweep starts at the start frequency when triggered.
The "Reset" button resets the sweep to the start frequency.
The external trigger signal is input at the rear of the instrument (BNC connector TRIGGER or AUX connector).

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR EAUT`

`SOUR:LFO:FREQ:MODE SWE` (External trigger)

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:MODE` on page 350
`:TRIGger<hw>[:SWEep]:SOURce` on page 446
`[:SOURce]:LFOutput:FREQuency:MODE` on page 345

Execute Single Sweep - LF Sweep
Triggers the sweep manually. A manual sweep can only be triggered if "Mode Single" is selected.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute` on page 348

Reset Sweep - LF Sweep
Resets the sweep. The start frequency is set and the next sweep starts from there.

SCPI command:
`[:SOURce<hw>]:SWEep:RESet[:ALL]` on page 423

Sweep Source - LF Sweep

Selects the source for LF sweeps.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource on page 348

Start Freq - LF Sweep

Sets the start frequency.

SCPI command:

[:SOURce]:LFOutput:FREQuency:STARt on page 345

Stop Freq - LF Sweep

Sets the stop frequency.

SCPI command:

[:SOURce]:LFOutput:FREQuency:STOP on page 346

Current Freq - LF Sweep

Displays the current frequency.

If "Step" is set, the frequency for the next frequency step of the sweep is entered here.

SCPI command:

[:SOURce]:LFOutput:FREQuency:MANual on page 344

Spacing - LF Sweep

Selects linear or logarithmic sweep spacing.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:SPACing on page 353

Shape - LF Frequency Sweep

Selects the cycle mode for a sweep sequence (shape)

"Sawtooth" One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

"Triangle" One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:SHAPe on page 352

Step Lin/Log - LF Sweep

Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

"Step Lin" or "Step Log" is displayed depending on whether "Spacing Lin" or "Log" is selected.

"Step Lin" With the linear sweep, the step width is a fixed frequency value which is added to the current frequency. The linear step width is entered in Hz.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] on page 353

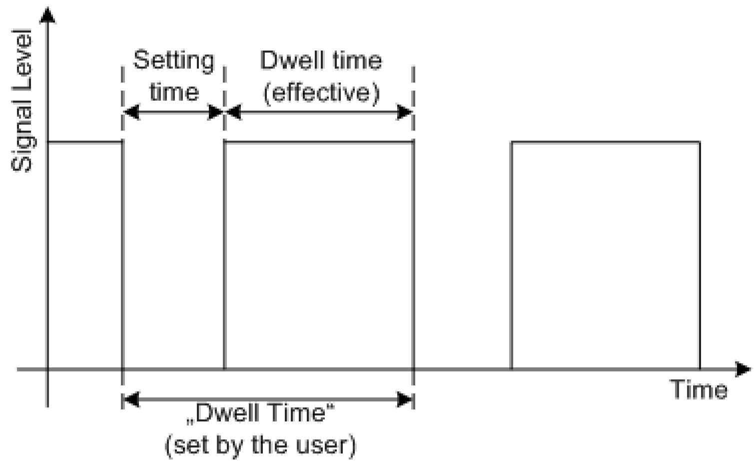
"Step Log" With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in %.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic` on page 354

Count - LF Frequency Sweep
Sets the number of sweep steps.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:POINts` on page 352

Dwell Time - LF Sweep
Sets the dwell time. The dwell time determines the duration of the individual sweep steps.



The "Dwell Time" set by the user is used as the step time of the sweep. The effective net dwell time is shorter, reduced by the setting time. This setting time may be greater than the time specified in the data sheet.

Note:
It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 26).

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:DWELl` on page 348

Trigger Slope - Level Sweep
Sets the polarity of the active slope of an applied instrument trigger. This setting affects the TRIGGER input (BNC connector or the AUX interface at the rear of the instrument).

"Positive" The rising edge of the trigger signal is active.

"Negative" The falling edge of the trigger signal is active.

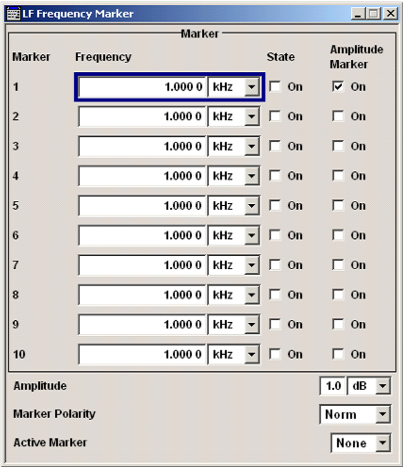
SCPI command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 341

Edit Marker - LF Frequency Sweep
Opens the "LF Frequency Marker" dialog. This dialog is used for setting and editing the markers. For a detailed description, see chapter 5.6, "LF Gen./Noise", on page 159.

SCPI command:
n.a.

5.6.4 LF Frequency Marker Settings

The "LF Frequency Marker" dialog is called via the EDIT MARKER button in the "LF Frequency Sweep" menu.



Up to ten frequency markers can be defined. The frequency of the marker signal at the MARKER output changes according to the selected polarity when the frequency mark is reached. For each of these markers an amplitude marker can be activated in addition. If activated, the marker signal is attenuated by the set amplitude when the frequency mark is reached. Only one marker is output at the MARKER output at one time.

Marker - LF Frequency Marker
Displays the marker index.

SCPI command:
n.a.

Frequency - LF Frequency Marker
Enters the frequency for the corresponding marker. If the marker is activated, the signal level at the MARKER output changes on reaching this frequency mark.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer<ch>:FREQuency` on page 349

State - LF Frequency Marker
Switches in or off the selected marker. If on, the marker is output at the MARKER output on reaching the mark.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer<ch>:FSTate` on page 350

Amplitude Marker - LF Frequency Marker
Activates or deactivates the selected amplitude marker. If activated, the level is reduced by the amplitude entered below on reaching the mark.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer<ch>:VSTate` on page 350

Amplitude - LF Frequency Marker
Sets the amplitude marker attenuation.This value is valid for all markers.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer:AMPLitude` on page 349

Marker Polarity - LF Frequency Marker
Selects the marker output polarity.

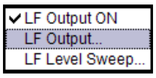
SCPI command:
`[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity` on page 418

Active Marker - LF Frequency Marker
Selects the active marker. The active marker is output with an higher voltage than all other markers.

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer:ACTive` on page 349

5.7 LF Output

The dialog is used to perform the settings regarding the LF output.



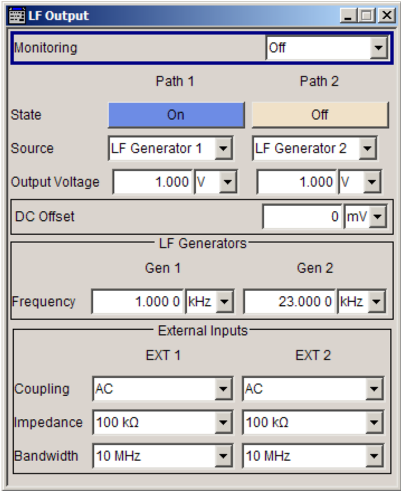
To open the "LF Output" dialog, select "LF Output > Configure > LF Output" or use the MENU key under "LF Output".

The LF Output requires option R&S SMF-B20.

In the upper section of the dialog, the LF output is activated and configured.

The "LF Generators" section displays the LF frequencies as adjusted in the "LF Gen./ Noise" dialog. This value can be also be changed.

In the "External Inputs" section, the external inputs are configured. For a detailed description, see chapter 5.5.1.2.2, "External Modulation Sources", on page 143.



5.7.1 LF Output Settings

Monitoring - LF Output

Selects the LF output monitoring mode. The settings for the LF output are synchronized to amplitude modulation or frequency/phase modulation settings.

SCPI command:

`[:SOURce]:LFOutput:MONitor:MODE` on page 347

State - LF Output

(This feature is available for monitoring mode Off only)

Activates/deactivates the LF Output.

The selected modulation signal is output at the LF output connector at the front of the instruments.

SCPI command:

`[:SOURce]:LFOutput<ch>[:STATe]` on page 347

Source – LF Output

(This feature is available for monitoring mode Off only)

Selects the internal and/or external source to be used for the LF output signal.

"LF Generator 1/2"	Selects one of the internal LF generators as the source for the LF output signal.
"EXT 1/2"	Selects one of the external inputs as the source for the LF output signal.
"Noise Generator"	Selects the internal noise signal. The LF output signal is noise either with gaussian distribution or equal distribution.

SCPI command:

`[:SOURce]:LFOutput<ch>:SOURce` on page 347

Output Voltage - LF Output

(This feature is available for monitoring mode Off only)

Sets the output voltage of the LF output. The entered value determines the peak voltage.

SCPI command:
[:SOURce]:LFOutput<ch>:VOLTage on page 361

DC Offset - LF Output
(This feature is available for monitoring mode Off only)

Sets a DC offset at the LF Output.

SCPI command:
[:SOURce]:LFOutput:OFFSet on page 347

LF Frequency Gen.1/2 – LF Output
Displays the LF frequency as adjusted in the "LF Gen./Noise" dialog. This value can also be changed.

SCPI command:
[:SOURce]:LFOutput<ch>:FREQuency on page 344

5.7.2 LF Level Sweep

The "LF Level Sweep" dialog is used to activate and configure a sweep for the LF level.

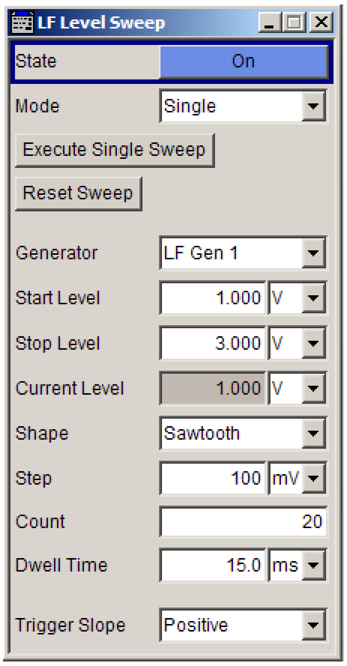
To open the dialog, select "LF Output > Configure > LF Level Sweep" or use the MENU key under "LF Output".

5.7.2.1 LF Level Sweep Settings

In the top section, the LF level sweep mode is activated and the sweep mode is selected. The buttons are used to reset the LF sweep (all sweep modes) or to execute the LF sweep (Single mode).

In the "LF Level Sweep" section, the sweep range, and other settings regarding the sweep can be done.

In the bottom section, the dwell time and the trigger slope can be set.



State - LF Level Sweep
Activates/deactivates LF level sweep mode.

Note: Activating the LF level sweep automatically deactivates the List mode, RF frequency sweep, RF level sweep, and LF frequency sweep.

SCPI command:
[:SOURce]:LFOutput:VOLTage:MODE on page 362

Mode - LF Level Sweep
Selects the sweep instrument operating mode and sweep mode.

"Auto" Sets an automatic repeated sweep cycle. If a different sweep mode was activated prior to the "Auto" mode, the cycle continues from the current sweep setting.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:LFO:SWE:VOLT:MODE AUTO
TRIG:LFVS:SOUR AUTO
SOUR:LFO:VOLT:MODE SWE
```

"Single" Sets a single sweep cycle. The sweep is triggered by the "Execute Single Sweep" button.
If a different sweep mode was activated prior to the "Single" mode, the current sweep is stopped. The single sweep always starts at the start frequency.
The "Reset Sweep" button resets the sweep to the start flevel.

Example:

```
SOUR:LFO:SWE:VOLT:MODE MAN
TRIG:LFVS:SOUR SING
SOUR:LFO:VOLT:MODE SWE
SOUR:LFO:SWE:VOLT:EXEC
```

"Step" Sets a step-by-step sweep cycle. Each sweep step is triggered by a variation of the value in the "Current Freq" entry window.
If this mode is activated, the cursor moves to the value displayed for "Current Freq". If a different sweep mode was activated prior to the "Step" mode, the current sweep is stopped. The step sweep starts at the current LF frequency.

Example:

```
SOUR:LFO:SWE:VOLT:MODE STEP
TRIG:LFVS:SOUR SING
SOUR:LFO:VOLT:MAN 12kHz
TRIG:LFVS:SOUR SING
SOUR:LFO:VOLT:MODE SWE
SOUR:LFO:VOLT:MAN 14kHz
SOUR:LFO:VOLT:MAN 16kHz
```

"Extern Single" Sets a single sweep cycle. The sweep is triggered by an external trigger signal.
If a different sweep mode was activated prior to the Extern Single mode, the current sweep is stopped. The Extern Single sweep always starts at the start frequency.
The external trigger signal is input at the rear of the instrument (BNC connector TRIGGER or AUX connector).
The "Reset Sweep" button resets the sweep to the start flevel.

Example:

```
SOUR:LFO:SWE:VOLT:MODE MAN
TRIG:LFVS:SOUR EXT
SOUR:LFO:VOLT:MODE SWE
```

"Extern Step" Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under "Extern Single"). The step width corresponds to the step width set for the rotary knob.
If a different sweep mode was activated prior to the "Extern Step" mode, the current sweep is stopped. The "Extern Step" sweep always starts at the LF start frequency.
The "Reset Sweep" button resets the sweep to the start flevel.

Example:

`SOUR:LFO:SWE:VOLT:MODE STEP`

`SOUR:LFO:SWE:VOLT:STEP:LIN 2`

`TRIG:LFVS:SOUR EXT`

`SOUR:LFO:VOLT:MODE SWE`

"Extern Start/ Stop" Sets an automatically repeated sweep cycle that is started, stopped and restartet by subsequent external trigger events.
The first external trigger signal starts the sweep (Start).
The next external trigger signal stops the sweep at the current LF frequency (Stop).
The third external trigger signal starts the sweep at the start frequency (Start).
If a different sweep mode was activated prior to the "Extern Start/Stop" mode, the current sweep is stopped and the "Extern Start/Stop" sweep starts at the start frequency when triggered.
The "Reset" button resets the sweep to the start level.
Refer to the description of the rear panel for information about the connectors for external trigger signal input (see section "Legend of Rear Panel").

Example:

`SOUR:LFO:SWE:VOLT:MODE AUTO`

`TRIG:LFVS:SOUR EAUT`

`SOUR:LFO:VOLT:MODE SWE` (External trigger)

SCPI command:
`[:SOURce]:LFOutput:SWEep:VOLTage:MODE` on page 356
`:TRIGger<hw>:LFVSweep:SOURce` on page 443
`[:SOURce]:LFOutput:VOLTage:MODE` on page 362

Execute Single Sweep - LF Level Sweep
Triggers the sweep manually. A manual sweep can only be triggered if "Mode Single" is selected.

Example:

```
SOUR:LFO:SWE:VOLT:MODE AUTO
TRIG:LFVS:SOUR SING
SOUR:LFO:VOLT:MODE SWE
```

SCPI command:
[:SOURce]:LFOutput:SWEep:VOLTage:EXECute on page 355

Reset Sweep - LF Level Sweep
Resets the sweep. The start frequency is set and the next sweep starts from there.

SCPI command:
[:SOURce<hw>]:SWEep:RESet[:ALL] on page 423

Generator - LF Level Sweep
Sets the source for the LF level sweep.

SCPI command:
[:SOURce]:LFOutput:SWEep:VOLTage:LFSource on page 355

Start Level - LF Level Sweep
Sets the start frequency.

SCPI command:
[:SOURce]:LFOutput:VOLTage:STARt on page 363

Stop Level - LF Level Sweep
Sets the stop frequency.

SCPI command:
[:SOURce]:LFOutput:VOLTage:STOP on page 364

Current Level - LF Level Sweep
Displays the current frequency.

If "Step" is set, the frequency for the next frequency step of the sweep is entered here.

SCPI command:
[:SOURce]:LFOutput:VOLTage:MANual on page 362

Shape - LF Level Sweep
Selects the cycle mode for a sweep sequence (shape) .

"Sawtooth" One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

"Triangle" One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start level again.

SCPI command:
[:SOURce]:LFOutput:SWEep:VOLTage:SHAPe on page 357

Step - LF Level Sweep
Sets the step width for the individual sweep steps.

SCPI command:
[:SOURce]:LFOutput:SWEep:VOLTage:STEP[:LINear] on page 358

Count - LF Level Sweep
Sets the number of sweep steps.

SCPI command:
[:SOURce]:LFOutput:SWEep:VOLTage:POINts on page 357

Dwell Time - LF Level Sweep
Sets the dwell time. The dwell time determines the duration of the individual sweep steps.

SCPI command:
[:SOURce]:LFOutput:SWEep:VOLTage:DWELl on page 355

Trigger Slope - LF Level Sweep
Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the TRIGGER input (BNC connector at the rear of the instrument or AUX connector).

"Positive" The rising edge of the trigger signal is active.

"Negative" The falling edge of the trigger signal is active.

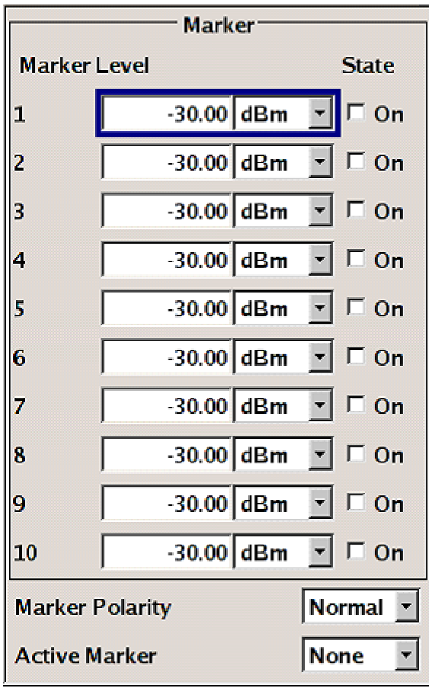
SCPI command:
[:SOURce]:INPut:TRIGger:SLOPe on page 341

Edit Marker - Level Sweep
Opens the LF Level Marker menu. This menu is used for setting and editing the markers. For a detailed description , see chapter 5.7.3, "LF Level Marker Settings", on page 177.

SCPI command:
n.a.

5.7.3 LF Level Marker Settings

The "LF Level Marker" dialog is called via the EDIT MARKER button in the "LF Level Sweep" dialog.



Marker - LF Level Marker
Displays the index of the marker.

SCPI command:
n.a.

Level - LF Level Marker
Enters the level for the corresponding marker. If the marker is activated, the signal level at the MARKER output changes according to the set polarity on reaching the entered level.

SCPI command:
`[:SOURce<hw>]:LFOutput:SWEep:VOLTage:MARKer<ch>:VOLTage`
on page 356

State - LF Level Marker
Activates or deactivates the selected marker. If on, the marker is output at the MARKER output on reaching the mark.

SCPI command:
`[:SOURce<hw>]:LFOutput:SWEep:VOLTAGE:MARKer<ch>:VSTate` on page 356

Marker Polarity - LF Level Marker
Selects the marker output polarity.

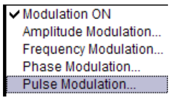
SCPI command:
`[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity` on page 418

Active Marker - LF Level Marker
Selects the active marker. The active marker is output with an higher voltage than all other markers.

SCPI command:
[:SOURce]:LFOutput:SWEep:VOLTage:MARKer:ACTive on page 355

5.8 Pulse Generator

The "Pulse Generator" dialog is used to activate and configure a pulse modulation signal.



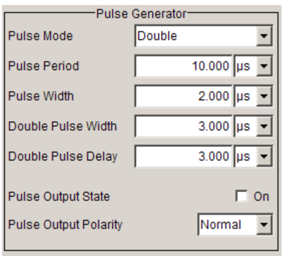
To open the "Pulse Modulation / Generator " menu, select "Modulation > Configure > Pulse Modulation", or select "Pulse Mod > Configure > Pulse Modulation", or use the MENU key under "Modulation".

The pulse generator requires option R&S SMF-K23, it provides single and double pulse modulation with selectable pulse widths and periods. The signal is output at the PULSE OUT connector.

In addition, the generation of a user-definable pulse train is enabled with option R&S SMF-K27 and narrow pulse modulation with option R&S SMF-K3.

5.8.1 Pulse Generator Settings

The settings for the pulse characteristics and the trigger are provided in the "Pulse Generator" section of the "Pulse Modulation" dialog.



The parameters differ according to the selected pulse mode. The modes "Single", "Double" and "Train" are provided. Option R&S SMF-K23 offers extended features, e.g. generation of double pulse or selection of trigger mode. Option R&S SMF-K27 enables the generation of pulse trains.

Pulse Mode - Pulse Generator
Sets the mode of the pulse generator.

Note: Single and double are available with option R&S SMF-K23, selection pulse train requires option R&S SMF-K27.

"Single" A single pulse is generated in one pulse period.

"Double" Two pulses are generated in one pulse period. Additional settings for the double pulse are available in the menu.

"Train" Requires option R&S SMF-K27.
A user-defined pulse train is generated. Additional settings for the pulse train are available in the menu after selection of the pulse train mode (see chapter 5.8.2, "Pulse Train Generation", on page 183).
A pulse train is a sequence of pulses with user-defined on and off times. The ontime/offtime value pairs are defined in a pulse train list. The currently used pulse train file is displayed in the sub menu.

SCPI command:
[:SOURce<hw>]:PULM:MODE on page 394

Pulse Period - Pulse Generator
Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

SCPI command:
[:SOURce<hw>]:PULM:PERiod on page 395

Pulse Width - Pulse Generator
Sets the width of the generated pulse. The width determines the pulse length. The pulse width must be at least 20 ns less than the set pulse period.

SCPI command:
[:SOURce<hw>]:PULM:WIDTh on page 406

Pulse Delay - Pulse Generator
Sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts. The pulse delay is not effective for double pulse generation.

SCPI command:
[:SOURce<hw>]:PULM:DELay on page 393

Double Pulse Width - Pulse Generator
(Double Pulse only)

Sets the width of the second pulse.

SCPI command:
[:SOURce<hw>]:PULM:DOUBle:WIDTh on page 394

Double Pulse Delay - Pulse Generator
(Double Pulse only)

Sets the delay from the start of the first pulse to the start of the second pulse.

SCPI command:
[:SOURce<hw>]:PULM:DOUBle:DELay on page 393

Pulse Output State – Pulse Generator
Activates/deactivates the pulse generator output at the PULSE OUT connector

SCPI command:
[:SOURce<hw>]:PGEN:OUTPut[:STATe] on page 379

Output Polarity – Pulse Generator

Sets the polarity of the output signal (PULSE OUT connector).

SCPI command:
`[:SOURce<hw>]:PGEN:OUTPut:POLarity` on page 379

Trigger Mode - Pulse Generator

Selects the trigger mode for pulse modulation.

"Auto" The pulse generator signal is generated continuously.

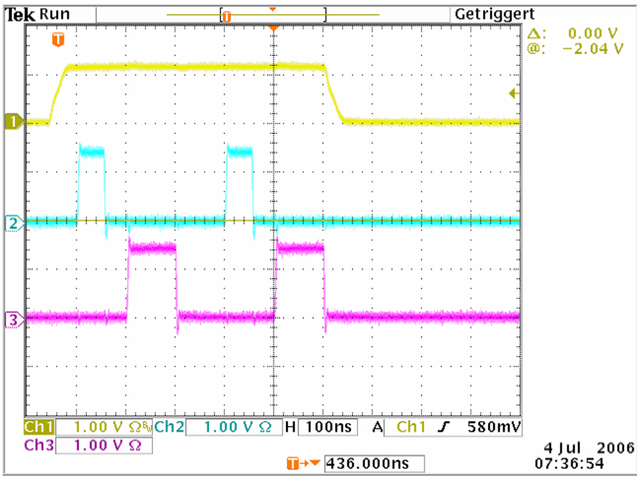
"Ext Single" The pulse moduilation is triggered by an external trigger event. The trigger signal is supplied via the PULSE IN connector.

"Ext Gated" The pulse generator signal is gated by an external gate signal. The signal is supplied via the PULSE IN connector.

Example: Generation of pulse signals using trigger modes Ext gated (Single Pulse)

The measurement were made using a 6-dB-attenuator.

Parameter	Value
Trigger Mode	Ext Gated
Double Pulse State	Off
External Trigger Input Slope	Positive
Pulse Delay	100 ns
Pulse Width	100 ns
Pulse Period	300 ns



Channel 1 = Indicates the external gate signal which is input at the PULSE EXT connector. The signal is active when it is high (positive).

Channel 2 = Indicates the sync signal. The sync signal starts after a trigger delay of typically 50 ns (see specifications). It is repeated after the set pulse period of 300 ns as long as the gate signal is active. The sync signal is output at the PULSE SYNC connector.

Channel 3 = Indicates the pulse signal. The first pulse starts after the pulse delay of 100 ns. The second pulse starts after the set pulse period. They are output at the PULSE VIDEO connector.

SCPI command:

[:SOURce<hw>]:PULM:TRIGger:MODE on page 402

Trigger Level – Input/Trigger Settings

Selects the external trigger level (threshold TTL, 0.5 V or -2.5 V).

SCPI command:

[:SOURce<hw>]:PULM:TRIGger:EXTernal:LEVel on page 402

External Trigger Input Slope - Pulse Generator

(External Trigger only)

Sets the polarity of the active slope of an applied trigger signal.

"Positive" The pulse generator is triggered on the positive slope of the external trigger signal.

"Negative" The pulse generator is triggered on the negative slope of the external trigger signal.

SCPI command:

`[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe` on page 402

Gate Input Polarity - Pulse Generator

Selects the polarity of the Gate signal.

The signal is supplied via the PULSE IN connector.

"Positive" The pulse signal is generated while the gate signal is high.

"Negative" The pulse signal is generated while the gate signal is low.

SCPI command:

`[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity` on page 401

External Impedance - Pulse Generator

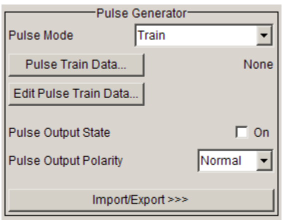
Selects the impedance for external pulse trigger.

SCPI command:

`[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance` on page 401

5.8.2 Pulse Train Generation

Upon selection of mode pulse train the menu is extended for configuring a user-defined pulse train.



A pulse train is a sequence of pulses with user-defined on and off times. The ontime/offtime value pairs are defined in a pulse train list. The currently used pulse train file is displayed in the sub menu.

An internally created pulse train list can be exported or externally created list can be imported.

Pulse Train Data – Pulse Generator

Calls the "File Select" menu for selecting and creating a pulse train file or to open the "File Manager".

SCPI command:

`[:SOURce<hw>]:PULM:TRAin:CATalog` on page 397

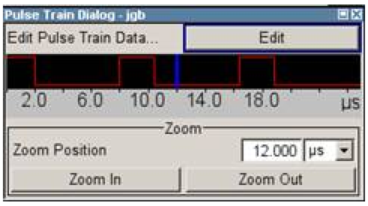
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 401

`[:SOURce<hw>]:PULM:TRAin:DELete` on page 397

Edit Pulse Train Data – Pulse Generator

Calls the pulse train dialog. The pulse train defined by the selected file is displayed. The pulse train can be edited in a table that is called by the "Edit" button in the lower left corner of the dialog.

The display of the pulse train can be zoomed, the zoom center is defined by the blue marker.



Zoom Position – Pulse Generator
(For Pulse Mode Train only)

Positions the blue marker in the pulse train. The marker defines the center of any zoom in or zoom out action.

SCPI command:
n.a.

Zoom in/out – Pulse Generator
(For Pulse Mode Train only)

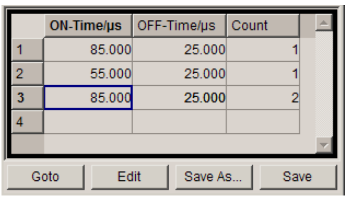
Zooms in or out the graphical display of the pulse train. The zoom factor of each zoom action is 2.

SCPI command:
n.a.

Edit – Pulse Generator

(For Pulse Mode Train only)

Calls the editor for editing the ontime/offtime values of the selected file. A file consists of any number of ontime/offtime value pairs. The currently selected file is displayed.



	ON-Time/µs	OFF-Time/µs	Count
1	85.000	25.000	1
2	55.000	25.000	1
3	85.000	25.000	2
4			

"Ontime/us" Sets the ontime of the ontime/offtime value pair.

SCPI command:
`[:SOURce<hw>]:PULM:TRAin:ONTime` on page 398

"Offtime/us" Sets the offtime of the ontime/offtime value pair.

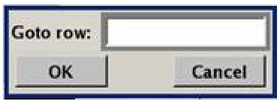
SCPI command:
`[:SOURce<hw>]:PULM:TRAin:OFFTime` on page 397

"Count" Sets the number of repetitions for each ontime/offtime value pair.

SCPI command:
[:SOURce<hw>]:PULM:TRAin:REPetition on page 399

"Goto" Selects row for editing.

If Goto row is selected, a window opens for entering the requested row.

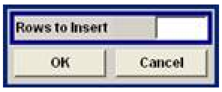


(it is not possible to change individual positions of the list)

"Edit" Calls a selection of possible actions described below.

"Insert Row" Insert a new row before the marked row.

"Insert Range" Insert new rows before the marked row. The number of rows to be inserted can be defined in an entry window.



"Fill...." Opens a sub menu for defining a set of list values to be automatically entered in the list.
The start line and the number of rows to be filled are defined under "From" and "Range".
The column to be filled is selected under "Select column to fill". Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters.
The filling of the column with the selected value settings is started with button "Fill".

"Delete Row" Deletes the marked row.

"Delete Range" Deletes the selected number of rows including the marked row. The number of rows to be inserted can be defined in an entry window.

"Save As" Open the file menu to save the list under a new name.
Each list is saved to the R&S SMF compact flash card as a separate file with the file prefix *.pulstrn. The file name and the directory to which the file is saved are user-selectable.

"Save" The list is saved under its current name.

Import/Export - Pulse Train Mode
Expands the menu with the area for import and export of pulse train files.

Externally edited Excel tables with on/off time and repetition triplets can be imported as text files or CSV files and used for pulse train mode.

On the other hand, internally created pulse train lists can be exported as text files or CSV files.

Mode – Import/Export Pulse Train Files
Selects if pulse train lists should be imported or exported. The settings offered below depend on the selected mode.

SCPI command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 405

Extension – ASCII File Settings
Selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

SCPI command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension` on page 403

Decimal Point - ASCII File Settings
Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

SCPI command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal`
on page 404

Column Separator- ASCII File Settings
Selects the separator between the frequency and level column of the ASCII table.

SCPI command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn`
on page 404

Select ASCII Source / Destination - Import/Export Pulse Train Files
Calls the "File Manager" for selecting the ASCII file to be imported into a pulse train list (source) or the ASCII file the pulse train list is exported (destination) in.

SCPI command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog` on page 403
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect` on page 403

Select Destination / Source - Import/Export Pulse Train Files
Calls the "File Manager" for selecting the pulse train list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

SCPI command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect` on page 406

Import / Export - Import/Export Pulse Train Files
Starts the export or import of the selected file.

If import is selected, the ASCII file is imported as pulse train list.

If export is selected, the pulse train list is exported into the selected ASCII file.

SCPI command:

`[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute` on page 405

5.9 Attenuator

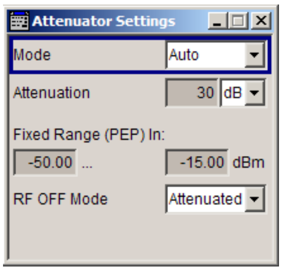
Settings for the attenuator can be accessed in the block diagram by way of the "Attenuator" function block, or by means of the setup menu with the same name which is openend using the MENU key.

To open the "Attenuator" dialog, select "Attenuator > Configure" or use the MENU key under "Attenuator".

The attenuator requires option R&S SMF-B26 or R&S SMF-B27.

5.9.1 Attenuator Settings

The menu is used to set the attenuator for the RF output.



Mode – Attenuator Settings

Sets the attenuator mode at the RF output.

"Auto" The mechanical attenuator switches in steps of 10 dB at fixed points.

"Fixed" The attenuator is fixed at the current position.

SCPI command:

`:OUTPut<hw>:AMODe` on page 258

Attenuation – Attenuation Settings

Sets the attenuation. To enter a value in this field, the attenuator mode Fixed has to be selected. If Auto is selected, this field is read-only.

SCPI command:

`[:SOURce]:POWer:ATTenuation` on page 385

Fixed Range in (PEP): - Attenuation Settings
Displays the level range in which the level is set without interruption for the attenuator mode Fixed setting.

SCPI command:
`:OUTPut<hw>:AFIXed:RANGe:LOWer` on page 257
`:OUTPut<hw>:AFIXed:RANGe:UPPer` on page 258

RF OFF Mode - Attenuation Settings
Selects the mode of the mechanical attenuator, when the RF signal is switched off.

Note: The setting of the "RF OFF" mode is not affected by an instrument preset (PRESET key), `*RST` and the "Save/Recall" function. This parameter is influenced only by the Factory Preset

"Normal"	The current attenuation remains when the RF signal is switched off and thus provides fast and wear-free switching.
"Attenuated"	The attenuation is set to maximum when the RF signal is switched off. This setting is recommended for applications that require a high level of noise suppression.

SCPI command:
`[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE` on page 385

6 Remote Control Basics

This chapter provides basic information on operating an instrument via remote control.

6.1 Remote Control Interfaces and Protocols

The instrument supports different interfaces for remote control. The following table gives an overview.

Table 6-1: Remote control interfaces and protocols

Interface	Protocols, VISA*) address string	Remarks
Local Area Network (LAN)	Protocols: ● VXI-11 ● socket communication (Raw Ethernet, simple telnet) VISA*) address string: TCPIP::host address[::LAN device name][::INSTR]	A LAN connector is located on the front or rear panel of the instrument, or both. The interface is based on TCP/IP and supports various protocols. For a description of the protocols refer to: ● chapter 6.1.3.1, "VXI-11 Protocol", on page 192 ● chapter 6.1.3.2, "Socket Communication", on page 192
USB	VISA*) address string: USB::<vendor ID>::<product ID>::<serial number>[::INSTR]	USB connectors are located on the front or the rear panel of the instrument, or both. For a description of the interface refer to chapter 6.1.4, "USB Interface", on page 193
Serial Interface	VISA*) address string: ASRL[0-9][::INSTR]	For a description of the interface refer to chapter 6.1.5, "Serial Interface", on page 194.
GPIB (IEC/IEEE Bus Interface)	VISA*) address string: GPIB::primary address[::INSTR] (no secondary address)	Optional GPIB bus interfaces according to standard IEC 625.1/IEEE 488.1 are located on the rear panel of the instrument. For a description of the interface refer to chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 194.

*) VISA is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is a prerequisite for remote control over LAN (when using VXI-11 protocol), USB and serial interface. However, no VISA installation is necessary to remote control while using socket communication. For more information, see chapter 6.1.1, "VISA Libraries", on page 190.

Within this interface description, the term GPIB is used as a synonym for the IEC/IEEE bus interface.

SCPI (Standard Commands for Programmable Instruments)

SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. 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. 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.

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.

6.1.1 VISA Libraries

VISA is a standardized software interface library providing input and output functions to communicate with instruments. The I/O channel (LAN or TCP/IP, USB, GPIB,...) is selected at initialization time by means of the channel–specific address string ("VISA resource string"), or by an appropriately defined VISA alias (short name). A VISA installation is a prerequisite for remote control using the following interfaces:

- chapter 6.1.3.1, "VXI-11 Protocol", on page 192
- chapter 6.1.4, "USB Interface", on page 193
- chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 194
- chapter 6.1.5, "Serial Interface", on page 194

For more information about VISA refer to the user documentation.

6.1.2 Messages

The messages transferred on the data lines of the GPIB bus or via the VXI-11 protocol are divided into the following categories:

- Interface messages
  Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They are used to communicate between the controller and the instrument. Interface messages can only be sent by instruments that have GPIB bus functionality. For details see the sections for the required interface.
- Instrument messages
  Instrument messages are employed in the same way for all interfaces, if not indicated otherwise in the description. Structure and syntax of the instrument messages are described in chapter 6.3, "SCPI Command Structure", on page 208. A detailed description of all messages available for the instrument is provided in the chapter "Remote Control Commands".
  There are different types of instrument messages, depending on the direction they are sent:
  - Commands
  - Instrument responses

Commands

Commands (program messages) are messages the controller sends to the instrument. They operate the instrument functions and request information. The commands are subdivided according to two criteria:

- According to the effect they have on the instrument:
  - **Setting commands** cause instrument settings such as a reset of the instrument or setting the frequency.
  - **Queries** cause data to be provided for remote control, e.g. for identification of the instrument or polling a parameter value. Queries are formed by directly appending a question mark to the command header.
- According to their definition in standards:
  - **Common commands**: their function and syntax are precisely defined in standard IEEE 488.2. They are employed identically on all instruments (if implemented). They refer to functions such as management of the standardized status registers, reset and self test.
  - **Instrument control commands** refer to functions depending on the features of the instrument such as frequency settings. Many of these commands have also been standardized by the SCPI committee. These commands are marked as "SCPI compliant" in the command reference chapters. Commands without this SCPI label are device-specific, however, their syntax follows SCPI rules as permitted by the standard.

Instrument responses

Instrument responses (response messages and service requests) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status.

6.1.3 LAN Interface

To be integrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols. For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol. They are connected using a commercial RJ45 cable. The TCP/IP network protocol and the associated network services are preconfigured on the instrument. Software for instrument control and (for specified protocols only) the VISA program library must be installed on the controller.

VISA library

Instrument access via VXI11 protocols is usually achieved from high level programming platforms using VISA as an intermediate abstraction layer. VISA encapsulates the low level VXI or GPIB function calls and thus makes the transport interface transparent for the user. See chapter 6.1.1, "VISA Libraries", on page 190 for details.

IP address

Only the IP address or the computer name (LAN device name) is required to set up the connection. The IP address/computer name is part of the "visa resource string" used by the programs to identify and control the instrument. The visa resource string has the form:

`TCPIP::host address[::LAN device name][::INSTR]` , where:

- **TCPIP** designates the network protocol used
- **host address** is the IP address
- **LAN device name** is the computer name of the control device (alternative to IP address)
- **INSTR** indicates that the VXI-11 protocol is used

Example:

Instrument has the IP address *192.1.2.3*; the valid resource string is:

`TCPIP::192.1.2.3::INSTR`

Computer name is *RSSM1*; the valid resource string is:

`TCPIP::RSSM1::INSTR`

Identifying instruments in a network

If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by means of the resource string.

6.1.3.1 VXI-11 Protocol

The VXI-11 standard is based on the ONC RPC (Open Network Computing Remote Procedure Call) protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

6.1.3.2 Socket Communication

An alternative way for remote control of the software is to establish a simple network communication using sockets. The socket communication, also referred as “Raw Ethernet communication”, does not require a VISA installation on the remote controller side.

The simplest way to establish socket communication is to use the build-in telnet program. The telnet program is part of every operating system and supports a communication with the software on a command-by-command basis. For better utilization and to enable automation by means of programs, user defined sockets can be programmed.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or the host name of the instrument and the number of the port configured for remote-control. All R&S Microwave Signal Generator use port number

5025 for this purpose. The port is configured for communication on a command-to-command basis and for remote control from a program.

6.1.3.3 Interface Messages

In the LAN connection, the interface messages are called low–level control messages. These messages can be used to emulate interface messages of the GPIB bus.

Command	Long term	Effect on the instrument
&ABO	Abort	Aborts processing of the commands just received.
&DCL	Device Clear	Aborts 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	Transition to the "local" state (manual control).
&GTR	Go to Remote	Transition to the "remote" state (remote control).
&GET	Group Execute Trigger	Triggers a previously active instrument function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
&LLO	Local Lockout	Disables switchover from remote control to manual control by means of the front panel keys.
&NREN	Not Remote Enable	Enables switchover from remote control to manual operation by means of the front panel keys
&POL	Serial Poll	Starts a serial poll.

6.1.4 USB Interface

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to enter an address string or install a separate driver.

USB address

The used USB address string is:

```
USB::<vendor ID>::<product ID>::<serial number>[::INSTR]
```

where:

- <vendor ID> is the vendor ID for Rohde&Schwarz
- <product ID> is the product ID for the R&S instrument
- <serial number> is the individual serial number on the rear of the instrument

Example:

`USB::0x0AAD::0x0047::100001::INSTR`

0x0AAD is the vendor ID for Rohde&Schwarz

0x47 is the product ID for the R&S SMF

100001 is the serial number of the particular instrument

6.1.5 Serial Interface

Remote control via the serial interface is possible either via RS232 interface or via a Bluetooth connection. The controller/Bluetooth device and the instrument must be connected via an external USB/serial-adapter (see recommended extras, data sheet) and a serial crossover (null modem) cable. A USB connection requires the VISA library to be installed on the controller. VISA will detect and configure the R&S SMF automatically when the USB connection is established.

Serial address

The used serial address string is:

`ASRL[0-9][::INSTR]`

where `ASRL[0-9]` determines the number of the COM port on the controller side, that has to be used for the serial connection.

Access via a bluetooth device requires the entry of the bluetooth pin in addition (see "Bluetooth Pin" on page 41).

To enable an error-free and correct data transmission, the parameters of the generator and the controller must have the same setting. The serial interface is preset for a baud rate 115200, no parity and one stop bit. The parameters can be manually changed in "Remote Channel Settings" dialog (see chapter 5.2.3.13, "Remote Channel Settings", on page 34).

6.1.6 GPIB Interface (IEC/IEEE Bus Interface)

To be able to control the instrument via the GPIB bus, the instrument and the controller must be linked by a GPIB bus cable. A GPIB bus card, the card drivers and the program libraries for the programming language used must be provided in the controller. The controller must address the instrument with the GPIB bus address (see chapter 6.1.6.2, "GPIB Instrument Address", on page 196).

Characteristics

The GPIB interface is described by the following characteristics:

- Up to 15 instruments can be connected
- The total cable length is restricted to a maximum of 15 m; the cable length between two instruments should not exceed 2m.

- A wired "OR"-connection is used if several instruments are connected in parallel, since the slowest instrument determines the speed.

6.1.6.1 GPIB Interface Messages

Interface messages are transmitted to the instrument on the data lines, with the attention line (ATN) being active (LOW). They are used for communication between the controller and the instrument and can only be sent by a computer which has the function of a GPIB bus controller. GPIB interface messages can be further subdivided into:

- **Universal commands**: act on all instruments connected to the GPIB bus without previous addressing
- **Addressed commands**: only act on instruments previously addressed as listeners

Universal Commands

Universal commands are encoded in the range 10 through 1F hex. They affect all instruments connected to the bus and do not require addressing.

Command	Effect on the instrument
DCL (Device Clear)	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) *)	Resets the interfaces to the default setting.
LLO (Local Lockout)	The LOC/IEC ADDR key is disabled.
SPE (Serial Poll Enable)	Ready for serial poll.
SPD (Serial Poll Disable)	End of serial poll.
PPU (Parallel Poll Unconfigure)	End of the parallel-poll state.
*) IFC is not a real universal command, it is sent via a separate line; however, it also affects all instruments connected to the bus and does not require addressing	

Addressed Commands

Addressed commands are encoded in the range 00 through 0F hex. They only affect instruments addressed as listeners.

Command	Effect on the instrument
GET (Group Execute Trigger)	Triggers a previously active instrument function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
GTL (Go to Local)	Transition to the "local" state (manual control).
GTR (Go to Remote)	Transition to the "remote" state (remote control).

Command	Effect on the instrument
PPC (Parallel Poll Configure)	Configures the instrument for parallel poll.
SDC (Selected Device Clear)	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.

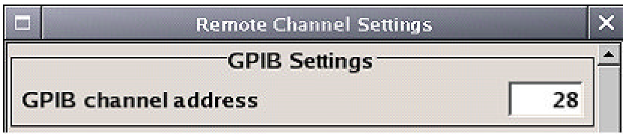
6.1.6.2 GPIB Instrument Address

In order to operate the instrument via remote control, it must be addressed using the GPIB address. The remote control address is factory preset, but it can be changed if it does not fit in the network environment. For remote control, addresses 0 through 30 are allowed. The GPIB address is maintained after a reset of the instrument settings.

Changing the GPIB address of the instrument

The GPIB address can be changed manually or using a remote control command.

1. Manually: press the SETUP key and select "Remote > GPIB".

   Select parameter "GPIB channel address" and set the GPIB address.

2. Using remote control command:
   `SYST:COMM:GPIB:ADDR 18`

6.2 Starting a Remote Control Session

The instrument and the controller have to be connected with the suitable cable and switched on.

A remote control program must open a connection to the instrument (using VISA functionality), before it can send commands to and receive device responses from the instrument.

Instrument Address

In order to operate the instrument via remote control it must be addressed using the defined interface address. See chapter 6.1.3, "LAN Interface", on page 191, chapter 6.1.4, "USB Interface", on page 193, chapter 6.1.5, "Serial Interface", on page 194or chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 194 for details.

The VISA resource string is indicated in the "Setup > Remote Channel Settings" menu.

Refer to chapter 6.2.3, "Examples", on page 198 for practical examples on setting up of a remote control link and starting of a remote control session.

6.2.1 Switching to Remote Control

When it is switched on, the instrument is always in the manual operating state and can be operated via the front panel controls (for instruments equipped with a display) or via mouse and external keyboard.

Starting remote control

1. Send a command from a controller to the instrument.

   The instrument is switched to remote control as soon as it receives a command from the controller.

   While remote control is active, operation via the front panel or via mouse and keyboard is disabled and "REMOTE" is displayed in the status line.

   The instrument remains in the remote state until it is reset to the manual state via the instrument or via the remote control interface (see chapter 6.2.2, "Returning to Manual Operation", on page 197).

   Tip: Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

2. Although operation via front panel, mouse and keyboard is disabled, the dialog boxes can still be opened, e.g. to verify settings, but buttons and setting fields are displayed in gray and cannot be activated.
   Use the command `SYST:KLOC ON` to disable the access to the dialogs.

3. To prevent unintentional return to manual operation, disable the LOCAL key of the instrument using the `&LLO` command (see chapter 6.1.3.3, "Interface Messages", on page 193).

   The instrument switches to "REM-LLO" state and transition to manual mode is not anymore possible via the remote control command `*GTL`.
   Switching to manual mode is only possible via remote control then.

4. Enable the LOCAL key with the interface message `&NREN`.

6.2.2 Returning to Manual Operation

Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

► To return to manual operation, use one of the following ways:

   a) Press the LOCAL key on the front panel.
   b) Select "Setup > Remote Control Channels" and press "Local".

c) While using the socket communication, terminate the remote control session.
d) Send the interface command `&GTL` via the remote control interface.

Tip: Use the `&NREN` to enable the LOCAL key if the key is disabled.

6.2.3 Examples

This sections provides examples for setting up of remote control connection and starting a remote control session over LAN and GPIB interfaces.

This section assumes basic knowledge of programming and operation of the controller. A description of the interface commands can be obtained from the relevant manuals.

6.2.3.1 Remote Control over LAN using VXI-11 Protocol

Through the examples in this section, the program 'Measurement & Automation Explorer' from National Instruments under Windows operating system is used for setting up a LAN remote control link and starting a remote control session.

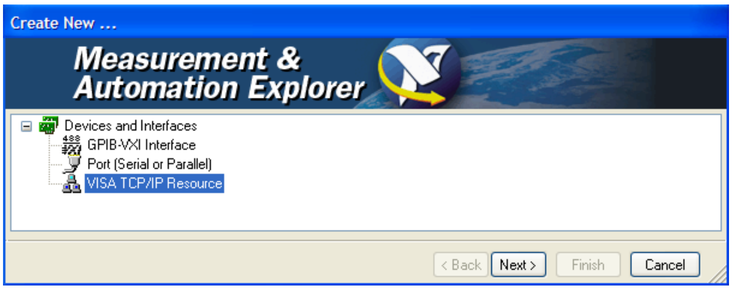
Configuring the controller

The instrument is preconfigured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, enter the computer name in the position of the IP address.

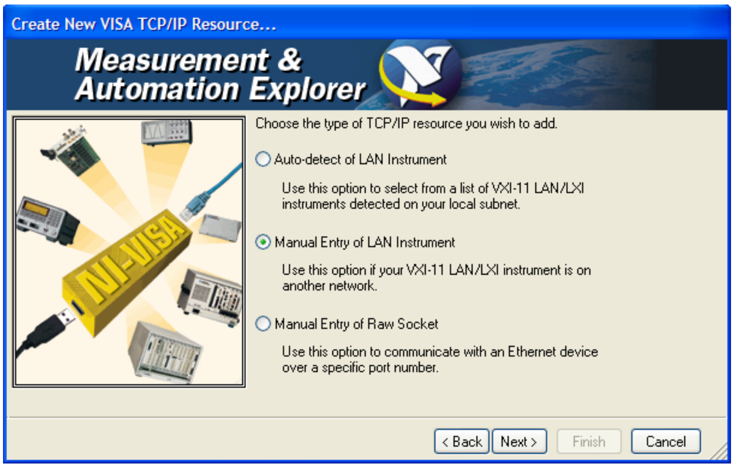
To enable the external controller to communicate with the software via TCP/IP protocol, set up a remote control link as follow:

1. Connect the controller and the instrument to the network (network cable) and switch them on.
2. Start the 'Measurement & Automation Control' program on the controller.
3. Select "Devices and Interfaces > Create New".

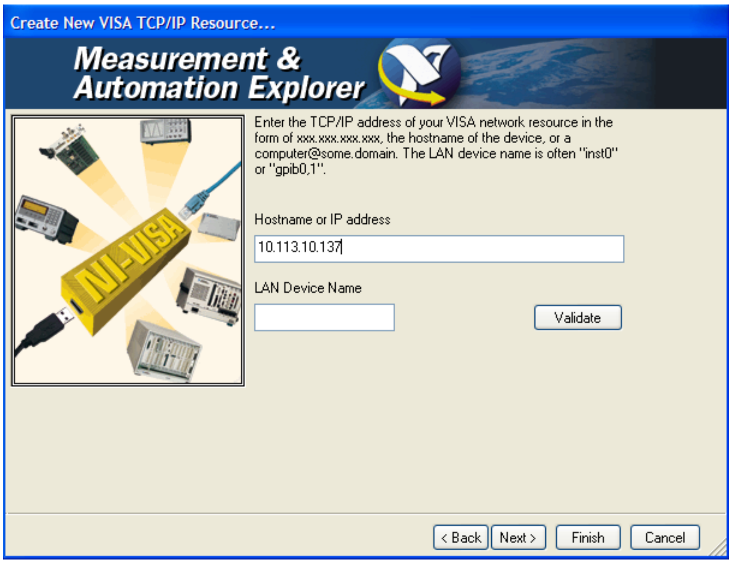
4. Select "VISA TCP/IP Resource" and confirm with "Next".



5. Choose the type of TCP/IP resource you wish to add and select Next.

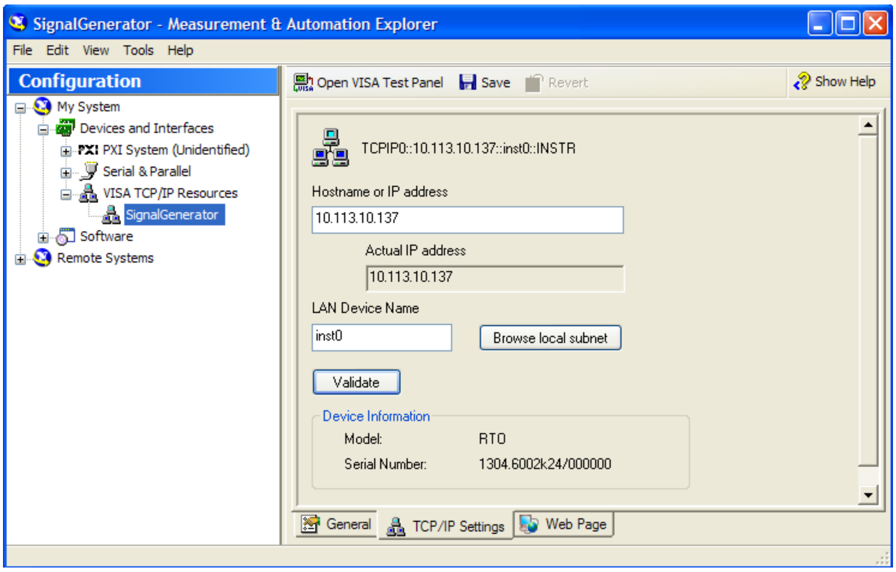


6. Enter the IP address or the host name of the R&S SMF and select "Next".

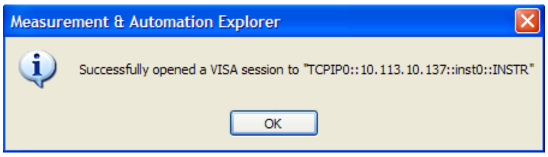


7. Enter the alias name if required.
The alias name must not be mistaken for the computer name. It is only used for instrument identification within the program and displayed in the menu as an option in case of an Ethernet link.
8. Confirm the settings with "Finish".

The instrument is configured and the settings are displayed in the "TCP/IP Settings" tab.



9. To test the connection, select "Validate".
   A message indicates whether the link to the instrument can be set up or not.

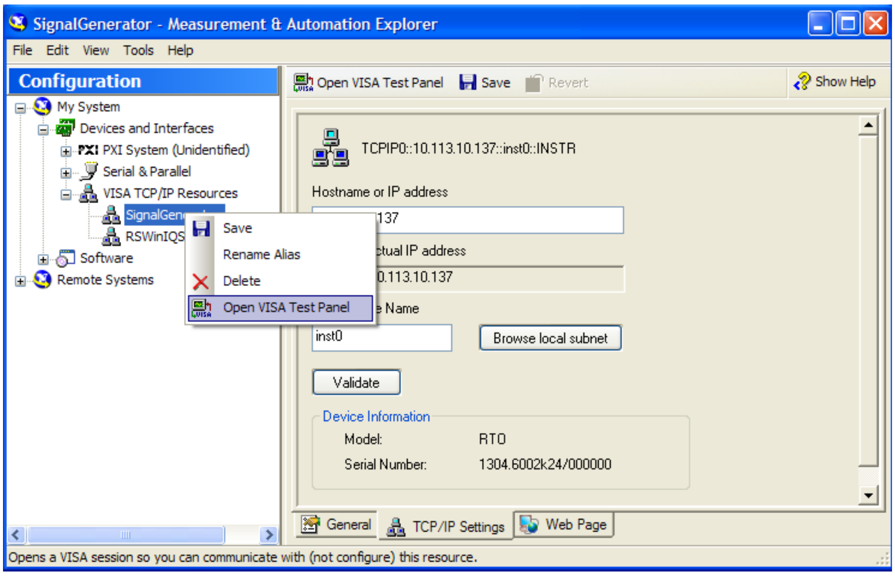


If a connection cannot be set up, check whether the controller and the instrument are connected to the network (network cable) and switched on. Correct spelling of the IP address or the computer name can also be checked. For further error location, inform the network administrator. In large networks, specification of additional addresses may be required for link setup, e.g. gateway and subnet mask, which are known to the network administrator.

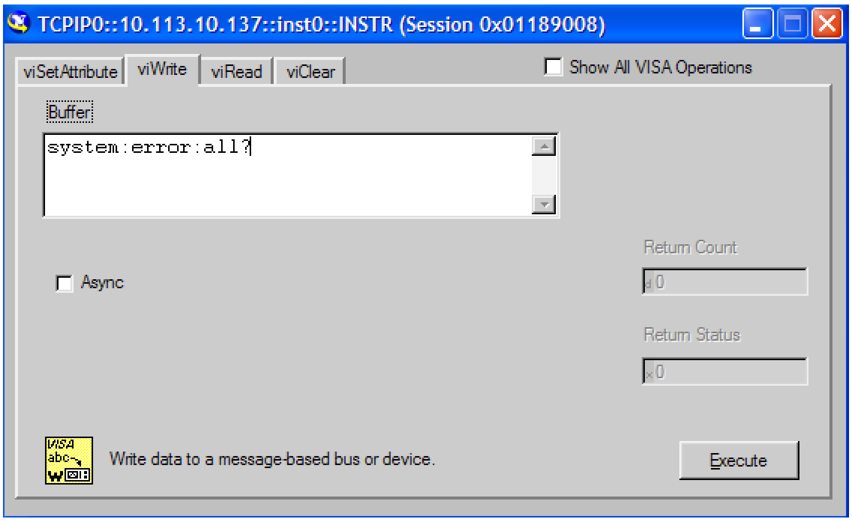
The instrument is now registered in the program and can be addressed via the resource string or alias name.

Starting a remote control over LAN (using VXI-11)

1. Start the 'Measurement & Automation Explorer' on the controller.
2. In the "Configuration" window, select "Device and Interfaces > VISA TCP/IP Resources", select the required instrument and select "Open VISA Test Panel".



3. In the "viWrite" tab, write the command to be send to the instrument and select "Execute".



Instrument responses are displayed on the "viRead" tab.

Tip: For further program operation refer to the online help of the program.

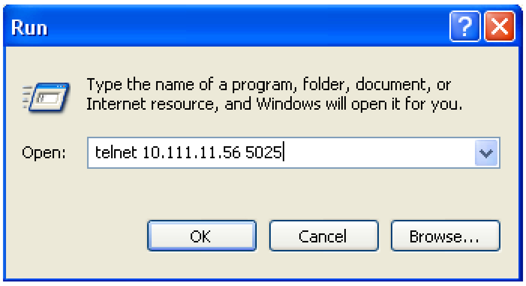
6.2.3.2 Remote Control over LAN using Socket Communication

This chapter provides an example on how to establish a remote control connection over telnet protocol and a simple sockets-based program example that can be further developed.

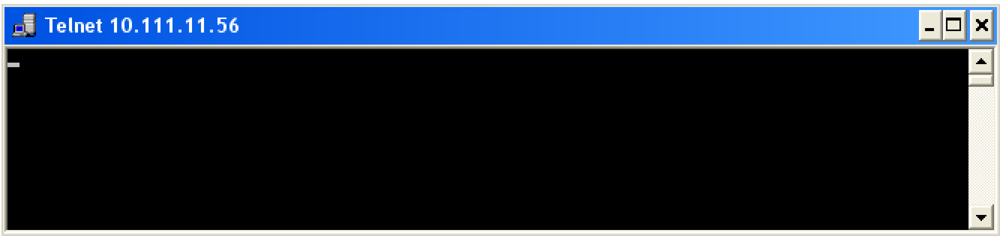
Setting up a Telnet Connection

To control the software, only a telnet program is required. The telnet program is part of every operating system.

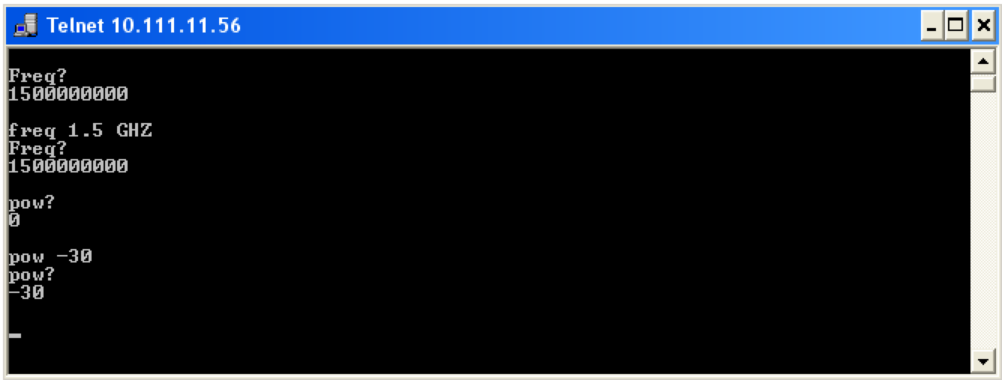
1. To establish a Telnet connection with the R&S SMF, start the telnet program and enter the socket address.
   The socket address is a combination of the IP address or the host name of the R&S SMF and the number of the port configured for remote-control via telnet.
   Tip: The R&S SMF uses the port number 5025 for remote connection via Telnet.

   The connection to the instrument is set up and remote-control commands can be sent.

2. Even if the cursor is not visible on the screen, enter blind a remote-control command and confirm with Enter.

   After the first remote-control command had been send, the instrument is in the "REMOTE" state, i.e. instrument control from the front panel or via mouse and key-board is disabled and "REMOTE" is displayed in the status line.

Telnet program examples

The following program example shows a simple TcpClient class that is intended to explain on how to get started with programming of sockets.

The example sets up a socket communication to R&S SMF and opens a simple user interface, very similar to the telnet, which allows input of commands. To enable real automation, further development of the program is required.

TcpClient.h

```
#include <string>
//defines structs for socket handling
#include <netinet/in.h>
using namespace std;
typedef struct sockaddr_in SockAddrStruct;
typedef struct hostent     HostInfoStruct;
class TcpClient
{
  public:
    TcpClient();
    ~TcpClient();
    void connectToServer( string &hostname, int port );
    void disconnect( );
    void transmit( string &txString );
    void receive( string &rxString );
    string getCurrentHostName( ) const;
    int    getCurrentPort( ) const;
  private:
    string           currentHostName;
    int              currentPort;
    int              currentSocketDescr;
    SockAddrStruct   serverAddress;
    HostInfoStruct * currentHostInfo;
    bool             clientIsConnected;
    int              receiveBufferSize;
};
```

TcpClient.cpp

```
#include <string>
//defines structs for socket handling
#include <netinet/in.h>
using namespace std;
typedef struct sockaddr_in SockAddrStruct;
typedef struct hostent     HostInfoStruct;
class TcpClient
{
  public:
    TcpClient();
    ~TcpClient();
    void connectToServer( string &hostname, int port );
```

```
    void disconnect( );
    void transmit( string &txString );
    void receive( string &rxString );
    string getCurrentHostName( ) const;
    int    getCurrentPort( ) const;
  private:
    string           currentHostName;
    int              currentPort;
    int              currentSocketDescr;
    SockAddrStruct   serverAddress;
    HostInfoStruct * currentHostInfo;
    bool             clientIsConnected;
    int              receiveBufferSize;
};

#include <netdb.h>
#include <netinet/in.h>
#include <unistd.h>
#include "TcpClient.h"
TcpClient::TcpClient()
: currentHostName( "" )
, currentPort( 0 )
, currentSocketDescr( 0 )
, serverAddress ( )
, currentHostInfo( NULL )
, clientIsConnected( false )
, receiveBufferSize( 1024 )
{
}
TcpClient::~TcpClient()
{
  currentHostInfo = NULL;
}

void TcpClient::connectToServer( string &hostname, int port )
{
  currentHostInfo = gethostbyname( hostname.c_str( ) );
  if( currentHostInfo == NULL )
  {
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("error connecting host\n" );
  }
  currentHostName = hostname;
  currentPort     = port;
  currentSocketDescr = socket(AF_INET, SOCK_STREAM, 0);
  if( currentSocketDescr == 0 )
  {
```

```
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("can't create socket\n" );
  }
  serverAddress.sin_family = currentHostInfo->h_addrtype;
  serverAddress.sin_port   = htons( currentPort );
  memcpy( (char *) &serverAddress.sin_addr.s_addr,
  currentHostInfo->h_addr_list[0], currentHostInfo->h_length );
  if( connect( currentSocketDescr, ( struct sockaddr *) &serverAddress,
  sizeof( serverAddress ) ) < 0 )
  {
   throw string("can't connect server\n" );
  }
  clientIsConnected = true;
}
void TcpClient::disconnect( )
{
  if( clientIsConnected )
  {
    close( currentSocketDescr );
  }
  currentSocketDescr = 0;
  currentHostName    = "";
  currentPort        = 0;
  currentHostInfo    = NULL;
  clientIsConnected  = false;
}
void TcpClient::transmit( string &txString )
{
  if( !clientIsConnected )
  {
  throw string("connection must be established before any data can be sent\n");
  }
  char * transmitBuffer = new char[txString.length() +1];
  memcpy( transmitBuffer, txString.c_str(), txString.length() );
  transmitBuffer[txString.length()] = '\n'; //newline is needed!
  if( send( currentSocketDescr, transmitBuffer, txString.length() + 1, 0 ) < 0 )
  {
    throw string("can't transmit data\n");
  }
  delete [] transmitBuffer;
}
void TcpClient::receive( string &rxString )
{
  if( !clientIsConnected )
  {
  throw string("connection must be established before any data can be received\n");
  }
```

```
  char * receiveBuffer = new char[receiveBufferSize];
  memset( receiveBuffer, 0, receiveBufferSize );
  bool receiving = true;
  while( receiving )
  {
    int receivedByteCount = recv( currentSocketDescr,
    receiveBuffer, receiveBufferSize, 0 );
    if( receivedByteCount < 0 )
    {
      throw string("error while receiving data\n");
    }
    rxString += string( receiveBuffer );
    receiving = ( receivedByteCount == receiveBufferSize );
  }
  delete [] receiveBuffer;
}
string TcpClient::getCurrentHostName( ) const
{
  return currentHostName;
}
int TcpClient::getCurrentPort( ) const
{
  return currentPort;
}
```

TelnetClient.cpp

```
#include <iostream>
#include "TcpClient.h"
void printUsage()
{
  cout<<"usage: EthernetRawCommand <server-ip> [scpi-command]"<<endl;
}
int main( int argc, char *argv[] )
{
  int errorCode          = 0; //no error
  bool useSingleCommand = false;
  string singleCommand  = "";
  string hostname       = "";
  int    port           = 5025;
  string input          = "";
  TcpClient client;
  switch( argc )
  {
    case 3:
      useSingleCommand = true;
      singleCommand    = argv[2];
    case 2:
      hostname         = argv[1];
      break;
```

```
    default:
        printUsage();
        return(-1);
  }
  try
  {
    client.connectToServer( hostname, port );
    bool terminate = false;
    while( !terminate )
    {
      char buffer[1024];
      if( useSingleCommand )
      {
        input =  singleCommand; //send string
      }
      else
      {
        cin.getline( buffer, 1024 );
        input = buffer;
        if( input == "end" )
        {
          terminate = true;
        }
      }
      if( !terminate)
      {
        client.transmit( input ); //send string
        int qPos = input.find( "?", 0 );
        //receive string only when needed
        if( qPos > 0 )
        {
          string rcStr = "";
          client.receive( rcStr );
          cout << rcStr << endl;
        }
      }
      if( useSingleCommand )
      {
        terminate = true;
      }
    }
  }catch( const string errorString )
  {
    cout<<errorString<<endl;
  }
  client.disconnect( );
  return errorCode;
}
```

6.3 SCPI Command Structure

SCPI commands consist of a so-called header and, in most cases, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

6.3.1 Syntax for Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk (*) and possibly one or more parameters.

Examples:

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

6.3.2 Syntax for Device-Specific Commands

Not all commands used in the following examples are necessarily implemented in the instrument.

For demonstration purposes only, assume the existence of the following commands for this section:

- `DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`
- `FORMat:READings:DATA <type>[,<length>]`
- `HardCOPy:DEVice:COLor <Boolean>`
- `HardCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`
- `HardCOPy[:IMMediate]`
- `HardCOPy:ITEM:ALL`
- `HardCOPy:ITEM:LABel <string>`
- `HardCOPy:PAGE:DIMensions:QUADrant[<N>]`
- `HardCOPy:PAGE:ORIentation LANDscape | PORTrait`
- `HardCOPy:PAGE:SCALe <numeric value>`
- `MMEMory:COPY <file_source>,<file_destination>`
- `SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
- `SENSe:FREQuency:STOP <numeric value>`
- `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`HardCOPy:DEVice:COLor ON` is equivalent to `HCOP:DEV:COL ON`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: `HardCOPy:PAGE:DIMensions:QUADrant[<N>]`

Command: `HCOP:PAGE:DIM:QUAD2`

This command refers to the quadrant 2.

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. With GSM, for instance, slots are counted from 0 to 7. In remote control, the slots are selected using the suffixes 1 to 8. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `HardCOPy[:IMMediate]`

Command: `HCOP:IMM` is equivalent to `HCOP`

Optional mnemonics with numeric suffixes

Do not omit an optional mnemonic if it includes a numeric suffix that is relevant for the effect of the command.

Example:

Definition:`DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`

Command: `DISP:MAX ON` refers to window 1.

In order to refer to a window other than 1, you must include the optional `WINDow` parameter with the suffix for the required window.

`DISP:WIND2:MAX ON` refers to window 2.

Parameters

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma (,). For a description of the parameter types, refer to chapter 6.3.3, "SCPI Parameters", on page 211.

Example:

Definition:HardCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>

Command:HCOP:DEV:CMAP:COL:RGB 3,32,44

Special characters

<table>
<tr><td>|</td><td>Parameters
A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
Example:
Definition:HardCOPy:PAGE:ORIentation LANDscape | PORTrait
Command HCOP:PAGE:ORI LAND specifies landscape orientation
Command HCOP:PAGE:ORI PORT specifies portrait orientation
Mnemonics
A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used.
Example:
DefinitionSENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>
The two following commands with identical meaning can be created:
SENS:BAND:RES 1
SENS:BWID:RES 1</td></tr>
<tr><td>[ ]</td><td>mnemonics in square brackets are optional and may be inserted into the header or omitted.
Example: HardCOPy[:IMMediate]
HCOP:IMM is equivalent to HCOP</td></tr>
<tr><td>{ }</td><td>Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
Example: SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}
The following are valid commands:
SENS:LIST:FREQ 10
SENS:LIST:FREQ 10,20
SENS:LIST:FREQ 10,20,30,40</td></tr>
</table>

6.3.3 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric 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 allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `SENSe:FREQ:STOP 1.5GHz` = `SENSe:FREQ:STOP 1.5E9`

Units

For physical quantities, the unit can be entered. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)
- N (nano)

If the unit is missing, the basic unit is used.

Example:

`SENSe:FREQ:STOP 1.5GHz` = `SENSe:FREQ:STOP 1.5E9`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:

`HCOP:PAGE:SCAL 90PCT`

Special numeric values

The texts listed below are interpreted as special numeric values. In the case of a query, the numeric value is provided.

- **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 numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP, DOWN.

- **INF/NINF**
  INFinity, Negative INFinity (NINF) represent the numeric values 9.9E37 or -9.9E37, respectively. INF and NINF are only sent as instrument responses.
- **NAN**
  Not A Number (NAN) represents the value 9.91E37. NAN is only sent as a instrument 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.

Example:

Setting command: `SENSe:LIST:FREQ MAXimum`

Query: `SENS:LIST:FREQ?, Response: 3.5E9`

Queries for special numeric values

The numeric values associated to `MAXimum/MINimum/DEFault` can be queried by adding the corresponding mnemonics to the command. They must be entered following the quotation mark.

Example: `SENSe:LIST:FREQ? MAXimum`

Returns the maximum numeric value as a result.

Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `HCOPy:DEV:COL ON`

Query: `HCOPy:DEV:COL?`

Response: `1`

Text parameters

Text parameters observe the syntactic rules for mnemonics, 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: `HardCOPy:PAGE:ORIentation LANDscape`

Query: `HCOP:PAGE:ORI?`

Response: `LAND`

Character strings

Strings must always be entered in quotation marks (' or ").

Example:

`HCOP:ITEM:LABel "Test1"` or `HCOP:ITEM:LABel 'Test1'`

Block data

Block data is a format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

`FORMat:READings:DATA  #45168xxxxxxxx`

The 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.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

6.3.4 Overview of Syntax Elements

The following table provides an overview of the syntax elements:

:	The colon separates the mnemonics of a command. In a command line 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 asterisk marks a common command.
"	Quotation marks introduce a string and terminate it.
#	The hash symbol introduces binary, octal, hexadecimal and block data. ● Binary: #B10110 ● Octal: #O7612 ● Hexa: #HF3A7 ● Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

6.3.5 Structure of a command line

A command line may consist of one or several commands. It is terminated by one of the following:

- a <New Line>

- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

`MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL`

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Example:

`HCOP:ITEM ALL; HCOP:IMM`

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 `HCOP` command system, i.e. they have one level in common.

When abbreviating the command line, the second command begins with the level below HCOP. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

`HCOP:ITEM ALL;IMM`

However, a new command line always begins with the complete path.

Example:

`HCOP:ITEM ALL`

`HCOP:IMM`

6.3.6 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.

- The requested parameter is transmitted without a header.
  Example: `HCOP:PAGE:ORI?`, Response: `LAND`
- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.
  Example: `SENSe:FREQuency:STOP? MAX`, Response: `3.5E9`
- Numeric values are output without a unit. Physical quantities are referred to the basic units or to the units set using the `Unit` command. The response `3.5E9` in the previous example stands for 3.5 GHz.

- Truth values (Boolean values) are returned as `0` (for OFF) and `1` (for ON).
  Example:
  Setting command: `HCOPy:DEV:COL ON`
  Query: `HCOPy:DEV:COL?`
  Response: `1`
- Text (character data) is returned in a short form.
  Example:
  Setting command: `HardCOPy:PAGE:ORIentation LANDscape`
  Query: `HCOP:PAGE:ORI?`
  Response: `LAND`

6.4 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command is one which finishes executing before the next command starts executing. Commands that are processed quickly are usually implemented as sequential commands. Sequential commands are not implemented in the instrument, however the execution time of most commands is so short that they act as sequential commands when sent in different command lines.
- An overlapping command is one which does not automatically finish executing before the next command starts executing. Usually, overlapping commands take longer to process and allow the program to do other tasks while being executed. If overlapping commands do have to be executed in a defined order, e.g. in order to avoid wrong measurement results, they must be serviced sequentially. This is called synchronization between the controller and the instrument.

Setting commands within one command line, even though they may be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line.

Example: Commands and queries in one message

The response to a query combined in a program message with commands that affect the queried value is not predictable.

The following commands always return the specified result:

`:FREQ:STAR 1GHZ;SPAN 100 :FREQ:STAR?`

Result:

`1000000000` (1 GHz)

Whereas the result for the following commands is not specified by SCPI:

`:FREQ:STAR 1GHz;STAR?;SPAN 1000000`

The result could be the value of `STARt` before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1 GHz if the instrument executes commands as they are received.

As a general rule, send commands and queries in different program messages.

Example: Overlapping command with *OPC

The instrument implements `INITiate[:IMMediate]` as an overlapped command. Assuming that `INITiate[:IMMediate]` takes longer to execute than `*OPC`, sending the following command sequence results in initiating a sweep and, after some time, setting the `OPC` bit in the `ESR`:

`INIT; *OPC.`

Sending the following commands still initiates a sweep:

`INIT; *OPC; *CLS`

However, since the operation is still pending when the instrument executes `*CLS`, forcing it into the "Operation Complete Command Idle" State (OCIS), `*OPC` is effectively skipped. The `OPC` bit is not set until the instrument executes another `*OPC` command.

Example: Overlapped command followed by non-conflicting commands

Suppose that the instrument is switched on to provide a real time test signal that requires some calculation time. At the same time some settings for the configuration of a different signal are made which do not interact with the generated signal (e.g. the signal may be used later on). The signal generation and the signal configuration are independent from each other, so none of the following overlapped commands needs to be synchronized:

`SOUR:BB:3GPP:STAT ON`

`SOUR:BB:GSM:FORM FSK2`

6.4.1 Preventing Overlapping Execution

To prevent an overlapping execution of commands, one of the commands *OPC, *OPC? or *WAI can be used. All three commands cause a certain action only to be carried out after the hardware has been set. By suitable programming, the controller can be forced to wait for the corresponding action to occur.

*Table 6-2: Synchronization using *OPC, *OPC? and *WAI*

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending *OPC? directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Sending *WAI directly after the command whose processing should be terminated before other commands are executed.

Command synchronization using *WAI or *OPC? appended to an overlapped command is a good choice if the overlapped command takes only little time to process. The two synchronization techniques simply block overlapped execution of the command.

For time consuming overlapped commands it is usually desirable to allow the controller or the instrument to do other useful work while waiting for command execution. Use one of the following methods:

***OPC with a service request**

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Set bit no. 5 in the SRE: *SRE 32 to enable ESB service request.
3. Send the overlapped command with *OPC
4. Wait for a service request

   The service request indicates that the overlapped command has finished.

***OPC? with a service request**

1. Set bit no. 4 in the SRE: *SRE 16 to enable MAV service request.
2. Send the overlapped command with *OPC?
3. Wait for a service request

   The service request indicates that the overlapped command has finished.

Event Status Register (ESE)

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Send the overlapped command without *OPC, *OPC? or *WAI
3. Poll the operation complete state periodically (by means of a timer) using the sequence: *OPC; *ESR?

   A return value (LSB) of 1 indicates that the overlapped command has finished.

***OPC? with short timeout**

1. Send the overlapped command without *OPC, *OPC? or *WAI
2. Poll the operation complete state periodically (by means of a timer) using the sequence: <short timeout>; *OPC?
3. A return value (LSB) of 1 indicates that the overlapped command has finished. In case of a timeout, the operation is ongoing.
4. Reset timeout to former value
5. Clear the error queue with `SYStem:ERRor?` to remove the "-410, Query interrupted" entries.

Using several threads in the controller application

As an alternative, provided the programming environment of the controller application supports threads, separate threads can be used for the application GUI and for controlling the instrument(s) via SCPI.

A thread waiting for a *OPC? thus will not block the GUI or the communication with other instruments.

6.5 Status Reporting System

The status reporting system stores all information on the current operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. Both can be queried with the commands `STATus...`.

6.5.1 Hierarchy of status registers

As shown in the following figure, the status information is of hierarchical structure.

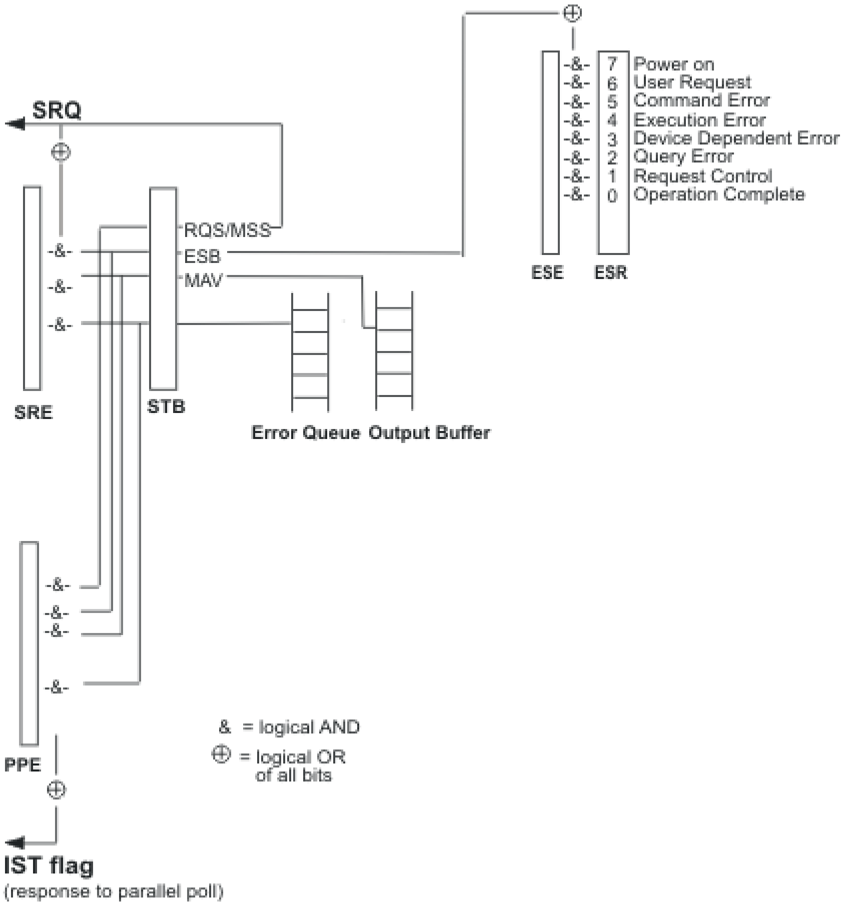


Fig. 6-1: Graphical overview of the status registers hierarchy

- **STB, SRE**

The STatus Byte (STB) register and its associated mask register Service Request Enable (SRE) form the highest level of the status reporting system. The STB provides a rough overview of the instrument status, collecting the information of the lower-level registers.

- **ESR, SCPI registers**
  The STB receives its information from the following registers:
  - The Event Status Register (ESR) with the associated mask register standard Event Status Enable (ESE).
  - The STATus:OPERation and STATus:QUEStionable registers which are defined by SCPI and contain detailed information on the instrument.
- **IST, PPE**
  The IST flag ("Individual STatus"), 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.
- **Output buffer**
  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 the overview.

All status registers have the same internal structure.

SRE, ESE

The service request enable register SRE can be used as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be used as the ENABle part of the ESR.

6.5.2 Structure of a SCPI Status Register

Each standard SCPI register consists of 5 parts. Each part has a width of 16 bits and has different functions. 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. 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 integers.

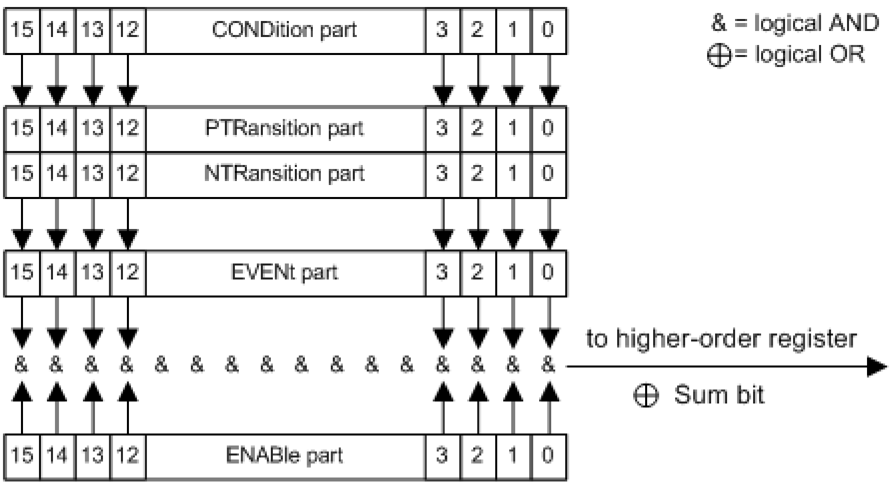


Fig. 6-2: The status-register model

Description of the five status register parts

The five parts of a SCPI register have different properties and functions:

- **CONDition**
  The `CONDition` part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.
- **PTRansition**
  The two transition register parts define which state transition of the `CONDition` part (none, 0 to 1, 1 to 0 or both) is stored in the `EVENt` part.
  The `Positive-TRansition` part acts as a transition filter. 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 as required. Its contents are not affected by reading.
- **NTRansition**
  The `Negative-TRansition` part also acts as a transition filter. 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 as required. Its contents are not affected by reading.
- **EVENt**
  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 transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it. This part is often equated with the entire register.

- **ENABle**
  The ENABle part determines whether the associated EVENt bit contributes to the sum bit (see 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 as required. Its contents are not affected by reading.

Sum bit

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 can lead to a service request throughout all levels of the hierarchy.

6.5.3 Contents of the Status Registers

In the following sections, the contents of the status registers are described in more detail.

6.5.3.1 Status Byte (STB) and Service Request Enable Register (SRE)

The STatus Byte (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. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB is read using the command *STB or a serial poll.

The STatus Byte (STB) is linked to the Service Request Enable (SRE) register. 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. The SRE can be set using the command *SRE and read using the command *SRE?.

Table 6-3: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
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 remote control.
3	Not used.
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.

Bit No.	Meaning
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 indicates a serious error 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	Not used.

6.5.3.2 IST Flag and Parallel Poll Enable Register (PPE)

As with the SRQ, the IST flag combines the entire status information in a single bit. It can be read by means of a parallel poll (see chapter 6.5.5.3, "Parallel Poll", on page 225) or using the 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?.

6.5.4 Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. The event status register can be read out using command `*ESR` on page 230. The ESE is the associated enable part. It can be set using the command `*ESE` on page 230 and read using the command `*ESE?`.

Table 6-4: Meaning of the bits used 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	not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent 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.
4	Execution Error This bit is set if a received command is syntactically correct but 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.

Bit No.	Meaning
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.
6	User Request This bit is set on pressing the LOCAL key, i.e. when the instrument is switched over to manual operation.
7	Power On (supply voltage on) This bit is set on switching on the instrument.

6.5.5 Application of the Status Reporting System

The purpose of the status reporting system is to monitor the status of one or several devices in a measuring system. To do this and react appropriately, the controller must receive and evaluate the information of all devices. The following standard methods are used:

- **Service request** (SRQ) initiated by the instrument
- **Serial poll** of all devices in the bus system, initiated by the controller in order to find out who sent a SRQ and why
- **Parallel poll** of all devices
- Query of a **specific instrument status** by means of commands
- Query of the **error queue**

6.5.5.1 Service Request

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 appropriately. An SRQ is always initiated if one or several of bits 2, 4 or 5 of the status byte are set and enabled in the SRE. Each of these bits combines the information of the error queue or the output buffer. In order to use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Example:

Use command `*OPC` on page 231 to generate an SRQ .

`*ESE 1` - set bit 0 of ESE (Operation Complete)

`*SRE 32` - set bit 5 of 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 such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

6.5.5.2 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 is 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 for instruments which do not adhere to SCPI or IEEE 488.2.

The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

6.5.5.3 Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller using 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 a logical "0" or "1".

In addition to the SRE register, which determines the conditions under which an SRQ is generated, there is a Parallel Poll Enable register (PPE) which is ANDed with the STB bit by bit, considering bit 6 as well. This register is ANDed with the STB bit by bit, considering bit 6 as well. The results are ORed, the result is possibly inverted and then sent as a response to the parallel poll of the controller. The result can also be queried without parallel poll using the command `*IST`.

The instrument first has to be set for the parallel poll using the command `PPC`. 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 `PPE`.

The parallel poll method is mainly used to find out quickly which one of the instruments connected to the controller has sent a service request. To this effect, SRE and PPE must be set to the same value.

6.5.5.4 Query of an instrument status

Each part of any status register can be read using queries. There are two types of commands:

- The common commands `*ESR?`, `*IDN?`, `*IST?`, `*STB?` query the higher-level registers.
- The commands of the `STATus` system query the SCPI registers (`STATus:QUEStionable`...)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

6.5.5.5 Error Queue

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 that can be looked up in the Error Log or queried via remote control using `SYSTem:ERRor[:NEXT]?` or `SYSTem:ERRor:ALL?`. Each call of `SYSTem:ERRor[:NEXT]?` provides one 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.

6.5.6 Reset Values of the Status Reporting System

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except `*RST` and `SYSTem:PRESet`, influence the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table 6-5: Resetting the status reporting system

Event	**Switching on supply voltage** **Power-On-Status-Clear**		**DCL, SDC** **(Device Clear, Selected Device Clear)**	***RST or SYS-Tem:PRE-Set**	**STA-Tus:PRE-Set**	***CLS**
Effect	**0**	**1**				
Clear STB, ESR	-	yes	-	-	-	yes
Clear SRE, ESE	-	yes	-	-	-	-
Clear PPE	-	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) The first command in a command line that immediately follows a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

6.6 General Programming Recommendations

Initial instrument status before changing settings

Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the instrument status. Thus, when a command attempts to define incompatible settings, the command is ignored and the instrument status remains unchanged, i.e. other settings are not automatically adapted. Therefore, control programs should always define an initial instrument status (e.g. using the *RST command) and then implement the required settings.

Command sequence

As a general rule, send commands and queries in different program messages. Otherwise, the result of the query may vary depending on which operation is performed first (see also Preventing Overlapping Execution).

Reacting to malfunctions

The service request is the only possibility for the instrument to become active on its own. Each controller program should instruct the instrument to initiate a service request in case of malfunction. The program should react appropriately to the service request.

Error queues

The error queue should be queried after every service request 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.

7 Remote Control Commands

In the following, all remote-control commands will be presented in detail with their parameters and the ranges of numerical values.

For an introduction to remote control and the status registers, refer to chapter 6, "Remote Control Basics", on page 189.

7.1 Common Commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the Status Reporting System.

Available common commands:

***CAL**

Calibration Query

Initiates a calibration of the instrument and subsequently queries the calibration status. 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` registers to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

Usage: Setting only

***ESE** <Value>

Event Status Enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:

<Value>

Range: 0 to 255

***ESR?**

Event Status Read

Returns the contents of the event status register in decimal form and subsequently sets the register to zero.

Return values:

<Contents>

Range: 0 to 255

Usage: Query only

***IDN?**

IDeNtification: returns the instrument identification.

Return values:

<ID> "Rohde&Schwarz,<device type>,<serial number>,<firmware version>"

Example: `Rohde&Schwarz,ZVA8-4Port,12345,0.10.1.23`

Usage: Query only

***IST?**

Individual STatus query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:

<ISTflag>	0 | 1
Usage:	Query only

***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. The query form writes a "1" into the output buffer as soon as all preceding commands have been executed. This is used for command synchronization.

***OPT?**

OPTion identification query

Queries the options included in the instrument. For a list of all available options and their description refer to the CD-ROM.

Return values:

<Options>	The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.
Usage:	Query only

***PCB** <Address>

Pass Control Back

Indicates the controller address to which remote control is returned after termination of the triggered action.

Setting parameters:

<Address>	Range: 0 to 30
Usage:	Setting only

***PRE** <Value>

Parallel poll Register Enable

Sets parallel poll enable register to the indicated value. The query returns the contents of the parallel poll enable register in decimal form.

Parameters:
<Value>

Range: 0 to 255

***PSC** <Action>

Power on Status Clear

Determines whether the contents of the `ENABle` registers are preserved or reset when the instrument is switched on. Thus a service request can be triggered when the instrument is switched on, if the status registers ESE and SRE are suitably configured. The query reads out the contents of the "power-on-status-clear" flag.

Parameters:
<Action> 0 | 1

0
The contents of the status registers are preserved.

1
Resets the status registers.

***RCL** <Number>

RECALL calls up the instrument status which was stored under the specified number using the `*SAV` command, e.g. `*SAV 4`. It also activates the instrument settings which are stored in a file and loaded using the `MMEMory:LOAD <number>, <file_name.extension>` command.

***RST**

ReSeT

Sets the instrument to a defined default status. It is equivalent to `SYSTem:PRESet`. The default settings are indicated in the description of commands.

Usage: Setting only

***SAV** <Number>

SAVE stores the current device state under the specified number (see also `*RCL` on page 232). The command is used to store the current instrument state in an intermediate memory. The instrument state can be recalled by using the command `*RCL` with the associated number.

To transfer the stored instrument settings in a file, use the command `:MMEMory:STORe:STATe`.

***SRE** <Contents>

Service Request Enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents> Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

Range: 0 to 255

***STB?**

STatus Byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

TRiGger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal (Manual Trigger). This common command complements the commands of the `TRIGger` subsystem.

Usage: Event

***TST?**

self TeST query

Triggers selftests of the instrument and returns an error code in decimal form (see Service Manual supplied with the instrument). "0" indicates no errors occured.

Usage: Query only

***WAI**

WAIt to continue

Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also command synchronization and *OPC).

Usage: Event

7.2 Preset Commands

The preset commands are not bundled in one subsystem. Therefore, they are listed separately in this section. In addition, a specific preset command is provided for each digital standard and for the fader. These specific commands are described in the associated subsystems.

Four presetting actions are available:

- Activating the default state of all internal instrument functions (*RST on page 232). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. GPIB address or reference oscillator source settings.
- Activating the preset state of the parameters related to the selected signal path (:SOURce<hw>:PRESet on page 234)
- Activating the preset state of all parameters that are not related to the signal path (:DEVice:PRESet on page 234)
- Activating the original state of delivery (factory reset, :SYSTem:FPReset on page 235). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

:DEVice:PRESet

The command presets all parameters which are not related to the signal path. This includes presetting the LF generator and bit/block error measurement.

Example: `DEV:PRES`
presets all instruments settings that are not related to the signal path

Usage: Event

:SOURce<hw>:PRESet

The command presets all parameters which are related to the selected signal path.

Fading (if available) and transient recorder are only preset by command `*RST`.

Example: `SOUR:PRES`
presets all settings that are related to signal path

Usage: Event

SYSTem:PRESet <Preset>

The command triggers an instrument reset. It has the same effect as the PRESET key on the front panel and the `*RST` command.

For an overview of the settings affected by the preset function, see chapter 5.2.2, "Default Instrument Settings - Preset Key", on page 21.

Return values:
<Preset> string

Example: `SYST:PRES`
All instrument settings (also those that are not currently active) are reset to their default values.

Usage: Event
SCPI conform

:SYSTem:FPReset

The command triggers an instrument reset to the original state of delivery.

Note: Since Factory Preset resets the Remote Channel and network settings to the default values, executing Factory Preset via remote control terminates the connection to the instrument, if these settings had been configured to values different to the default ones!

The factory preset function resets nearly all instrument settings. In addition to the regular preset by means of the PRESET key, a "Factory Preset" resets also the following values:

- Reference frequency settings ("Ref Oscillator" menu)
- Power on settings ("Level/EMF" menu)
- Network settings including hostname ("Setup" menu)
- Remote Channel settings including GPIB address ("Setup" menu)
- Start/Stop Gui Update "(Setup" menu)
- Display and keyboard settings ("Setup" menu).

To maintain security, password settings and all settings protected by these passwords like disabled USB and LAN connections are not changed.

Not affected by the "Factory Preset" are also user data, lists or instrument settings files, created for example by means of the Save/Recall function.

Example: `SYST:FPR`
all instrument settings (also those that are not currently active) are reset to the factory values.

Usage: Event

7.3 CALibration Subsystem

The CALibration system contains the commands for adjustment. Adjustment is triggered by the query commands. The response "0" indicates error-free adjustment, and the response "1" means that an error occurred during adjustment.

:CALibration:ALL[:MEASure]?

The command starts all internal adjustments for which no external measuring equipment is needed.

Return values:

<Measure> 0|1

Example: `CAL:ALL:MEAS?`
starts the adjustment of all functions for the entire instrument.
Response: "0"
adjustment has been performed successfully.

Usage: Query only
SCPI conform

:CALibration<hw>:FREQuency[:MEASure]?

The command starts all adjustments which affect the frequency.

Return values:

<Measure> 0|1

Example: `CAL:FREQ:MEAS?`
starts the adjustments for maximum frequency accuracy.
Response: "0"
the adjustments have been performed successfully.

Usage: Query only

:CALibration<hw>:LEVel:LOOPgain:STATe <State>

The command switches on or off use of external loopgain correction data.

Parameters:

<State> 0|1|OFF|ON

Example: `CAL:LEV:LOOP:STAT ON`
switches on use of external loopgain correction data.

:CALibration<hw>:LEVel[:MEASure]?

The command starts all adjustments which affect the level.

Return values:

<Measure> 0|1

Example: `CAL:LEV:MEAS?`
starts adjustments for maximum level accuracy.
Response: "0"
adjustment has been performed successfully.

Usage: Query only

:CALibration:LFOutput[:MEASure] <Measure>

Performs all adjustments which affect the internal modulation generator.

Parameters:

<Measure>

Example: `CAL:LFO?`
starts the adjustments for the modulation generators.
`Response: 0`
the adjustments have been performed successfully.

Options: R&S SMF-B20

7.4 DIAGnostic Subsystem

The `DIAGnostic` system contains the commands used for instrument diagnosis and servicing. SCPI does not define any DIAGnostic commands; the commands listed here are all Device-specific. All DIAGnostic commands are query commands which are not influenced by `*RST`.

:DIAGnostic<hw>:BGINfo?

The command checks the modules available in the instrument using the variant and revision state.

If the command is sent without parameters being specified, a complete list of all modules is returned (the various entries are separated by commas). The length of the list is variable and depends on the instrument equipment configuration.

If the command is sent with parameters, a list of the specified modules is returned (the various entries are separated by commas). A list of modules names can be called up using the command `:DIAGnostic<hw>:BGINfo:CATalog` on page 238.

Return values:

<Bginfo> < Module name> <Module stock number incl. variant> <Module revision> <Module serial number>

Each entry for one module consists of four parts which are separated by space characters.

Example: `DIAG:BGIN:CAT?`

queries the instrument configuration.

`Response:    FSYN,MWIF,....`

returns the data of all available modules.

`DIAG:BGIN? 'FSYN'`

queries the configuration of the FSYN.

`Response: FSYN 1234.5678.02 1.5.3 100023`

module FSYB with stock number 1234.5678.02 has revision 1.5.3 and serial number 100023.

Usage: Query only

:DIAGnostic<hw>:BGINfo:CATalog?

The command queries the names of the assemblies available in the instrument.

A complete list of all assemblies is returned (the various entries are separated by commas). The length of the list is variable and depends on the instrument equipment configuration.

Return values:

<Catalog> string

Example: `DIAG:BGIN:CAT`

queries the names of the assemblies.

Response: `MBRD,SSYN,....`

Usage: Query only

:DIAGnostic:INFO:OTIMe?

The command queries the number of operation hours.

Return values:

<OTIMe> float

Example: `DIAG:INFO:OTIM`

queries the operation hours.

`Response:    100023`

The instrument was operated for 100023 hours up to now.

Usage: Query only

:DIAGnostic:INFO:POCount?

The command queries the number of power-on events.

Return values:

<Pocount> float

Example:

`DIAG:INFO:POC`

queries the number of power on events.

`Response: 123`

The instrument was switched on for 123 times up to now.

Usage: Query only

7.5 DISPlay Subsystem

The DISPlay system contains the commands to set the power-save mode of the instrument.

:DISPlay:PSAVe:HOLDoff <Holdoff>

This command sets the wait time for the screen-save mode of the display. The available value range is 1 to 60 minutes, the resolution 1 minute. The entry is dimensionless.

Parameters:

<Holdoff> float

Range: 1 to 60
*RST: 1
Default unit: minute

Example:

`DISP:PSAV:HOLD 10`

sets the wait for the screen saver mode to 10 minutes.

:DISPlay:PSAVe[:STATe] <State>

This command activates/deactivates the screen-save mode of the display. With the screen-save mode activated the display including backlight is completely switched off after the elapse of the wait time (see command `DISPlay:PSAVe:HOLDoff`) when no entries via front panel, external mouse or external keyboard are made.

This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example:

`DISP:PSAV ON`

activates screen saver mode.

7.6 FORMat Subsystem

The FORMat subsystem contains the commands which determine the format of the data that the R&S SMF returns to the controller. This affects all query commands which return a list of numerical data or block data. Reference is made to this in the descriptions of the commands.

:FORMat:BORDer <Border>

The command determines the sequence of bytes within a binary block. This only affects blocks which use the IEEE754 format internally.

Parameters:

<Border> NORMal|SWAPped

NORMal
The instrument expects (with setting commands) and sends (with queries) the least significant byte of each IEEE754 floating-point number first and the most significant byte last.

SWAPped
The instrumenet expects (with setting commands) and sends (with queries) the most significant byte of each IEEE754 floating-point number first and the least significant byte last.

*RST: NORMal

Example: `FORM:BORD SWAP`
the data is transferred with the most significant bit first.

Usage: SCPI conform

:FORMat[:DATA] <Data>

The command determines the data format which the R&S Signal Generator uses to return data. When data is transferred from the control computer to the instrument, the instrument detects the data format automatically. In this case, the value set here is irrelevant.

Parameters:

<Data> ASCii|PACKed

ASCii
Numerical data is transferred as plain text separated by commas.

PACKed
Numerical data is transferred as binary block data. The format within the binary data depends on the command. The various binary data formats are explained in the description of the parameter types.

*RST: ASCii

Example: `FORM ASC`
The data is transferred as ASCII data.

:FORMat:SREGister <Sregister>

The command determines the numerical format which is returned when the status registers are queried.

Parameters:

<Sregister> ASCii|BINary|HEXadecimal|OCTal

ASCii
The register content is returned as a decimal number.

BINary
The register content is returned as a binary number. #B is placed in front of the number.

HEXadecimal
The register content is returned as a hexadecimal number. #H is placed in front of the number.

OCTal
The register content is returned as an octal number. #Q is placed in front of the number.

*RST: ASCii

Example: `FORM:SREG HEX`
The register content is returned as a hexadecimal number.

Usage: SCPI conform

7.7 HCOPy Subsystem

The HCOPy subsystem contains the commands to generate a hardcopy of the display.

:HCOPy:DATA?

The commands transfers the hardcopy data directly as a NByte stream to the remote client.

Return values:

<Data> string

Example: `HCOP:DEV:LANG JPG`
`HCOP:DATA?`
transfers the hardcopy to the remote client.

Usage: Query only

:HCOPy:DEVice <Device>

!!ERROR: Document structure missing in rcdescription > Must contain atleast one child

Parameters:

<Device> FILE

*RST: FILE

Example: `HCOP:DEV FILE`
the hardcopy will be stored in a file.

:HCOPy:DEVice:LANGuage <Language>

The command selects the bitmap graphic format for the screenshot. It is also possible to directly retrieve the data using command `HCOP:DATA?`. This command is an alias to command `HCOPy:IMAGe:FORMat`.

Parameters:

<Language> BMP|JPG|XPM|PNG

*RST: BMP

Example: `HCOP:DEV:LANG BMP`
selects bitmap as image format.
`HCOP:FILE '/usb/HCopy'`
defines the directory, path and file name for storing the hardcopy.
`HCOP`
triggers the hardcopy generation.

:HCOPy[:EXECute]

The command triggers the generation of a hardcopy.

Example: `HCOP`

triggers the generation of a hardcopy of the current display.

Usage: Event

:HCOPy:FILE[:NAME] <Name>

This command creates/selects a file into which the hardcopy will be stored. The path is specified together with the file name. Access to the file via remote control is possible using the commands of the MMEM-Subsystem. In contrast, command `HCOPy:DATA?` transfers the hardcopy contents directly to the remote client where they can be further processed.

If automatic file naming is activated, the hardcopy is stored into a file with an automatically generated name (commands `HCOPY:FILE[:NAME]:AUTO:...`).

Parameters:

<Name> string

Example: `HCOP:FILE:NAME '/usb/HCopy'`

defines the hardcopy file name.

:HCOPy:FILE[:NAME]:AUTO?

This command queries the path including the file name of the file with automatically generated name.

Return values:

<Auto> string

Example: `HCOP:DEV:LANG BMP`

selects output format *,bmp.

`HCOP:FILE:AUTO:DIR '/usb/HCopy'`

defines the destination directory '/usb/HCopy'.

`HCOP:FILE:AUTO:PREF 'gen'`

the file name starts with the prefix 'gen'. The usage of automatic naming with prefix and date in the file name is preset `(...:STAT ON)`.

`HCOP`

triggers the generation of a hardcopy of the current trace.

`HCOP:FILE:AUTO?`

queries the path including the file name

`Response:`

/usb`/HCopy/gen101012008001.bmp`'

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

This command defines the directory into which the hardcopy files will be stored if auto naming is activated (`HCOP:FILE:AUTO:STAT ON`).The directory will be created if it does not exist yet.

Parameters:

<Directory> string

*RST: .\HCopy

Example: `HCOP:FILE:AUTO:DIR '/usb/HCopy'`
defines the destination directory '/usb/HCopy'

:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

This command deletes all files with extensions "bmp", "img", "png" and "xpm" in the directory set for automatic naming.

Example: `HCOP:FILE:AUTO:DIR:CLE`
deletes all image files with extensions "bmp", "img", "png" and "xpm".

Usage: Event

:HCOPy:FILE[:NAME]:AUTO:FILE?

This command queries the file name that what generated using the automatic naming settings. By default the automatically generated file name is composed of:

<Prefix><YYYY><MM><DD><Number>.<Format>.

Each component can be deactivated/activated separately to individually design the file name.

Return values:

<File> string

Example: `HCOP:DEV:LANG BMP`
selects output format *.bmp.
`HCOP:FILE:AUTO:DIR '/usb/HCopy'`
defines the destination directory '/usb/HCopy'
`HCOP:FILE:AUTO:PREF 'gen'`
the file name starts with the prefix 'gen'. The usage of automatic naming with prefix and date in the file name is preset (…`:STAT ON`).
`HCOP`
triggers the generation of a hardcopy of the current trace.
`HCOP:FILE:AUTO:FILE?`
queries the file name
`Response: 'gen101012008001.bmp'`

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?

The command returns the day of the current system date which will be used in the file name if automatic naming is activated.

Return values:

<Day>	float
Example:	`HCOP:FILE:AUTO:DAY?` returns the day in the date part of the automatic file name.
Usage:	Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>

This command activates the usage of the day in the automatic file name.

Parameters:

<State>	0|1|OFF|ON *RST: ON
Example:	`HCOP:FILE:AUTO:DAY:STAT OFF` deactivates the use of the day in the automatically generated file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?

This command queries the month in the date part in the automatic file name.

Return values:

<Month>	float
Example:	`HCOP:FILE:AUTO:MONT?` queries the month in the date part in the automatic file name.
Usage:	Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>

This command activates the usage of the month in the automatic file name.

Parameters:

<State>	0|1|OFF|ON *RST: ON
Example:	`HCOP:FILE:AUTO:MONT:STAT OFF` deactivates the usage of the month in the automatic file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

This command queries the number in the automatic file name. The number is assigned in such a way that always the lowest possible value for an unique file name within the selected path is used.

On initially switching on the device the number will be reset to the lowest possible value. Starting with number 0 the output directory will be scanned for already existing files. As long as files with the same name are existing the number will be incremented by 1. The number will be automatically set to a number so that the resulting file name will be unique within the selected path. The current number will not be saved in the save recall file but will be temporarily stored within the database. On subsequent saves the number will be incremented.

Return values:

<Number> float

Example: `HCOP:FILE:AUTO:NUMB?`
queries the number in the automatic file name.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>

This command defines the prefix part in the automatic file name. The usage of the prefix is activated with command `HCOP:FILE:AUTO:PREF:STAT ON`.

Parameters:

<Prefix> string

*RST: HCopy

Example: `HCOP:FILE:AUTO:PREF 'Snapshot'`
appends "Snapshot" as prefix to the generated file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

This command activates the usage of the prefix in the automatic file name. The prefix is entered with command `HCOP:FILE:AUTO:PREF`.

Parameters:

<State> 0|1|OFF|ON

*RST: ON

Example: `HCOP:FILE:AUTO:PREF:STAT OFF`
deactivates the usage of the prefix in the automatic file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?

This command queries the year in the date part in the automatic file name.

Return values:

<Year> float

Example: `HCOPy:FILE:AUTO:YEAR?`
queries the year in the date part in the automatic file name.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

This command activates the usage of the year in the automatic file name.

Parameters:

<State> 0|1|OFF|ON

*RST: ON

Example: `HCOP:FILE:AUTO:YEAR:STAT OFF`
deactivates the usage of the year in the automatic file name.

:HCOPy:FILE[:NAME]:AUTO:STATe <State>

This command activates/deactivates automatic naming of the hardcopy files.

Parameters:

<State> 0|1|OFF|ON

*RST: ON

Example: `HCOP:FILE:AUTO:STAT OFF`
deactivates automatic naming.

:HCOPy:IMAGe:FORMat <Format>

This command selects the bitmap graphic format for the screenshot. It is also possible to directly retrieve the data using command `HCOP:DATA?`.

This command is an alias to command `HCOPy:DEVice:LANGuage`.

Parameters:

<Format> BMP|JPG|XPM|PNG

*RST: BMP

Example: `HCOP:IMAG:FORM XPM`
selects the image format XPM.

:HCOPy:IMAGe:SIZE <Size>

The command selects the image size of the hardcopy. The first value of the size setting defines the width, the second value the height of the image.

Parameters:

<Size> 320,640|640,480|800,600|1024,768

*RST: depends on device

Example: `HCOP:IMAG:SIZE 640,480`
sets width and height of the image.

7.8 KBOard Subsystem

The KBOard system contains the commands to set the external keyboard.

:KBOard:LANGuage <Language>

This command selects the keyboard language. The assignment of some keys depends on the selected language.

Parameters:

<Language> US|DE

*RST: US

Example: `KBO:LANG US`
selects keyboard language American English.

Usage: SCPI conform

:KBOard:LAYout?

This command selects the keyboard language. The assignment of some keys depends on the selected language.

Return values:

<Layout> CHINese|DANish|DUTCh|ENGUK|ENGUS|FINNish|FRENch|FREBe|FRECa|GERMan|ITALian|JAPanese|KORean|NORWegian|PORTuguese|RUSSian|SPANish|SWEDish

*RST: US

Example: `KBO:LAY US`
activates American keyboard layout.

Usage: Query only
SCPI conform

7.9 MMEMory Subsystem

The MMEMory subsystem (**M**ass **Mem**ory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

The default directory is determined using the command `MMEMory:CDIR`.

The `/opt` directory is a protected and therefore unaccessable system director. The files on this directory contain data that must not be changed. Therefore, this directory should not be accessed, since reconstruction of the system partition will lead to data loss.

7.9.1 File Naming Conventions

To enable files in different file systems to be used, the following file naming conventions should be observed.

The file name can be of any length and no distinction is made between uppercase and lowercase letters. The file and the optional file extension are separated by a dot. All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the file name). Where possible, special characters should not be used. Use of the slashes "\" and "/" should be avoided since they are used in file paths. A number of names are reserved by the operating system, e.g. CLOCK$, CON, AUX, COM1...COM4, LPT1...LPT3, NUL and PRN.

In the R&S Microwave Signal Generator all files in which lists and settings are stored are given a characteristic extension. The extension is separated from the actual file name by a dot (see chapter 7.9.2, "Extensions for User Files", on page 250 for an overview the file types).

The two characters "*" and "?" function as "wildcards", i.e. they are used for selecting several files. The "?" character represents exactly one character, while the "*" character represents all characters up to the end of the file name. "*.*" therefore stands for all the files in a directory.

When used in conjunction with the commands, the parameter `<file_name>` is specified as a string parameter with quotation marks. It can contain either the complete path including the drive, only the path and file name, or only the file name. The file name must include the file extension. The same applies for the parameters `<directory_name>` and `<path>`.

Depending on how much information is provided, either the values specified in the parameter or the values specified with the command `MMEM:CDIR` (default directory) are used for the path and drive setting in the commands.

Before the instrument settings can be stored in a file, they have to be stored in an intermediate memory using common command `*SAV <number>`. The specified number is subsequently used in the `MMEM:STOR:STATe<number>, <file>` command. Also, subsequently to loading a file with instrument settings with command `MMEM:LOAD:STAT <number>, <file>`, these settings have to be activated with the common command `*RCL <number>`.

Example:

In this example, the current instrument setting is always stored in the file `test1.savrcl` in the directory `user` on the internal flash card.

`*SAV 4`

`MMEM:STOR:STAT 4,"var/rs_gen/test1.savrcl"`

If the complete path is specified, the file is stored in the specified path.

`MMEM:CDIR  'var/rs_gen'*SAV 4`

`MMEM:STOR:STAT 0,"test1.savrcl"`

If the parameter only contains the file name, the file is stored in the default directory which was selected with the `MMEM:CDIR` command.

7.9.2 Extensions for User Files

The following table list all available file extensions for user files. The currently available files on the instrument depends on the installed options.

7.9.3 Remote Control Commands

:MMEMory:CATalog? <path>

Returns the content of the current or a specified directory.

Return values:

<path> <used_memory>,<free_memory>,<file_name>,<file_entry>,...

<used_memory>
Total amount of storage currently used in the directory, in bytes.

<free_memory>
Total amount of storage available in the directory, in bytes.

<file_entry>
All files of the directory are listed with their file name, format and size in bytes.

Query parameters:

<path> string

String parameter to specify the directory. If the direcory is omitted, the command queries the content of the current directory, queried with `MMEM:CDIR` command.

Example: `MMEM:CAT? '/usb/user'`
reads out all files at the highest directory level of the memory stick.
`Response: 127145265,175325184,"test,DIR, 0","temp,DIR,0","readme.txt,ASC, 1324","state.savracl,STAT, 5327","waveform.wv,BIN,2342"`
the directory `/usb/user` contains the subdirectories `test` and `temp` as well as the files `readme.txt`, `state.savrcl` and `waveform.wv` which have different file types.

Usage: Query only

:MMEMory:CATalog:LENGth?

Returns the number of files in the current or in the specified directory.

Return values:

<Length> <path>

String parameter to specify the directory. If the direcory is omitted, the command queries the content of the current directory, queried with `MMEM:CDIR` command.

<count> Number of files

Example: `MMEM:CAT:LENG? '/usb/user'`
reads out the number of files at the highest directory level of the memory stick.
Response:
`'1'`
there is 1 file at the highest directory level of the memory stick.

Usage: Query only

:MMEMory:CDIRectory <Cdirectory>

Changes the default directory for mass memory storage. The directory is used for all subsequent `MMEM` commands if no path is specified with them. It is also possible to change to a higher directory using two dots '..' .

Setting parameters:

<Cdirectory> <directory_name>

Example: `MMEM:CDIR 'test'`
changes from the current directory level to the subdirectory `test`.

Usage: Setting only
SCPI conform

:MMEMory:COPY <file_source>[,<file_destination>]

Copies an existing to a new file. Instead of just a file, this command can also be used to copy a complete directory together with all its files.

It is also possible to specify the path using another parameter. The command is:
`MMEMory:COPY <file_source><msus_source>[,<file_destination>, <msus_destination>]`

Setting parameters:

<file_source> string

String parameter to specify the name of the file to be copied.
If <destination> is not specified, <source> is copied to the `MMEM:CDIR` directory. Files which already exist with the same name in the destination directory are overwritten without an error message.
It is also possible to specify the path using another parameter. The command is: `MMEMory:COPY <file_source><msus_source>[,<file_destination>, <msus_destination>]`

file_destination string

String parameter to specify the name of the new file. If no file destination is specified, the source file is copied to the current direcotry, queried with the `MMEM:CDIR` command. Files which already exist with the same name in the destination directory are overwritten without an error message.

Example: `MMEM:COPY '/var//USER/TEST1.SVARCL','/usb'`
copies the file '`test1.savrcl`' in the `user` directory on the internal flash card to the memory stick without changing the file name.

Usage: Event
SCPI conform

:MMEMory:DATA <file_name>[,<binary block data>]
:MMEMory:DATA? <file_name>

Writes the block data <binary block data> to the file identified by <file_name>. The IEC/IEEE-bus terminator should be set to EOI in order to ensure correct data transfer.

The associated query command transfers the specified file from the instrument to the IEC/IEEE bus and then on to the control computer. It is important to ensure that the intermediate memory on the control computer is large enough to take the file. In this case, the setting for the IEC/IEEE-bus terminator is irrelevant. This command can be used to read/transfer stored instrument settings or waveforms directly from/to the instrument.

Parameters:

<file_name> String parameter to specify the name of the file.

Setting parameters:

<binary block data> #<number><length entry><block data>

always comes first in the binary block
<number> the first digit indicates how many digits the subsequent length entry has
<length entry> indicates the number of subsequent bytes
<binary block data> binary block data for the specified length.

Example: `MMEM:DATA 'TEST1.WV',#3767<binary data>`
writes the block data to the file `test1.wv`.
The digit "3" indicates a length entry of 3 digits; the digits "767" indicate a length of the binary data in bytes.
`MMEM:DATA? 'TEST1.WV'`
sends the data of the file `Test1.wv` from the instrumenet to the controller in the form of a binary block.

:MMEMory:DCATalog?

Returns the subdirectories of the current or specified directory.

Return values:

<Dcatalog> <file_entry>

Names of the subdirectories separated by colons. The first two strings are related to the parent directory.

Query parameters:

<path_name> String parameter to specify the directory. If the direcory is omitted, the command queries the content of the current directory, queried with `MMEM:CDIR` command.

Example: `MMEM:DCAT?`
`Response: 'test', 'wave', 'digital'`
the subdirectories `test`, `wave` and `digital` exist in the current directory.

Usage: Query only

:MMEMory:DCATalog:LENGth? [<path_name>]

Returns the number of subdirectories in the current or specified directory.

Return values:

<file_entry_count> Number of parent and subdirectories.

Query parameters:

<path_name> String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory, to be queried with `MMEM:CDIR` command.

Example: `MMEM:DCAT:LENG?`
reads out the number of subdirectories in the current directory.
Response: 3
there are 3 subdirectories in the current directory.

:MMEMory:DELete <Delete>

Removes a file from the specified directory.

Setting parameters:

<Delete> <file_name>

String parameter to specify the name and directry of the file to be removed.

Example: `MMEM:DEL '/var//user/test1.savrcl'`
deletes the file `test1.savrcl` in the `user` directory.

Usage: Event
SCPI conform

:MMEMory:LOAD:STATe <sav_rcl_state_number>, <file_name>

This command loads the specified file stored under the specified name in an internal memory.

After the file has been loaded, the instrument setting must be activated using an `*RCL` command.

Setting parameters:

<sav_rcl_state_number> <numeric_value>

Determines to the specific <number> to be used with the `*RCL` command, e.g. `*RCL 4`.

<file_name> <string>

String parameter to specify the file name with extension `*.savrcl`.

Example: `*SAV 4`
stores the current instrument setting in an intermediate memory with number 4. This setting can be called using command `*RCL` and the associated number of the memory, e.g. `*RCL 4`.
`MMEM:STOR:STAT 4,'/var//user/test4.savrcl'`
stores the instrument setting stored with the `*SAV` command under memory number 4 in the file `test4.savrcl` in the `user` directory.
`MMEM:LOAD:STAT 4,'/var//user/test4.savrcl'`
loads the file `test4.savrcl` in the `user` directory.
`*RCL 4`
activates the instrument setting of the file `test4.savrcl`.

Usage: Setting only

:MMEMory:MDIRectory <directory_name>

Creates a new subdirectory for mass memory storage in the specified directory. If no directory is specified, a subdirectory is created in the default directory. This command can also be used to create a directory tree.

Setting parameters:

<directory_name> string

String parameter to specify the new directory.

Example: `MMEM:MDIR 'carrier'`
creates the subdirectory 'carrier' in the current directory.

Usage: Setting only

:MMEMory:MOVE <file_source>, <file_destination>

Moves an existing file to a new location or, if no path is specified, renames an existing file.

It is also possible to specify the path using another parameter. The command is:

`MMEMory:MOVE`

`file_source,msus_source[, file_destination, msus_destination]`

Setting parameters:

<file_source> String parameter to specify the name of the file to be moved.

<file_destination> String parameters to specify the name of the new file.

Example: `MMEM:MOVE 'test1.savrcl','keep1.savrcl'`
renames the file `test1.savrcls` as `keep1.savrcl`.
`MMEM:MOVE 'test1.savrcl',`
`'\instrument_one\keep1.savrcl'`
moves the file `test1.savrcl` to the subdirectory `instrument_one` and stores it there under the name `keep1.savrcl`.

Usage: Setting only
SCPI conform

:MMEMory:MSIS <Msis>

The command is without effect for the Linux operating system.

Usage: SCPI conform

:MMEMory:RDIRectory <Rdirectory>

Removes an existing directory from the mass memory storage system. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

Setting parameters:

<Rdirectory> string

String parameter to specify the directory to be deleted.

Example: `MMEM:RDIR 'carrier'`
deletes the subdirectory 'carrier' in the current directory.

Usage: Setting only

:MMEMory:STORe:STATe <sav_rcl_state_number>, <file_name>

Stores the current instrument setting in the specified file.

The instrument setting must first be stored in an internal memory with the same number using the common command `*SAV`.

Setting parameters:

<sav_rcl_state_number> <integer>

Corresponds to the specific <number> defined with the `*SAV` command, e.g. `*SAV 4`.

<file_name> <string>

String parameter to specify the file name with extension `*.savrcl`.

Example: `*SAV 4`
stores the current instrument setting in an intermediate memory with number 4. This setting can be called using command `*RCL` and the associated number of the memory, e.g. `*RCL 4`.
`MMEM:STOR:STAT 4,'/var//user/test4.savrcl'`
stores the instrument setting stored with the `*SAV` command under memory number 4 in the file `test4.savrcl` in the `user` directory.

Usage: Event

7.10 OUTPut Subsystem

The `OUTPut` system contains the commands which set the properties of the RF OUT-PUT connector.

The properties of the LF output connector are set in the chapter 7.12.8, "SOURce:LFOutput Subsystem", on page 342 system.

:OUTPut:ALL[:STATe] <State>

The command switches on or off all RF output signals of the instrument.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `OUTP:ALL OFF`
switches off all RF output signals.

:OUTPut<hw>:AFIXed:RANGe:LOWer?

The command queries the minimum level which can be set without the attenuator being adjusted (Attenuator FIXed).

Return values:

<Lower> float

Default unit: dBm

Example: `OUTP:AFIX:RANG:LOW`
queries the minimum level for the FIXed setting.

Example: `Response: -50`
The minimum level is -50 dBm.

Usage: Query only

:OUTPut<hw>:AFIXed:RANGe:UPPer?

The command queries the maximum level which can be set without the attenuator being adjusted (Attenuator FIXed).

Return values:

<Upper> float

Default unit: dBm

Example: `OUTP:AFIX:RANG:UPP`
queries the maximum level for the FIXed setting for the RF output.

Example: `Response: -27`
The maximum level is -27 dBm.

Usage: Query only

:OUTPut<hw>:ALC:SEARch:MODE <Mode>

The command activates/deactivates the RF output during the power search.

Parameters:

<Mode> NORMal|MINimum

*RST: OFF

Example: `POW:ALC:SEAR:MODE NORM`
during the power search, the RF output is active.

:OUTPut<hw>:AMODe <Amode>

The command switches the mode of the attenuator at the RF output (Attenuator MODe).

Parameters:

<Amode> AUTO|FIXed

AUTO
The mechanical switching attenuator switches in steps of 10 dB at fixed points.

FIXed
The level settings are made without switching the attenuator or the relays. When this operating mode is switched on, the attenuator and the relays are fixed in their current positions and the resulting variation range is defined.

*RST: AUTO

Example: `POW:ALC ON`
activates automatic level control for RF output.
`OUTP:AMOD FIX`
sets the fixed mode with uninterrupted level for RF output.

:OUTPut:BLANk:MODE <Mode>

The command selects the RF blanking method for sweeps with step widths less than 10 MHz.

Parameters:

<Mode> OFF|AUTO|ON

*RST: AUTO

Example: `OUTP:BLAN:MODE AUTO`

blanking is performed only when the step synthesizer switches to the next step.

:OUTPut:BLANk:POLarity <Polarity>

The command sets the polarity of the No Signal (Blank) Marker.

Parameters:

<Polarity> NORMal|INVerted

*RST: NORMal

Example: `OUTP:BLAN:POL NORM`

:OUTPut:BLANk:WIDTh <Width>

The command selects the width of the blank marker.

Parameters:

<Width> RFBLanking|TRIGrf

RFBLanking
The blank marker starts after the external sweep trigger signal.

TRIGrf
The blank marker starts already with the external sweep trigger signal.

*RST: RFBL

Example: `OUTP:BLAN:MODE RFBL`

the blank marker starts after the trigger signal.

:OUTPut:FPRoportional:SCALe <Scale>

The command selects the V/GHz ratio for the output.

Parameters:

<Scale> S0V5|S1V0

*RST: S1V0

Example: `OUTP:FPR:SCAL S0V5`

sets the V/GHz ratio for the output to 0.5.

:OUTPut<hw>[:STATe] <State>

This command activates and deactivates the RF output.

Parameters:

<State> 0|1|OFF|ON

Example: `OUTP OFF`
deactivates the RF output.

Usage: SCPI conform

:OUTPut<hw>[:STATe]:PON <Pon>

This command selects the state which the RF output assumes when the instrument is switched on.

Parameters:

<Pon> OFF|UNCHanged

OFF
The output is deactivated when the instrument is switched on.

UNCHanged
When the instrument is switched on, the output remains in the same state as it was when the instrument was switched off.

Example: `OUTP:PON OFF`
RF output A is deactivated when the instrument is switched on.

7.11 Power Sensor Measurement Subsystems

The power sensor measurement uses several subsystems:

- The `CALCulate` subsystem is used to configure the time gated measurements in power analysis.
- The `DISPlay` subsystem is used to configure the diagram appearance.
- The `INITiate` command switches the local state of the continuous power measurement on and off.
- The `READ` system is used to start and to retrieve the measurement result of the power viewer measurement.
- The `SENSe` subsystem contains the commands for configuring the power viewer and power analysis measurements with power sensors connected to the generator.
  Up to three sensors can be connected to the signal generator.
- The `TRACe` subsystem is used to configure the traces in power analysis and to retrieve the measurement results.

Power Viewer

The power viewer measurement is started with the `READ` command, this command also retrieves the measurement results.

The sensors are distinguished by means of the suffix under `SENSe`:

- Power sensor connected to the SENSOR port = `SENSe[1]`
- First Power sensor connected to the USB interface = `SENSe2`
- Second Power sensor connected to the USB interface = `SENSe3`

Third Power sensor connected to the USB interface = `SENSe4`

Power and Pulse Data Analysis, Gated Measurements (option R&S SMF-K28)

Pulse data analysis in time measurement mode is available with power sensors R&S NRP-Z81.

The power analysis measurement commands are subsumed under the `SENSe[:POWer]:SWEep:…` commands. Three measurement modes are available: Frequency, Power and Time.

The power analysis measurement is started with the `SENSe[:POWer]:SWEep:INITiate` command and the measurement result retrieved with the `TRACe[:POWer]:SWEep:…` commands.

The four sensors are distinguished by means of the suffix at the second key word `SENSe`.

The time gate settings are performed using the `CALCulate[:POWer]:SWEep:…` commands.

The measurement diagram and results can be stored in a hardcopy with the `SENSe[:POWer]:SWEep:HCOPy:…` commands.

General parameter and measurement settings are valid for all connected sensors, therefore, no suffix is used in these commands.

7.11.1 CALCulate Subsystem

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>AVERage?

This command queries the average power value of the time gated measurement.

Return values:

<Average>	float

Example:	`SENS:SWE:MODE TIME`
	activates time mode for power analysis.
	`CALC:SWE:TIME:GATE:STAT ON`
	activates time gated measurement.
	`SENS:SWE:INIT`
	activates a single power analysis measurement.
	`CALC:SWE:TIME:GATE2:AVER?`
	queries the average power in time gate 2 for trace 1 (=default).

Usage:	Query only
Options:	Option R&S SMF-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED <Feed>

This command selects the trace for time gated measurement. Both gates are assigned to the same trace.

Parameters:

<Feed>	TRACe1|TRACe2|TRACe3 *RST: TRACe1
Example:	`CALC:SWE:TIME:GATE:FEED TRAC2` assignes the gates to trace 2.
Options:	Option R&S SMF-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>MAXimum?

This command queries the average power value of the time gated measurement.

Return values:

<Maximum>	float

Example:	`SENS:SWE:MODE TIME`
	activates time mode for power analysis.
	`CALC:SWE:TIME:GATE:STAT ON`
	activates time gated measurement.
	`SENS:SWE:INIT`
	activates a single power analysis measurement.
	`CALC:SWE:TIME:GATE2:MAX?`
	queries the peak power in time gate 2 for trace 1 (=default).

Usage:	Query only
Options:	Option R&S SMF-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>STARt <Start/Stop>

This command sets the start time of the selected gate. Insert value and unit.

Parameters:

<Start/Stop> float

*RST: Start/Stop: 5/15 (Gate1), 25/35 (Gate2)
Default unit: µs

Example: `CALC:SWE:TIME:GATE2:STAR 20us`
sets a start time of 20 us for gate 2.

Example: `CALC:SWE:TIME:GATE2:STOP 30us`
sets a stop time of 30us for gate 2.

Options: Option R&S SMF-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe <State>

This command activates gate settings for the selected trace. The measurement ist started with command `SENS:POW:INIT`. Both gates are active at one time.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `CALC:SWE:TIME:GATE:STAT ON`
'enables time gated measurement.

Options: Option R&S SMF-K28

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe <State>

This command activates / deactivates the trace mathematics mode for "Frequency" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State> 0|1|OFF|ON

Example: `CALC:POW:SWE:FREQ:MATH2:STATe`

Example: switches on math mode in trace 2.

Options: R&S SMF-K28

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract <Subtract>

This command executes the subtraction of the operands 1 and 2 and assigns the result to the selected trace in "Frequency" measurement mode.

Parameters:

<Subtract>	T1T1|T1T2|T1T3|T1T4|T1REF|T2T1|T2T2|T2T3|T2T4|T2REF|T3T1|T3T2|T3T3|T3T4|T3REF|T4T1|T4T2|T4T3|T4T4|T4REF

Example: `CALC:POW:SWE:FREQ:MATH4:SUBT T2REF`

Example: Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.

Options: R&S SMF-K28

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe <State>

This command activates / deactivates the trace mathematics mode for "Power" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State>	0|1|OFF|ON

Example: `CALC:POW:SWE:POW:MATH2:STATe`

Example: switches on math mode in trace 2.

Options: R&S SMF-K28

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract <Subtract>

This command executes the subtraction of the operands 1 and 2 and assigns the result to the selected trace in "Power" measurement mode.

Parameters:

<Subtract>	T1T1|T1T2|T1T3|T1T4|T1REF|T2T1|T2T2|T2T3|T2T4|T2REF|T3T1|T3T2|T3T3|T3T4|T3REF|T4T1|T4T2|T4T3|T4T4|T4REF

Example: `CALC:POW:SWE:POW:MATH4:SUBT T2REF`

Example: Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.

Options: R&S SMF-K28

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe <State>

This command activates / deactivates the trace mathematics mode for "Time" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State>	0|1|OFF|ON

Example: `CALC:POW:SWE:TIME:MATH1:STATe`

Example: switches on math mode.

Options: R&S SMF-K28

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract <Subtract>

This command executes the subtraction of the operands 1 and 2 and assigns the result to the selected trace in "Time" measurement mode.

Parameters:

<Subtract> T1T1|T1T2|T1T3|T1T4|T1REF|T2T1|T2T2|T2T3|T2T4|T2REF|T3T1|T3T2|T3T3|T3T4|T3REF|T4T1|T4T2|T4T3|T4T4|T4REF

Example: `CALC:POW:SWE:TIME:MATH4:SUBT T2REF`

Example: Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.

Options: R&S SMF-K28

7.11.2 DISPlay Subsystem

:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor <Color>

This command defines the background color of the measurement diagram. The background color is also effective for the hardcopy of the diagram.

Parameters:

<Color> BLACk|WHITe

*RST: BLACk

Example: `DISP:SWE:BACK:COL WHIT`
the measurement is indicated with a white background.

:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe <State>

This command activates/deactivates the indication of a grid in the diagram area..

Parameters:

<State> 0|1|OFF|ON

*RST: ON

Example: `DISP:SWE:GRID:STAT OFF`
deactivates the indication of a grid in the diagram area.

Usage: SCPI conform

7.11.3 INITiate Command

INITiate<ch>[:POWer]:CONTinuous <Continuous>

The command switches the local state of the continuous power measurement by the R&S NRP-Zxx power sensors on and off. Switching the local state off enhances the measurement performance during remote control

The remote measurement is triggered by the READ query (command `READ<ch>[:POWer]`) which also provides the measurement results. The local state is not influenced by this command, measurements results can be retrieved with local state on or off.

Parameters:

<Continuous> 0|1|OFF|ON

*RST: OFF

Example: `INIT:CONT ON`

switches local state of continuous power measurement on.

7.11.4 READ Subsystem

READ<ch>[:POWer]?

The command triggers the measurement with power sensors and provides the power measurement result of the selected power sensor. The value is provided with the unit set with command `SENSe:UNIT[:POWer]`.

For certain power sensors, e.g. R&S NRP-Z81, two values are returned, first the value for the average level and - separated by a comma - the peak level

Note: The local state is not influenced by this command, measurements results can be retrieved with local state on or off. For long measurement times it is recommended to use a SRQ (MAV bit) for command synchronization.

Return values:

<Power> string

Example: `SENS:UNIT DBM`

selects unit dBm for presentation of measurement result.

`READ1?`

queries the measurement result of the sensor connected to the SENSOR interface.

`Response: -45.6246576745440230`

-45.6 dBm were measured at the given frequency.

or e.g. for R&S NRP-Z81

`Response:`

`-55.62403263352178,-22.419472478812476`

-55,6 dbm is the measured average level, -22. 4 dBm is the measured peak level at the given frequency

Usage: Query only

7.11.5 SENSe Subsystem

SENSe<ch>[:POWer]:CORRection:SPDevice:STATe <State>

The command activates the use of the s-parameters correction data of the selected power sensor.

Note: For power sensor with attenuator this command is automatically set to ON.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SENS:POW:CORR:SPD:STAT ON`
activates the use of the s-parameters correction data of power sensor 1.

SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority <Priority>

The command selects which power measurement result (average or peak power) is indicated when permanent display is active.

Parameters:

<Priority> AVERage|PEAK

*RST: AVERage

Example: `SENS1:DISP:PERM:STAT ON`
the permanent viewer is switched on.
`SENS1:DISP:PERM:PRI AVER`
the measured average power is indicated.

SENSe<ch>[:POWer]:DISPlay:PERManent:STATe <State>

The command switches on and off the permanent indication of the power measurement result in the upper right corner of the block diagram. For each sensor, the type of sensor, the connector, the measurement source and - if set - the offset is indicated.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SENS1:POW:DISP:PERM:STAT ON`
the permanent viewer is switched on.

SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?

The command queries the current filter length for auto filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE AUTO`)

Return values:

<Auto>	float

Example:	`SENS1:FILT:TYPE AUTO`
	selects auto filter mode for the power sensor connected to the SENSOR connector.
	`SENS1:FILT:LENG:AUTO?`
	queries the automatically set filter length.
	`Response: 1024`

Usage:	Query only

SENSe<ch>[:POWer]:FILTer:LENGth[:USER] <User>

The command selects the filter length for user filter mode (`SENSe:POWer:FILTer:TYPE USER`). As the filter length works as a multiplier for the time window, a constant filter length results in a constant measurement time. Values 1 and 2^n are setable.

The time window is fixed to 20 ms.

Parameters:

<User>	float Range: 1 to 65536 *RST: 1

Example:	`SENS:FILT:TYPE USER`
	selects user filter mode.
	`SENS:FILT:LENG 16`
	sets a filter length of 16. The resulting measurement time is 640 ms (2x16x20 ms).

SENSe<ch>[:POWer]:FILTer:NSRatio <Nsratio>

The command defines the noise content for fixed noise filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE NSRation`). This value determines the proportion of intrinsic noise in the measured result.

Parameters:

<Nsratio>	float Range: 0.0001 to 1.0 *RST: 0.001

Example: `SENS1:FILT:TYPE NSR`
selects fixed noise filter mode for the power sensor connected to the SENSOR connector.
`SENS1:FILT:NSR 0.2`
sets a noise content of 0.2.

SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe <Mtime>

The command defines the timeout for fixed noise filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE NSRation`). This value ensures limited settling times.

Parameters:

<Mtime> float

Range: 1.0 to 999.99
*RST: 4
Default unit: s

Example: `SENS1:FILT:TYPE NSR`
selects fixed noise filter mode for the power sensor connected to the SENSOR connector.
`SENS1:FILT:NSR .2`
sets a noise content of 0.2.
`SENS1:FILT:NSR:MTIM 5`
limits the settling time to 5 seconds

SENSe<ch>[:POWer]:FILTer:SONCe

The command activates the search for the optimum filter length for the current measurement conditions. The found filter length can be retrieved with command `:SENSe:POWer:FILTer:LENGth:USER?`. This command is only available for user filter mode (`:SENSe:POWer:FILTer:TYPE USER`).

Example: `SENS:FILT:TYPE USER`
selects user filter mode.
`SENS:FILT:SONC`
activates the search for the optimum filter length.
`SENS:FILT:LENG?`
returns the found optimum filter length.
`Response: 128`

Usage: Event

SENSe<ch>[:POWer]:FILTer:TYPE <Type>

The command selects the filter mode. The filter length is the multiplier for the time window and thus directly influences the measurement time.

Parameters:

<Type> AUTO|USER|NSRatio

AUTO
The filter length is automatically selected depending on the measured value. For high values, a short filter length is selected and for low values a long filter length is selected.

USER
The filter length is set manually. As the filter length works as a multiplier for the measurement time, this results in a constant measurement time.

NSRatio
The filter lenghth (averaging factor) is selected so that the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content. The desired noise content is entered with command `SENSe:FILTer:NSRatio`.
To avoid very long settling times when the power is low, the averaging factor can be limited with the Timeout parameter (command `SENSe:FILTer:NSRatio:MTIMe`).

*RST: AUTO

Example: `SENS:FILT:TYPE AUTO`
selects automatic filter selection.

SENSe<ch>[:POWer]:FREQuency <Frequency>

The command sets the RF frequency of the source if the user source is selected (`SENSe[:POWer]:SOURce USER`).

Parameters:

<Frequency> float

*RST: 1 GHz

Example: `SENS:SOUR USER`
selects user-defined source.
`SENS:FREQ 2.44 GHz`
enters the RF frequency of the source which is 2.44 GHz.

SENSe<ch>[:POWer]:OFFSet <Offset>

The command enters a level offset which is added to the measured level value after activation with command `SENSe[:POWer]:OFFSet:STATe ON`. This allows e.g. an attenuator in the signal path to be taken into account.

Parameters:

<Offset>	float Range: -100.0 to 100.0 *RST: 0 Default unit: dB
Example:	`SENS:POW:OFFS 10.0` sets a level offset of 10 dB

SENSe<ch>[:POWer]:OFFSet:STATe <State>

The command activates the addition of the level offset to the measured value. The level offset value is set with command `SENSe[:POWer]:OFFSet`.

Parameters:

<State>	0|1|OFF|ON *RST: OFF

Example:	`SENS1:POW:OFFS 0.4dB`
	sets a level offset of 0.4 dB
	`SENS1:POW:OFFS:STAT ON`
	a level offset of 0.4 dB is added to the measured value.

SENSe<ch>[:POWer]:SNUMber?

The command queries the serial number of the sensor.

Return values:

<Snumber>	string
Example:	`SENS:SNUM?` queries the serial number.
Usage:	Query only

SENSe<ch>[:POWer]:SOURce <Source>

The command selects the signal source for the measurement.

Parameters:

<Source>	A|B|USER *RST: A
Example:	`SENS:SOUR A` selects the RF signal as measurement source. The RF frequency is used as the measurement frequency of the sensor and the corresponding correction factor is used. The level setting of the instrument serves as reference level of the measurement.

SENSe<ch>[:POWer]:STATus[:DEVice]?

The command queries if a sensor is connected to the signal generator.

The sensor is selected by suffix in the keyword SENSe or READ of the command header. Suffix 1 denotes the sensor connected to the SENSOR connector, suffix 2 the sensor connected first to one of the USB interfaces and suffix 3 the sensor connected second to one of the USB interfaces.

Return values:

<DEVice> 0|1|OFF|ON

Example: `SENS:STAT?`
queries if a sensor is connected to the instrument.
`Response: 1`
a sensor is connected to the POWER SENSOR interface.

Usage: Query only

SENSe<ch>[:POWer]:SVERsion?

The command queries the software version of the connected R&S NRP power sensor.

Return values:

<Sversion> string

Example: `SENS:POW:SVER?`
queries the software version of the R&S NRP power sensor.

Usage: Query only

SENSe[:POWer]:SWEep:ABORt <Abort>

This command aborts the power analysis with NRP power sensors.

Setting parameters:

<Abort>

Example: `SENS:SWE:ABOR;*OPC?`
aborts the current power measurement.

Usage: Setting only

Options: Option R&S SMF-K28

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY

This command generates a reference curve for "Frequency" measurement.

Example: `SENS:POW:SWE:FREQ:REF:DATA:COPY`

Example: generates a reference curve in frequency mode.

Usage: Event

Options: R&S SMF-K28

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues <Xvalues>

This command sets or queries the x values of the two reference points, i.e. "Frequency X (Point A)" and "Frequency X (Point B)" in "Frequency" measurement.

Parameters:

<Xvalues> string

Example: `SENSe:POW:SWE:FREQ:REF:DATA:XVAL 100MHZ,22GHZ`

Example: sets the x value of reference "Point A" to 10 MHz, and the value of "Point B" to 10 GHz.

Options: R&S SMF-K28

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues <Yvalues>

This command sets or queries the y values of the two reference points, i.e. "Pow Y (Point A)" and "Power Y (Point B)" in "Frequency" measurement.

Parameters:

<Yvalues> string

Example: `SENSe:POW:SWE:FREQ:REF:DATA:YVAL -10,25`

Example: sets the y value of reference "Point A" to -10 dBm, and the value of "Point B" to -25 dBm.

Options: R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:RMODe <Rmode>

This command selects single or continuous mode for measurement mode frequency in power analysis.

Parameters:

<Rmode> SINGle|CONTinuous

*RST: SINGle

Example: `SENS:SWE:FREQ:RMOD SING`
selects single measurement

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe] <State>

This command activates the use of a frequency range for the power measurement that is different to the set signal generator frequency range. The separate frequency range is entered with commands `SENS:SWE:FREQ:SENS:STAR` and `SENS:SWE:FREQ:SENS:STop`.

Parameters:

<State> 0|1|OFF|ON

*RST: 1 MHz

Example: `SENS2:SWE:FREQ:SENS:SRAN ON`

activates use of a separate frequency range for frequency versus power measurement for sensor 2.

`SENS2:SWE:FREQ:SENS:STAR 2.0GHZ`

sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.

`SENS2:SWE:FREQ:SENS:STOP 2.9GHZ`

sets a sweep stop at 2.9 GHz irrespective of the current signal generator frequency settings.

Options: Option R&S SMF-K28

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt <Start>

This command enters the start frequency for the frequency power analysis with separate frequencies.

Parameters:

<Start> float

*RST: 1 MHz

Example: `SENS2:SWE:FREQ:SENS:SRAN:STAT ON`

activates use of a separate frequency range for frequency versus power measurement for sensor 2.

`SENS2:SWE:FREQ:SENS:STAR 2.0GHZ`

sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.

Options: R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP <Stop>

This command enters the stop frequency for the frequency power analysis with separate frequencies.

Parameters:

<Stop> float

*RST: 22 GHz

Example: `SENS:SWE:FREQ:SENS2:SRAN:STAT ON`
activates use of a separate frequency range for frequency versus power measurement.
`SENS:SWE:FREQ:SENS2:STAR 2.0GHZ`
sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.
`SENS:SWE:FREQ:SENS2:STOP 2.9GHZ`
sets a sweep stop at 2.9 GHz irrespective of the current signal generator frequency settings.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE] <Mode>

This command selects the spacing for the frequency power analysis.

Parameters:

<Mode> LINear|LOGarithmic

*RST: LINear

Example: `SENS:SWE:FREQ:SPAC:MODE LIN`
sets linear spacing of the sweep

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:STARt <Start>

This command enters the start frequency for the frequency mode.

Parameters:

<Start> float

*RST: 1.0 MHZ

Example: `SENS:SWE:FREQ:STAR 2.0GHZ`
'sets a sweep start at 2 GHz.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:STEPs <Steps>

This command enters the number of measurement steps for the frequency mode.

Parameters:

<Steps> float

Range: 10 to 1000
*RST: 500

Example: `SENS:SWE:FREQ:STEP 500`
sets 500 steps

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:STOP <Stop>

This command enters the stop frequency for the frequency mode.

Parameters:

<Stop> float

*RST: 22.0 GHz

Example: `SENS:SWE:FREQ:STOP 20.0GHZ`
sets the sweep stop to 20 GHz

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE] <Mode>

This command selects the timing for frequency mode.

Parameters:

<Mode> FAST|NORMal|HPRecision

FAST
Selection FAST leads to a fast measurement with a short integration times for each measurement step.

NORMal
NORMal leads to a longer but more precise measurement due to a higher integration time for each step.

*RST: NORMal

Example: `SENS:SWE:FREQ:TIM:MODE FAST`
the fast measurement mode is selected.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO <Auto>

This command activates/deactivates autoscaling of the Y axis of the diagram.

Parameters:

<Auto> OFF|CEXPanding|FEXPanding|CFLoating|FFLoating

OFF
Auto scaling is deactivated. If switching from activated to deactivated Auto scaling, the scaling is maintained.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: OFF

Example: `SENS:SWE:FREQ:YSC:AUTO OFF`
deactivates auto scale

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet

This command resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function resets the diagram in such a way that it matches smaller power values again.

Example: `SENS:SWE:FREQ:YSC:AUTO:RES`
resets auto scale

Usage: Event

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum <Maximum>

This command enters the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

*RST: 40.0 dBm

Example: `SENS:SWE:FREQ:YSC:MAX 10DBM`
sets 10 dBm as the upper limit of the measurement diagram.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum <Minimum>

This command enters the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

*RST: -40.0 dBm

Example: `SENS:SWE:FREQ:YSC:MIN -10DBM`
sets -10 dBm as the lower limit of the measurement diagram.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DATA?

This command queries the measurement data directly. The data is transferred to the remote client as data stream, e.g. for further processing (see chapter 6.3.3, "SCPI Parameters", on page 211, description of block data).

Readable ASCII data is available for hardcopy language CSV. The representation of the values depends on the selected orientation for the CSV format.

Return values:

<Data> string

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
selects output format *.csv.
`SENS:SWE:HCOP:DEV:LANG:CSV:ORI HOR`
selects horizontal orientation
`SENS:SWE:HCOP:DEV:LANG:CSV:SEP SEM`
selects ";" as the separator between the values
`SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT`
selects "." as decimal point
`SENS:SWE:HCOP:DATA?`
queries the measurement data of the current traces
`Response:`
#2651009500000;1019000000;1028500000;1038000000
-9.5;-9.7;-6.3;-2.5
The hash symbol # 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 2 following digit indicates the length to be 65 characters.
Because horizontal representation is selected, a row with all the x-values of the active trace (frequency) follows. The second row contains all the y-values of the active trace (power). The rows end with a new line (each counts as one character).
Note: if more than one trace is active, the third row contains the x values of the second active trace, and so on.

Example: `SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT`
selects horizontal orientation
`SENS:SWE:HCOP:DATA?`
queries the measurement data of the current traces
`Response:`
#2681009500000;-9.5; 1019000000;-9.7; 1028500000;-6.3; 1038000000;-2.5;
for vertical representation the length of the data block is 68
the first power value, the second row contains the second frequency value of the active trace followed by the second power value, and so on. The rows end with a new line (each counts as one character).
Note: if more than one trace is active, the first row also contains the value pairs of the second active trace, and so on.

Usage: Query only

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DEVice <Device>

This command defines the output device. The setting is fixed to FILE, i.e. the hardcopy is stored in a file.

Parameters:

<Device> FILE|PRINter

*RST: FILE

Example: `SENS:SWE:HCOP:DEV FIL`
selects output device file

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage <Language>

This command selects the bitmap graphic format for the screenshot of the power analysis trace.

In addition, ASCII file format `*.csv` is offered. If file format `*.csv` is selected, the trace data is saved as an ASCII file with comma separated values. It is also possible to directly retrieve the data using command`SENS:SWE:HCOP:DATA?`.

Parameters:

<Language> BMP|JPG|XPM|PNG|CSV

*RST: BMP

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
selects output format `*.bmp`.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint <Dpoint>

This command defines which character should be used as the decimal point of the values, either dot or comma.

Parameters:

<Dpoint> DOT|COMMA

*RST: DOT

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT`
selects character dot for being used as decimal point.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer <Header>

This command defines whether each row (or column depending on the orientation) should be preceded by a header containing information about the trace (see also `SENSe[:POWer]:SWEep:HCOPy:DATA` on page 280).

Parameters:

<Header> OFF|STANdard

*RST: OFF

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:HEAD STAN`
selects the standard header for the `*.csv` file.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation <Orientation>

This command defines the orientation of the X/Y value pairs. For examples on how the data are arranged see "CSV Options Hardcopy- Power Analysis" on page 132.

Parameters:

<Orientation> HORizontal|VERTical

*RST: HORizontal

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT`
selects vertical orientation, the value pairs are written in a column like structure (separated by the selected separator, e.g. tab)

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator <Separator>

This command defines which character is to separate the values, either tabulator, semicolon, comma or blank.

Parameters:

<Separator> TABulator|SEMicolon|COMMa|BLANk

*RST: SEMicolon

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:SEP TAB`
a tab separates the values

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:DEVice:SIZE <Size>

This command sets the size of the hardcopy in number of pixels. The first value of the size setting defines the width, the second value the height of the image.

Parameters:

<Size> 320,240 | 640,480 | 800,600| 1024,768

*RST: 320,240

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
selects output format `*.bmp`.
`SENS:SWE:HCOP:DEV:SIZE 320,240`
the size of the bitmap is 320 pixels by 240 pixels.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy[:EXECute]

This command triggers the generation of a hardcopy of the current measurement diagram. The data is written into the file selected/created with the `SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]` command.

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
selects output format `*.bmp`.
`SENS:SWE:HCOP:FILE:AUTO:STAT OFF`
switches off automatic file naming.
`SENS:SWE:HCOP:FILE 'var/nrp_trace1'`
creates the file `nrp_trace1.bmp` in the set path.
`SENS:SWE:HCOP`
triggers the generation of a hardcopy of the current measurement diagram. The hardcopy is stored in the file `nrp_trace1.bmp`.

Usage: Event

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME] <Name>

This command creates/selects a file into which the hardcopy will be stored after the `SENS:SWE:HCOP:EXEC` command is sent. The directory is either defined with the command `MMEMory:CDIR` or the path is specified together with the file name. Access to the file via remote control is possible using the commands of the MMEM-Subsystem. In contrast, command `SENSe:SWEep:HCOPy:DATA?` transfers the hardcopy contents directly to the remote client where they can be further processed.

Parameters:
<Name> string

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
selects output format `*,bmp`.
`SENS:SWE:HCOP:FILE:AUTO:STAT OFF`
switches off automatic naming.
`SENS:SWE:HCOP:FILE 'var/trace/nrp_trace1'`
creates the file `nrp_trace1.bmp` in the trace directory.
`SENS:SWE:HCOP:EXEC`
triggers the generation of a hardcopy of the current trace. The hardcopy is stored in the file `nrp_trace1.bmp`.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

This command defines the directory into which the hardcopy files will be stored if auto naming is activated (`SENS:SWE:HCOP:FILE:AUTO:STAT ON`).

Parameters:

<Directory> string

Example: `SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
hardcopy file are stored in directory `var/nrp` if automatic naming is activated.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

This command deletes all files with extensions `bmp` , `img`, `png`, `xpm` and `csv` in the directory set for automatic naming.

Example: `SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
hardcopy file are stored in directory `var/nrp` if automatic naming is activated.
`SENS:SWE:HCOP:FILEAUTO:DIR:CLE`
deletes all hardcopy file that are stored in directory `var/nrp`.

Usage: Event

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE?

This command query the file name that what generated using the automatic naming settings.

Note: As default the automatically generated file name is composed of: `>Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`. Each component can be deactivated/activated separately to individually design the file name.

Return values:

<File> string

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
selects output format `*.bmp`.
`SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
hardcopy file are stored in directory `var/nrp` if automatic naming is activated.
`SENS:SWE:HCOP:FILE:AUTO:PREF 'sens1'`
the file name starts with the prefix `sens1`. The usage of automatic naming with prefix and date in the file name is preset (...`:STAT ON`).
`SENS:SWE:HCOP`
triggers the generation of a hardcopy of the current trace.
`SENS:SWE:HCOP:FILE:AUTO:FILE?`
queries the file name

Usage: Query only

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?

This command queries the day of the date part in the automatic file name.

Return values:
<Day> float

Example: `SENS:SWE:HCOP:FILE:AUTO:DAY?`
queries the day of the date part in the automatic file name.

Usage: Query only

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>

This command activates the usage of the day in the automatic file name.

Parameters:
<State> 0|1|OFF|ON
*RST: ON

Example: `SENS:SWE:HCOP:FILE:AUTO:DAY:STAT OFF`
deactivates the usage of the day in the automatic file name.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?

This command queries the day of the date part in the automatic file name.

Return values:
<Month> float

Example: `SENS:SWE:HCOP:FILE:AUTO:MONT?`
queries the month of the date part in the automatic file name.

Usage: Query only

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>

This command activates the usage of the month in the automatic file name.

Parameters:

<State> 0|1|OFF|ON

*RST: ON

Example: `SENS:SWE:HCOP:FILE:AUTO:MONT:STAT OFF`
deactivates the usage of the month in the automatic file name.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

This command queries the generated number in the automatic file name.

Return values:

<Number> float

Example: `SENS:SWE:HCOP:FILE:AUTO:NUMB?`
queries the number in the automatic file name.

Usage: Query only

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>

This command enters the prefix part in the automatic file name.

Parameters:

<Prefix> string

Example: `SENS:SWE:HCOP:FILE:AUTO:PREF 'sensor'`
the prefix sensor is used in the automatically generated file name of the hardcopy file.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

This command activates the usage of the prefix in the automatic file name.

Parameters:

<State>	0|1|OFF|ON *RST: ON
Example:	`SENS:SWE:HCOP:FILE:AUTO:PREF:STAT OFF` deactivates the usage of the prefix in the automatic file name.
Options:	Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?

This command queries the year of the date part in the automatic file name.

Return values:

<Year>	float
Example:	`SENS:SWE:HCOP:FILE:AUTO:YEAR?` queries the year of the date part in the automatic file name.
Usage:	Query only
Options:	Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

This command activates the usage of the year in the automatic file name.

Parameters:

<State>	0|1|OFF|ON *RST: ON
Example:	`SENS:SWE:HCOP:FILE:AUTO:YEAR:STAT OFF` deactivates the usage of the year in the automatic file name.
Options:	Option R&S SMF-K28

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe <State>

This command activates/deactivates automatic naming of the hardcopy files.

Parameters:

<State>	0|1|OFF|ON *RST: ON
Example:	`SENS:SWE:HCOP:FILE:AUTO:STAT OFF` deactivates automatic naming of the hardcopy files. The file name and directory is now defined with command `SENS:SWE:HCOP:FILE:NAME <path>`.
Options:	Option R&S SMF-K28

SENSe[:POWer]:SWEep:INITiate <Initiate>

This command starts the power analysis with NRP power sensor

Setting parameters:

<Initiate>

Example: `SENS:SWE:INIT`

start the power measurement.

Usage: Setting only

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:MODE <Mode>

This command selects power versus frequency measurement (frequency response), power vs power measurement (power sweep, AM/AM) or power vs. time measurement.

Parameters:

<Mode> FREQuency|POWer|TIME

*RST: FREQuency

Example: `SENS:SWE:MODE FREQ`

selects frequency mode.

Options: Option R&S SMF-K28

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:COPY

This command generates a reference curve for "Power" measurement.

Example: `SENS:POW:SWE:POW:REF:DATA:COPY`

Example: generates a reference curve in power mode.

Usage: Event

Options: R&S SMF-K28

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:POINts?

This command reads the number of points from the reference curve in "Power" measurement.

Return values:

<> float

Example: `SENS:POW:SWE:POW:REF:DATA:POIN?`

Example: queries the number of points from the reference curve in power mode.

Usage: Query only

Options: R&S SMF-K28

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues <Xvalues>

This command sets or queries the x values of the two reference points, i.e. "Power X (Point A)" and "Power X (Point B)" in "Power" measurement.

Parameters:

<Xvalues>	string
Example:	`SENSe:POW:SWE:POW:REF:DATA:XVAL -15DBM,20DBM`
Example:	sets the x value of reference "Point A" to -15 dBm, and the value of "Point B" to 20 dBm.
Options:	R&S SMF-K28

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues <Yvalues>

This command sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Power" measurement.

Parameters:

<Yvalues>	string
Example:	`SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10`
Example:	sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.
Options:	R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:RMODe <Rmode>

This command selects single or continuous mode for measurement mode power in power analysis.

Parameters:

<Rmode>	SINGle|CONTinuous *RST: SINGle
Example:	`SENS:SWE:POW:RMOD SING` selects single measurement
Options:	Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency <Sfrequency>

This command defines the separate frequency used for power vs. power measurement.

Parameters:

<Sfrequency>	float *RST: 1 MHz

Example: `SENS1:SWE:POW:SENS:SFR 2GHz`
'the measurement is performed at 2 GHz

SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe <State>

This command activates the use of a different frequency for the power measurement.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SENS1:SWE:POW:SENS:SFR:STAT ON`
activates the use of a separate frequency than the generator frequency for power analysis

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe <State>

This command enables pulse data analysis. The measurement is started with command INITiate.

Note: The command are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SENS1:SWE:TIM:PULS:STAT ON`
enables pulse data analysis.

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE <Base>

This command selects how the threshold parameters for pulse analysis are calculated.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<Base> VOLTage|POWer

*RST: VOLTage

Example: `SENS1:SWE:TIME:PULS:THR:BASE POW`
activates threshold calculation related to power.

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer: HREFerence <Hreference>

This command sets the upper reference level in terms of percentage of the overall pulse level (power or voltage). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<Hreference> float

Range: 0.0 to 100.0
*RST: 90.0

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer: REFerence <Reference>

Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define pulse width and pulse period.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<Reference> float

Range: 0.0 to 100.0
*RST: 50.0

Example: `SENS1:SWE:TIM:PULS:THR:REF 40`
sets the medial reference level to 40% of the overall pulse level.

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer: LREFerence <Lreference>

This command sets the lower reference level in terms of percentage of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<Lreference> float

Range: 0.0 to 100.0
*RST: 10.0

Example: `SENS:SWE:TIM:PULS:THR:LREF 10`
sets the lower reference level to 10%.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:SPACing[:MODE] <Mode>

This command queries the sweep spacing for the power versus power measurement. The setting is fixed to LINear.

Parameters:

<Mode> LINear

*RST: LINear

Example: `SENS:SWE:POW:SPAC?`

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:STARt <Start>

This command enters the start level for the power versus power measurement.

Parameters:

<Start> float

*RST: -40 dBm

Example: `SENS:SWE:POW:STAR -20.0DBM`
sets the start level to -20 dBm

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:STEPs <Steps>

This command enters the number of measurement steps for the power versus power measurement.

Parameters:

<Steps> float

Range: 10 to 1000
*RST: 500

Example: `SENS:SWE:POW:STEP 500`
sets the 500 measurement steps

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:STOP <Stop>

This command enters the stop level for the power versus power measurement.

Parameters:

<Stop> float

*RST: 30.0 dBm

Example: `SENS:SWE:POW:STOP 20.0DBM`

sets the stop level to 20 dBm

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:TIMing[:MODE] <Mode>

This command selects the timing mode of the measurement.

Parameters:

<Mode> FAST|NORMal|HPRecision

FAST

Selection FAST leads to a fast measurement with a short integration times for each measurement step.

NORMal

NORMal leads to a longer but more precise measurement due to a higher integration time for each step.

*RST: NORMal

Example: `SENS:SWE:POW:TIM:MODE FAST`

selects fast mode.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:YSCale:AUTO <Auto>

This command activates/deactivates autoscaling of the Y axis of the diagram.

Parameters:

<Auto> OFF|CEXPanding|FEXPanding|CFLoating|FFLoating

OFF
Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: OFF

Example: `SENS:SWE:POW:YSC:AUTO OFF`
deactivates auto scale

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet

This command resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example: `SENS:SWE:POW:YSC:AUTO:RES`
resets auto scale

Usage: Event

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum <Maximum>

This command enters the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

Range: min level to max level
*RST: 40 dBm

Example: `SENS:SWE:POW:YSC:MAX 10DBM`
sets 10 dBm as the upper limit of the measurement diagram.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:POWer:YSCale:MINimum <Minimum>

This command enters the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

Range: min level to max level
*RST: -40 dBm

Example: `SENS:SWE:POW:YSC:MIN -10DBM`
sets -10 dBm as the lower limit of the measurement diagram.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:RMODe <Rmode>

This command selects single or continuous mode for power analysis (all measurement modes).

Parameters:

<Rmode> SINGle|CONTinuous

*RST: SINGle

Example: `SENS:SWE:RMOD SING`
selects single measurement

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:RMODe <Rmode>

This command selects single or continuous mode for measurement mode time in power analysis.

Parameters:

<Rmode> SINGle|CONTinuous

*RST: SINGle

Example: `SENS:SWE:TIME:RMOD SING`
selects single measurement

Options: Option R&S SMF-K28

:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt] <Count>

This command selects the averaging factor in time mode. The count number determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing.

Parameters:

<Count> 1|2|4|8|16|32|64|128|256|512|1024

*RST: NORMal

Example: `SENS:SWE:MODE TIME`
selects time mode
`SENS:SWE:TIME:AVER 128`
selects averaging factor 128

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY

This command generates a reference curve for "Time" measurement.

Example: `SENS:POW:SWE:TIME:REF:DATA:COPY`

Example: generates a reference curve in time mode.

Usage: Event

Options: R&S SMF-K28

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:POINts?

This command reads the number of points from the reference curve in "Time" measurement.

Return values:

<> float

Example: `SENS:POW:SWE:TIME:REF:DATA:POIN?`

Example: queries the number of points from the reference curve in time mode.

Usage: Query only

Options: R&S SMF-K28

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues <Xvalues>

This command sets or queries the x values of the two reference points, i.e. "Time X (Point A)" and "Time X (Point B)" in "Time" measurement.

Parameters:

<Xvalues> string

Example: SENSe:POW:SWE:TIME:REF:DATA:XVAL 5,45

Example: sets the x value of reference "Point A" to 5 µs, and the value of "Point B" to 45 µs.

Options: R&S SMF-K28

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues <Yvalues>

This command sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Time" measurement.

Parameters:

<Yvalues> string

Example: SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10

Example: sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.

Options: R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency <Sfrequency>

This command defines the separate frequency used for power vs. time measurement.

Parameters:

<Sfrequency> float

*RST: 1 MHz

Example: SENS1:SWE:TIME:SENS:SFR 2GHz
the measurement is performed at 2 GHz

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe <State>

This command activates the use of a different frequency for the power measurement.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: SENS1:SWE:TIME:SENS:SFR:STAT ON
activates the use of a separate frequency than the generator frequency for power analysis

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO <Auto>

This command sets the trigger level, the hysteresis and the dropout time to default values.

Parameters:

<Auto> ONCE

Example: `SENS1:SWE:TIME:SENS:TRIG:AUTO ONCE`

the trigger level is automatically determined

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe <Dtime>

This command determines the minimum time for which the signal must be below (above) the power level defined by level and hysteresis before triggering can occur again.

Parameters:

<Dtime> float

Range: 0.0 to 10.0
*RST: 0
Def. value: 200 ns
Default unit: s

Example: `SENS1:SWE:TIME:SENS:TRIG:DTIM 10 us`

the drop out time is 10 us

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis <Hysteresis>

This command sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

Parameters:

<Hysteresis> float

Range: -10.0 to 10.0
*RST: 0.5
Default unit: dB

Example: `SENS1:SWE:TIME:SENS:TRIG:HYST 0.5 dB`

the hysteresis is 0.5 dB

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel <Level>

This command sets the trigger threshold.

Parameters:

<Level> float

Range: -200.0 to 100.0
*RST: 1
Default unit: dBm

Example: `SENS1:SWE:TIME:SENS:TRIG:LEV -20 dBm`
sets the trigger level to -20 dBm.

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce <Source>

This command selects if the measurement is free running (FREE) or starts only after a trigger event. The trigger can be applied internally or externally.

Parameters:

<Source> FREE|AUTO|INTernal|EXTernal

*RST: AUTO

Example: `SENS1:SWE:TIME:SENS:TRIG:SOUR FREE`
the power versus time measurement is performed free running

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:SPACing[:MODE]?

This command queries the sweep spacing for the power versus time measurement. The spacing is fixed to linear.

Return values:

<Mode> LINear

*RST: LINear

Example: `SENS:SWE:TIME:SPAC?`
queries the sweep spacing

Usage: Query only

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:STARt <Start>

This command enters the start time for the power versus time measurement. Value 0 defines the trigger point. By choosing a negative time value, the trace can be shifted in the diagram. It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

Parameters:

<Start> float

Range: -1.0 to 1.0
*RST: 0
Default unit: s

Example: `SENS:SWE:TIME:STAR 0s`
sets the start time to 0 s

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:STEPs <Steps>

This command enters the number of measurement steps for the power versus time measurement. Value 0 defines the trigger point.

Parameters:

<Steps> float

Range: 10 to 1000
*RST: 200

Example: `SENS:SWE:TIME:STEP 500`
sets the 500 measurement steps

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:STOP <Stop>

This command enters the stop time for the power versus time measurement.

Parameters:

<Stop> float

Range: 0.0 to 2.0
*RST: 1.0ms
Default unit: s

Example: `SENS:SWE:TIME:STOP 1ms`
sets the stop time to 1 ms

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:YSCale:AUTO <Auto>

This command activates/deactivates autoscaling of the Y axis of the diagram..

Parameters:

<Auto> OFF|CEXPanding|FEXPanding|CFLoating|FFLoating

OFF
Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: OFF

Example: `SENS:SWE:TIME:YSC:AUTO OFF`
deactivates auto scale

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet

This command resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example: `SENS:SWE:TIME:YSC:AUTO:RES`
resets auto scale

Usage: Event

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum <Maximum>

This command enters the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

Range: min level to max level
*RST: 40
Default unit: dBm

Example: `SENS:SWE:TIME:YSC:MAX 10DBM`
sets 10 dBm as the upper limit of the measurement diagram.

Options: Option R&S SMF-K28

SENSe[:POWer]:SWEep:TIME:YScale:MINimum <Minimum>

This command enters the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

Range: min level to max level
*RST: -40
Default unit: dBm

Example: `SENS:SWE:TIME:YSC:MIN -10DBM`
sets -10 dBm as the lower limit of the measurement diagram.

Options: Option R&S SMF-K28

SENSe<ch>[:POWer]:TYPE?

The command queries the type of sensor. The type is automatically detected.

Return values:

<Type> string

Example: `SENS:TYPE?`
queries the type of sensor connected to the POWER SENSOR connector.
`Response: NRP-Z21`
the R&S NRP-Z21 sensor is used.

Usage: Query only

SENSe<ch>[:POWer]:ZERO

The command activates the autozero function. Zeroing is required in regular interval (at least once a day) and if the temperature has varied more than about 5 °C, if the sensor has been replaced or if measurements of signals with very low power are to be performed. The RF power source must be switched off or disconnected from the sensor before starting the autozero function.

Example: `SENS:ZERO`
activates autozero function.

Usage: Event

SENSe<ch>:UNIT[:POWer] <Power>

The command selects the unit used for result query with command READ. The power sensor provides the measured value in Watt. In which unit the measured value is returned is selected here and might be either Watt, dBm or dBuV.

Parameters:

<Power> DBM|DBUV|WATT

*RST: DBM

Example: `SENS2:UNIT DBM`

selects unit dBm for the measured value returned by command `READ`.

`READ2?`

`Response: 7.34`

7.34 dBm are measured by sensor 2.

7.11.6 TRACe Subsystem

:TRACe<ch>[:POWer]:SWEep:COLor <Color>

This command defines the color of each trace..

Parameters:
<Color> INVers|GRAY|YELLow|BLUE|GREen|RED|MAGenta

*RST: trace 1 = YELLow, trace 2 = GREen, trace 3 = RED.

Example: `TRAC2:SWE:COL GRAY`
trace2 is indicated in gray color

:TRACe<ch>[:POWer]:SWEep:COPY <Copy>

This commands stores the selected trace data as reference trace.

Parameters:
<Copy> REFerence

Example: `TRAC2:SWE:COPY REF`
stores the current trace2 as reference trace'
`TRAC1:SWE:FEED REF`
assigns the reference trace to trace 1.

:TRACe<ch>[:POWer]:SWEep:DATA:POINts?

This commands queries the number of measurement points of the selected trace of the current power analysis.

Return values:
<Points> float

Example: `TRAC1:SWE:DATA:POIN?`
Response: `624`
Measurement trace 1 contains 624 measurement points

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:DATA:XVALues?

This commands queries the x-axis values - frequency, power or time values - of the selected trace of the current power analysis.

Return values:
<Xvalues> string

Example:

`SENS:SWE:MODE FREQ`
sets measurement mode **frequency versus power**.
`SENS:SWE:RMOD SING`
selects single measurement.
`SENS:SWE:INIT`
starts the measurement.
`*OPC?`
waits until measurement is performed.
`TRAC1:SWE:DATA:XVAL?`
queries the x-axis values of trace 1.
`TRAC1:SWE:DATA:YVAL`
queries the measurement values of trace 1.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:DATA:YVALues?

This commands queries the measurement (y-axis) values of the selected trace of the current power analysis.

Return values:

<Yvalues> string

Example:

`SENS:SWE:TRAC2:DATA:YVAL?`
queries the power values of trace 2.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:FEED <Feed>

This command selects the source for the trace data.

Parameters:

<Feed> SENSor1|SENSor2|SENSor3|REFerence|NONE

*RST: The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with number corresponding to the trace number, the preset value of the trace is "Off".

Example: `TRAC2:SWE:COPY REF`
stores trace2 as reference trace.
`TRAC1:SWE:FEED REF`
assigns the reference trace to trace 1.
`TRAC1:SWE:STAT ON`
assigns the reference trace to trace 1.
`SENS:SWE:RMOD SING`
selects single measurement
`SENS:SWE:INIT`
starts the measurement

:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe] <State>

This command selects fullscreen display, only the diagram is displayed in the measurement diagram and in the hardcopy file.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `TRAC:SWE:MEAS:FULL:DISP:ANN ON`
the display only shows the diagram.

:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] <State>

This command selects if the time gate borders and values are indicated in the measurement diagram and in the hardcopy file. The gate settings are performed with the `CALC:POW:SWE:TIME:GATE:...` commands.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `TRAC:SWE:MEAS:GATE:DISP:ANN ON`
the diagram also shows the gate information.

Options: Option R&S SMF-K28

:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe] <State>

This command selects if the markers and the marker list are indicated in the measurement diagram and in the hardcopy file..

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `TRAC:SWE:MEAS:MARK:DISP:ANN ON`
the diagram also shows the marker information.

Options: Option R&S SMF-K28

:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot?

The listed commands query the measured pulse parameters values.

Note: These commands are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Return values:
<Overshoot> float

Example: `TRAC1:SWE:MEAS:POW:HREF?`
queries the measured mesial threshold level of trace 1
`TRAC3:SWE:MEAS:POW:MAX?`
queries the measured peak power of trace 3

Usage: Query only

Options: Option R&S SMF-K28

:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe] <State>

This command selects if the pulse data is shown below the measurement diagram and also stored in the hardcopy file. The parameters to be indicated can be selected with the following `TRAC:SWE:MEAS:….` commands. Only six parameters are indicated at one time.

Note: This command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `TRAC:SWE:MEAS:PULS:DISP:ANN ON`
activates indication of the selected pulse data.

Options: Option R&S SMF-K28

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:ALL:DISPlay:ANNotation[:STATe] <State>

This command switches the indication of all pulse data of the selected trace off. The parameters to be indicated can be selected with the following `TRAC:SWE:MEAS:….` commands. Only six parameters are indicated at one time.

Note: This command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `TRAC:SWE:MEAS:PULS:ALL:DISP:ANN OFF`
switches the indication of all pulse data off

Options: Option R&S SMF-K28

:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe] <State>

This command selects the standard view, i.e. diagram and buttons but no lists are displayed and also stored in the hardcopy file.

Parameters:

<State> 0|1|OFF|ON

*RST: ON

Example: `TRAC:SWE:MEAS:STAN:DISP:ANN ON`
activates indication of the selected pulse data

Options: Option R&S SMF-K28

:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:ANNotation[:STATe] <State>

:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation:DISPlay: ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation: DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence: DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot: DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation: DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence: DISPlay:ANNotation[:STATe] <State>
:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot: DISPlay:ANNotation[:STATe] <State>

The listed commands select the pulse parameters which are indicated in the display and hardcopy file. Only six parameters can be indicated at one time.

Note: These commands are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State>	0|1|OFF|ON *RST: OFF

Example:	`TRAC:SWE:MEAS:TRAC2:PULS:PER:DISP:ANN ON`
	selects the pulse period to be indicated in the display
	`TRAC:SWE:MEAS:PULS:DISP:ANN ON`
	activates indication of the selected pulse data in the display

Options:	Option R&S SMF-K28

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE?

This command queries how the threshold parameters are calculated.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Base> VOLTage|POWer

Example: `TRAC1:SWE:PULS:THR:BAS?`
queries the threshold base of pulse data calculation.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence?

This command queries the upper threshold level of the overall pulse level. The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Hreference> float

Example: `TRAC2:SWE:PULS:THR:POW:HREF?`
queries the upper reference level of trace 2.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence?

This command queries the medial threshold level of the overall pulse level. This level is used to define the pulse width and pulse period.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Reference> float

Example: `TRAC3:SWE:PULS:THR:POW:REF?`
queries the medial threshold level of trace 3.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence?

This command queries the lower medial threshold level of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Lreference> float

Example: `TRAC:SWE:PULS:THR:POW:LREF?`
queries the medial threshold level of trace 1.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:STATe <State>

This command activates the selected trace.

Parameters:

<State> OFF|ON|HOLD

*RST: The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with a number corresponding to the trace number, the preset value of the trace is "Off".

Example: `TRAC2:SWE:COPY REF`
stores trace2 as reference trace'
`TRAC1:SWE:FEED REF`
assigns the reference trace to trace 1.
`TRAC1:SWE:STAT ON`
assigns the reference trace to trace 1.
`SENS:SWE:RMOD SING`
selects single measurement
`SENS:SWE:INIT`
starts the measurement

7.12 SOURce Subsystem

The `SOURce` subsystem contains the commands for configuring the digital and analog signals.

SOURce<hw>

For one-path instruments, the keyword `SOURce` is optional and can be omitted.

7.12.1 SOURce:AM Subsystem

The AM subsystem contains the commands for checking the amplitude modulation.

The settings for the internal modulation source (LF generator) are made in the `SOURce:LFOutput` subsystem.

The external signal is input at the EXT1 and/or EXT2 connector.

[:SOURce<hw>]:AM<ch>[:DEPTh] <Depth>

The command sets the overall modulation depth of the amplitude modulation in percent.

Parameters:

<Depth> float

Range: 0 to 100
*RST: 30 PCT

Example: `AM1:DEPT 15PCT`
sets the AM modulation depth to 15 percent for path 1.

Options: R&S SMF-B20

[:SOURce<hw>]:AM:RATio <Ratio>

The command sets the overall modulation depth of the amplitude modulation in percent.

Parameters:

<Ratio> float

Range: 0 to 100
*RST: 100

Example: `AM:RAT 50PCT`
sets the path 1/path 2 ratio to 50 percent.

Options: R&S SMF-B20

[:SOURce<hw>]:AM:SCAN:STATe <State>

The command activates/deactivates logarithmic amplitude modulation.

Parameters:

<State> OFF|ON

*RST: OFF

Example: `AM:SCAN:STAT ON`
activates the logarithmic amplitude modulation.

Options: R&S SMF-B20

[:SOURce<hw>]:AM<ch>:SENSitivity <Sensitivity>

The command sets the input sensitivity of the EXT input in db/V.

The command is available for scan state ON only.

Parameters:

<Sensitivity> float

*RST: 1

Example: `AM1:SENS 5`
sets the input sensitivity to 5 dB/V for path 1.

Options: R&S SMF-B20

[:SOURce<hw>]:AM<ch>:SOURce <Source>

The command selects the modulation source for amplitude modulation. The external signal is input at the EXT1 and/or EXT2 connector. Internal and external modulation source can be selected at the same time.

Parameters:

<Source> LF1|LF2|NOISe|EXT1|EXT2

*RST: EXT1

Example: `AM1:SOUR LF1`
selects the LF generator 1 as internal modulation source for path 1.

Options: R&S SMF-B20

[:SOURce<hw>]:AM<ch>:STATe <State>

The command activates/deactivates amplitude modulation.

Parameters:

<State> 0|1|OFF|ON

*RST: 0

Example: `AM:STAT ON`
activates AM modulation.

7.12.2 SOURce:CHIRp Subsystem

The `SOURce:CHIRp` subsystem contains the commands for setting the modulation chirp.

The keyword SOURce is optional with commands and can be omitted.

[:SOURce<hw>]:CHIRp:BANDwidth <Bandwidth>

The command sets the modulation bandwidth of the modulation chirp in Hz. The maximal bandwidth depends on the RF frequency set and the selected modulation mode (see data sheet).

Parameters:

<Bandwidth> float

Range: 0 Hz to 80 MHz
Increment: See data sheet
*RST: 1 kHz
Default unit: Hz

Example: `CHIR:BAND 5E3`
sets the modulation bandwidth to 5 kHz.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:COMPression:RATio?

The command queries the pulse compression ratio, i.e. the product of pulse width (s) and bandwidth (Hz). Pulse compression increases the range resolution as well as the signal to noise ratio of pulsed signals.

Return values:

<Ratio> float

Example: `CHIR:COMP:RAT?`
'queries the compression ratio.

Usage: Query only

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:PULSe:PERiod <Period>

The command sets the period of the generated modulation chirp. The period determines the repetition frequency of the internal signal.

Parameters:

<Period> float

Range: 200 ns to 100s
Increment: 200 ns
*RST: 10.000 ns
Default unit: s

Example: `CHIR:PULS:PER 420 ns`
the chirp period is 420 ns.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:PULSe:WIDTh <Width>

The command sets the width of the generated pulse. The pulse width must be at least 1us less than the set pulse period.

Parameters:

<Width> float

Range: 100 ns to 100 s
Increment: 100 ns
*RST: 1000 ns
Default unit: s

Example: `CHIR:PULS:WIDT 330 ns`
sets a width of 330 ns for the pulse.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:STATe <State>

The command activates/deactivates the generation of modulation chirps.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `CHIR:STAT ON`
activates generation of modulation chirps.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:GATE:POLarity <Polarity>

The command selects the active level of the gate signal.

Parameters:

<Polarity> NORMal|INVerted

*RST: NORM

Example: `CHIR:TRIG:EXT:GATE:POL NORM`
selects gate polarity normal.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:IMPedance <Impedance>

The commands set the impedance for external feed via the PULSE EXT input.

Parameters:

<Impedance> G10k|G50

G10k
10 kOhm to ground

G50
50 ohm to ground

*RST: G50

Example: `CHIR:TRIG:EXT:IMP G10K`
the PULSE IN input is set to 10 kOhm to ground.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:LEVel <Level>

The command selects the external trigger level.

Parameters:

<Level> TTL|M2V5|P0V5

TTL
trigger level is threshold TTL.

P0V5
trigger level is 0.5 V.

M2V5
trigger level is -2.5 V.

*RST: TTL

Example: `CHIRp:TRIG:EXT:LEV TTL`
selects threshold TTL as external trigger level.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:SLOPe <Slope>

The command sets the active slope of an externally applied trigger signal at the PULSE EXT input (BNC connector at the rear of the instrument).

Parameters:

<Slope> POS|NEG

*RST: POS

Example: `CHIR:TRIG:EXT:SLOP`

the active slope of the external trigger signal at the PULSE EXT input is the falling slope.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

[:SOURce<hw>]:CHIRp:TRIGger:MODE <Mode>

The command selects the trigger mode for modulation chirp.

Note: External trigger signals are supplied via the PULSE IN connector.

Parameters:

<Mode> AUTO|EXTernal|EGATe

AUTO
The modulation chirp is generated continuously.

EXTernal
The modulation chirp is triggered by an external trigger event.

EGATe
The modulation chirp is gated by an external gate signal.

*RST: AUTO

Example: `CHIR:TRIG:EXT:MODE EXT`

selects triggering by an external trigger event.

Options: R&S SMF-B20, R&S SMF-K3, and R&S SMF-K23

7.12.3 SOURce:CORRection Subsystem

The output level is corrected in the `CORRection` subsystem. Correction is performed by user-defined table values being added to the output level for the respective RF frequency. In the R&S SMF, this subsystem is used to select, transfer and activate user correction tables.

Each list is stored as a file. The name of the user correction file can be freely selected. The file extension `*.uco` is assigned automatically and cannot be changed.

The files can be stored in a freely selectable directory and opened from there. The default directory is set using command `:MMEMory:CDIRectory` on page 252. In the case of files which are stored in the default directory, only the file name has to be specified in commands. Otherwise, the complete absolute path has to be specified with every command. The extension can be omitted in any case.

In the following command examples, the files are stored in the default directory.

The amplitude can also be linearized automatically by means of a R&S NRP power sensor connected to the generator output signal. With the aid of the command `[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe`, a list with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables. The correction values can be acquired any time irrespective of the modulation settings of the generator.

[:SOURce]:CORRection:CSET:CATalog?

The command requests a list of user correction tables. The individual lists are separated by commas.

The lists are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog> string

Example: `MMEM:CDIR '/var//Lists/ucor'`
selects the directory for the user correction files.
`CORR:CSET:CAT?`
queries which correction tables are available.
Response:`UCOR1,UCOR2,UCOR3`
the correction tables `UCOR1, UCOR2 and UCOR3` are available.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

The command transfers the frequency data to the table selected with `:CORRection:CSET:SELect`.

The numerical suffix at SOURce must not be used for this command.

Parameters:

<Frequency> Frequency#1[, Frequency#2, ...]

Range: 300 kHz to RFmax (depending on model)
Default unit: Hz

Example: `CORR:CSET '/var//Lists/ucor/ucor1'`
selects the table `ucor1`.
`CORR:CSET:DATA:FREQ 100MHz,102MHz,103MHz,...`
enters the frequency value in the table `ucor1`.

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts?

The command queries the number of frequency values in the selected table.

The numerical suffix at SOURce must not be used for this command.

Return values:

<Points> float

Example: `CORR:CSET '/var//Lists/ucor/ucor1'`
selects the table ucor1.
`CORR:CSET:DATA:FREQ:POIN?`
queries the number of frequency values in the table ucor1.
Response: `440`
the table ucor1 contains 440 frequency values.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA:POWer <Power>

The command transfers the level data to the table selected with `:CORRection:CSET:SELect`.

`*RST` does not affect data lists. The numerical suffix at `SOURce` must not be used for this command.

Parameters:

<Power> Power#1[, Power#2, ...]

Range: -40 dB to 6 dB
Default unit: dB

Example: `CORR:CSET '/var//Lists/ucor/ucor1'`
selects the table `ucor1`.
`CORR:CSET:DATA:POW 1dB, 0.8dB, 0.75dB,...`
enters the level values in the table `ucor1`.

[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

The command queries the number of level values in the selected table.

The numerical suffix at SOURce must not be used for this command.

Return values:

<Points>	float

Example:	`CORR:CSET '/var//Lists/ucor/ucor1'`
	selects the table ucor1.
	`CORR:CSET:DATA:POW:POIN?`
	queries the number of level values in the table ucor1.
	Response: `440`
	the table ucor1 contains 440 level values.

Usage:	Query only

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

The command fills the selected user correction list with the level values measured by the power sensor for the given frequencies.

The power sensor used is selected by the suffix in key word `SENSe` of the command header.

Suffix:

<ch>	1 .. 3 Suffix 1 denotes the sensor connected to the SENSOR connector, suffix 2 the sensor connected first to one of the USB interfaces and suffix 3 the sensor connected second to one of the USB interfaces.
Example:	`CORR:CSET:DATA:SENS:POW:SONC` fills the user correction list with level values acquired by the power sensor connector to the SENSOR connector.
Usage:	Event

[:SOURce]:CORRection:CSET:DELete <Delete>

The command deletes the specified table.

The lists are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `:SOUR:CORR:CSET:CAT?`, in which case the file in the specified directory is deleted.

The numerical suffix under SOURce is irrelevant.

Setting parameters:

<Delete> <table name>

Example: `MMEM:CDIR '/var//Lists/ucor'`
selects the directory for the user correction files.
`CORR:CSET:DEL 'UCOR1'`
deletes the table `ucor1`.

Usage: Event

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of user correction data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog> string

Example: `MMEM:CDIR '/var//lists/ucor/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`CORR:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension `*.txt` are listed.
`CORR:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response: `'ucor1,ucor2'`
the ASCII files `ucor1.txt` and `ucor2.txt` are available.

Usage: Query only

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension <Extension>

The command selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

Parameters:

<Extension> TXT|CSV

*RST: TXT

Example: `MMEM:CDIR '/var//lists/ucor/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`CORR:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension *.txt are listed.
`CORR:DEXC:AFIL:CAT?`
queries the available files with extension *.txt.
Response: `'list1,list2'`
the ASCII files `ucor1.txt` and `ucor2.txt` are available.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect <Select>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:DEXC:AFIL:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:

<Select> <ascii file name>

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL '/var//user/ucor/import/ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn <Column>

The command selects the separator between the frequency and level column of the ASCII table.

Parameters:

<Column> TABulator|SEMicolon|COMMa|SPACe

*RST: SEMicolon|

Example: `CORR:DEXC:MODE EXP`
selects that the user correction list is exported into an ASCII file.
`CORR:DEXC:AFIL:SEL '/var//user/ucor/import/ucor.csv'`
selects ASCII file ucor.csv as destination for the user correction list data.
`CORR:DEXC:AFIL:SEP:COL TAB`
the pairs of frequency and level values are separated by a tabulator.
`CORR:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the user correction list ucor_imp is imported into ASCII file ucor.csv.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal <Decimal>

The command the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Parameters:

<Decimal> DOT|COMMa

*RST: DOT

Example: `CORR:DEXC:MODE EXP`
selects that the user correction list is exported into an ASCII file.
`CORR:DEXC:AFIL:SEL '/var//user/ucor/import/ucor.csv'`
selects ASCII file ucor.csv as destination for the user correction list data.
`CORR:DEXC:AFIL:SEP:COL TAB`
the pairs of frequency and level values are separated by a tabulator.
`CORR:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the user correction list ucor_imp is imported into ASCII file ucor.csv.

[:SOURce<hw>]:CORRection:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected, the ASCII file is imported as user correction list. When export is selected, the user correction list is exported into the selected ASCII file.

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL '/var//user/ucor/import/ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.
`CORR:DEXC:EXEC`
starts the import of the ASCII file data into the user correction file.

Usage: Event

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

The command selects if user correction lists should be imported or exported. Depending on the selection her, the file select command define either the source or the destination for user correction lists and ASCII files.

Parameters:

<Mode> IMPort|EXPort

*RST: IMPort

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL '/var//user/ucor/import/ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.

[:SOURce<hw>]:CORRection:DEXChange:SELect <Select>

The command selects the user correction list to be imported or exported.

The user correction files are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:DEXC:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:

<Select> <list name>

Example: CORR:DEXC:MODE IMP
selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.
CORR:DEXC:AFIL:SEL '/var//user/ucor/import/ucor.csv'
selects that ASCII file ucor.csv is imported.
CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'
selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.

[:SOURce<hw>]:CORRection:CSET[:SELect] <Select>

The command selects the table for user correction. Level correction must also be activated with the command SOURce<hw>:CORRection:CSET:STATe ON.

The lists are stored with the fixed file extensions *.uco in a directory of the user's choice. The directory applicable to the commands is defined with the command MMEMory:CDIR. A path can also be specified in command :SOUR:CORR:CSET:SEL, in which case the files in the specified directory are selected.

Parameters:
<Select> <table name>

Example: CORR:CSET '/var//Lists/ucor/ucor1'
selects the table ucor1.
CORR ON
activates level correction. Correction is performed using the table ucor1.

Usage: Event

[:SOURce<hw>]:CORRection:MEASure <Measure>

The command triggers the external measurement of the user correction of the level according to the user defined frequencies.

Example: SOUR:CORR:MEAS
triggers the external measurement of the user correction of the level according to the user defined frequencies.

[:SOURce<hw>]:CORRection:PMETer:TYPE <Type>

The command selects the power meter used for user correction.

Parameters:
<Type> NRP|NRVD|HP437|ML2438|P44X

*RST: NRP

Example: `SOUR:CORR:PMET:TYPE NRVD`
the specified power meter is used for user correction.

[:SOURce<hw>]:CORRection[:STATe] <State>

The command activates/deactivates level correction. Level correction is performed using the table which has been selected with the command `CORRection:CSET:SELect`.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:CORR:CSET '/var//lists/ucor/ucor1'`
selects the table `ucor1`.
`SOUR:CORR ON`
activates user correction.

[:SOURce<hw>]:CORRection:VALue?

The command requests the current value for user correction.

Return values:

<Value> float

Example: `CORR:VAL?`
queries the value currently used for level correction.
Response: `-3`
the correction value is - 3 dB.

Usage: Query only

7.12.4 SOURce:DM Subsystem

This section contains the commands for generating the digital modulation signal. Two external inputs (EXT1 and EXT2) are available as data source. The settings for the external inputs are independently of the type of modulation selected.

[:SOURce<hw>]:DM:ASK:DEPTh <Depth>

The command sets the modulation depth for ASK modulation.

Parameters:

<Depth> float

Increment: 0.01
*RST: 30 PCT

Example: `SOUR:DM:ASK 30PCT`
sets the modulation depth for the amplitude modulation to 30%.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:ASK:SOURce <Source>

The command selects the source for the ASK modulation signal.

Parameters:

<Source> EXT1|EXT2|PGENerator|RANDom

EXT 1/EXT 2
Selects the external inputs (either EXT1 or EXT2) as the source for ASK modulation.

PGEN
Selects the internal pulse generator as source for ASK modulation.

RAND
Selects random pulses generated by the noise generator as the source for ASK modulation.

*RST: EXT1

Example: `SOUR:DM:ASK:SOUR EXT1`
selects the external input EXT1 as source for the amplitude modulation signal.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:ASK:STATe <State>

The command activates/deactivates the ASK modulation.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:DM:ASK:STAT ON`
activates the amplitude modulation.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:EXTernal:POLarity<ch> <Polarity>

The command sets the polarity of the external modulation signal.

Parameters:

<Polarity> NORMal|INVerted

NORMal
The RF level is **ON** while the level is **HIGH**.

INVerted
The RF level is **ON** while the level is **LOW**.

*RST: NORMal

Example: `SOUR:DM:EXT:POL NORM`
sets the marker output polarity to normal.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:FSK:DEViation <Deviation>

The command sets the frequency deviation for FSK modulation.

Parameters:

<Deviation> float

Increment: 0.1 Hz
*RST: 40 MHz

Example: `SOUR:DM:FSK:DEV 20 MHz`
sets the deviation to 20 MHz.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:FSK:SOURce <Source>

The command selects the source for the FSK modulation signal.

Parameters:

<Source> EXT1|EXT2|PGENerator|RANDom

EXT 1/EXT 2
Selects the external inputs (either EXT1 or EXT2) as the source for FSK modulation.

PGEN
Selects the internal pulse generator as source for FSK modulation.

RAND
Selects random pulses generated by the noise generator as the source for FSK modulation.

*RST: EXT1

Example: `SOUR:DM:FSK:SOUR EXT1`
selects the external input EXT1 as source for the frequency modulation signal.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:FSK:STATe <State>

The command activates/deactivates the FSK modulation.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:DM:FSK:STAT ON`
activates the frequency modulation.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:PSK:DEViation <Deviation>

The command sets the phase deviation for PSK modulation.

Parameters:

<Deviation> float

Range: 0 to 100
*RST: 30 RAD

Example: `SOUR:DM:PSK:DEV 30RAD`
sets the deviation to 30 RAD.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:PSK:SOURce <Source>

The command selects the source for the PSK modulation signal.

Parameters:

<Source> EXT1|EXT2|PGENerator|RANDom

EXT 1/EXT 2
Selects the external inputs (either EXT1 or EXT2) as the source for PSK modulation.

PGEN
Selects the internal pulse generator as source for PSK modulation.

RAND
Selects random pulses generated by the noise generator as the source for PSK modulation.

*RST: EXT1

Example: `SOUR:DM:PSK:SOUR EXT1`
selects the external input EXT1 as source for the phase modulation signal.

Options: R&S SMF-B20

[:SOURce<hw>]:DM:PSK:STATe <State>

The command activates/deactivates the PSK modulation.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:DM:PSK:STAT ON`
activates the phase modulation.

Options: R&S SMF-B20

7.12.5 SOURce:FM Subsystem

The FM subsystem contains the commands for checking the frequency modulation.

Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem (e.g. frequency). The external signal is input at the EXT1 and/or EXT2 connector. Internal and external modulation source can be selected at the same time, thus enabling two-tone FM modulation.

For information about the required options, see chapter 5.5.3, "Frequency Modulation (FM)", on page 146.

[:SOURce<hw>]:FM<ch>[:DEViation] <Deviation>

The command enters the deviation of the FM signal.

Parameters:

<Deviation> float

Example: `FM1:DEV 3kHz`
sets the modulation depth of 3 kHz for path 1.

Options: R&S SMF-B20

[:SOURce<hw>]:FM:MODE <Mode>

The command selects the mode for the frequency modulation.

Parameters:

<Mode> NORMal | LNOise

NORMal
The maximum range for modulation bandwidth and FM deviation is available.

LNOise
Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

*RST: NORMal

Example: `FM:MODE NORM`
selects normal mode for external frequency modulation.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce<hw>]:FM:RATio <Ratio>

The command sets the path 1/path 2 ratio in percent.

Parameters:

<Ratio> float

Range: 0 to 100
Increment: 0.01

Example: `FM:RAT 50PCT`
sets the path 1/path 2 ratio to 50 percent.

Options: R&S SMF-B20

[:SOURce<hw>]:FM<ch>:SOURce <Source>

Selects the source for the FM signal.

Parameters:

<Source> LF1|LF2|NOISe|EXT1|EXT2

*RST: EXT1

Example: `FM1:SOUR LF2`
selects the LF generator 2 as internal modulation source for path 1.

Options: R&S SMF-B20

[:SOURce<hw>]:FM<ch>:STATe <State>

The command activates/deactivates frequency modulation.

Activation of frequency modulation deactivates phase modulation.

Correlation: FM ON deactivates phase modulation.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `FM1:STAT ON`
activates FM modulation for path 1.

Options: R&S SMF-B20

7.12.6 SOURce:FREQuency Subsystem

This subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

[:SOURce<hw>]:FREQuency:CENTer <Center>

The command sets the center frequency of the sweep. This setting in combination with the span setting (`[SOURce:]FREQuency:SPAN`) defines the sweep range.

This command is linked to the commands `[SOURce:]FREQuency:STARt` and `[SOURce:]FREQuency:STOP`, i.e. changing these values causes the CENTer value to change, and vice versa:

`CENTer = (STARt + STOP)/2`

As with the "Frequency" value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

100 kHz + `OFFSet` + `MULTiplier` ... RF_{max} +`OFFSet` + `MULTiplier`

Parameters:

<Center> float

Range: 100kHz to RFmax (RFmax depending on model)
Increment: 0.01Hz
*RST: 10GHz
Default unit: Hz

Example: `FREQ:CENT 400 MHz`
sets the center frequency for the frequency sweep to 400 MHz.
`FREQ:SPAN 200 MHz`
sets a span of 200 MHz. This sets the sweep range to 300 MHz to 500 MHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency[:CW|:FIXed] <Fixed>

The command sets the frequency of the RF output signal for CW mode (`SOURce:FREQuency:MODE CW`). In Sweep mode (`SOURce:FREQuency:MODE SWEep`), this value is linked to the current sweep frequency.

In addition to a numerical value, it is also possible to specify `UP` and `DOWN`. The frequency is then increased or decreased by the value which is set under `[SOURce<[1]|2>:]FREQuency:STEP`.

As with the "FREQ" value entered in the display, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

100 kHz + `OFFSet` + `MULTiplier` ... RF$_{max}$ +`OFFSet` + `MULTiplier`

Correlation: `FREQ` for `FREQ:MODE SWE` is linked to sweep frequency.

Parameters:

<Fixed> float

Range: 100kHz to RFmax
Increment: 0.01Hz
*RST: 100 MHz
Default unit: Hz

Example: `FREQ 500kHz`
sets the frequency of RF output signal A to 500 kHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency[:CW|:FIXed]:RCL <Rcl>

The command determines whether the current frequency setting is retained or whether the stored frequency setting is adopted when an instrument configuration is loaded.

*RST does not affect this setting.

Parameters:

<Rcl> INCLude|EXCLude

INCLude
The stored frequency is also loaded when a stored instrument configuration is loaded.

EXCLude
The RF frequency is not loaded when a stored instrument configuration is loaded. The current frequency is retained.

*RST: no default

Example: `FREQ:RCL INCL`
The stored frequency is set if the Recall command is called.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:MANual <Manual>

In Sweep mode (`:SOUR:FREQ:MODE SWE`) the command sets the frequency for the next sweep step in the "Step" sweep mode (`SOUR:SWE:MODE MAN`). Here only frequency values between the settings `[SOUR]:FREQ:STAR` and `...:STOP` are permitted. Each sweep step is triggered by a separate `SOUR:FREQ:MAN` command.

As with the "Frequency" value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

`STARt` + `OFFSet` + `MULTiplier` ... `STOP` +`OFFSet` + `MULTiplier`

Parameters:

<Manual> float

Range: STARt to STOP
Increment: 0.01Hz
*RST: 10 GHz
Default unit: Hz

Example: `SWE:MODE MAN`
sets the `Step` sweep mode.

Example: `FREQ:MAN 500MHz`
sets an RF frequency of 500 MHz for the next step in the `Step` sweep mode.
`FREQ:MODE SWE`
sets the Frequency Sweep mode. An RF frequency of 500 MHz is output.
`FREQ:MAN 550MHz`
triggers the next sweep step with an RF frequency of 550 MHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:MODE <Mode>

The command sets the instrument operating mode and therefore also the commands used to set the output frequency.

Parameters:

<Mode> CW|FIXed|SWEep|LIST

CW|FIXed
The instrument operates in fixed-frequency mode; `CW` and `FIXed` are synonyms. The output frequency is set with `:SOURce:FREQuency:CW|FIXed`.

SWEep
The instrument operates in SWEep mode. The frequency is set using the commands `SOURce:FREQuency:STARt; STOP; CENTer; SPAN; MANual`.

LIST
The instrument processes a list of frequency and level settings for the selected path.
The List mode settings are made in the SOURce:LIST Subsystem subsystem. The setting `SOURce:FREQuency:MODE LIST` also sets the command `SOURce:POWer:MODE` automatically to `LIST`.
Correlation: `FREQ:MODE LIST` sets `POW:MODE LIST`

*RST: CW

Example: `FREQ:MODE SWE`
sets the SWEep mode. The settings under `SOURce:FREQuency:STARt`; `STOP`; `CENTer`; `SPAN`; `MANual` become effective.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:OFFSet <Offset>

The command sets the frequency offset of a downstream instrument, e.g. a mixer. If a frequency offset is entered, the frequency entered with `SOURce:FREQuency:...` no longer corresponds to the RF output frequency. The following correlation applies:

`SOURce:FREQuency:...` = RF output frequency + `SOURce:FREQuency:OFFSet`.

Entering an offset does not change the RF output frequency, but rather the query value of `SOURce:FREQuency:...`.

Parameters:

<Offset> float

Range: -67GHz to 67GHz
Increment: 0.01Hz
*RST: 0Hz
Default unit: Hz

Example: FREQ:OFFS 500kHz
sets the frequency offset to 500 kHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:SPAN <Span>

This command specifies the span for the sweep. This setting in combination with the center frequency setting ([SOUR]:FREQ:CENT) defines the sweep range.

This command is linked to the commands [SOUR]:FREQ:STAR and [:SOUR]:FREQ:STOP, i.e. changing these values causes the SPAN value to change, and vice versa:

SPAN = (STOP - STARt)

Negative values for SPAN are permitted; STARt > STOP then applies.

Parameters:

<Span> float

Range:	100 kHz to RFmax
Increment:	0.01Hz
*RST:	4 GHz

Example: FREQ:CENT 400 MHz
sets the center frequency of the frequency sweep to 400 MHz.
FREQ:SPAN 200 MHz
sets a span of 200 MHz. This sets the sweep range to 300 MHz to 500 MHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:STARt <Start>

This command sets the start frequency for the sweep mode. STARt can be greater than STOP.

This command is linked to the commands [SOUR]:FREQ:CENT and [SOUR]:FREQ:SPAN, i.e. changing these values causes the STARt value to change, and vice versa:

STARt = (CENTer - SPAN/2).

As with the "Frequency" value entered in the header, the OFFSet value is also taken into consideration with this command. The specified value range is therefore only effective if OFFSet is set to 0. The value range for other OFFset values can be calculated using the following formula:

100 kHz + OFFSet + MULTiplier ... RF_{max} +OFFSet + MULTiplier

Parameters:

<Start> float

Range: 100kHz to RFmax
Increment: 0.01Hz
*RST: 1 GHz

Example: `FREQ:STARt 1 MHz`
sets the start frequency for the frequency sweep to 1 MHz.
`FREQ:STOP 2 GHz`
sets the stop frequency for the frequency sweep to 2 GHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:STOP <Stop>

This command sets the stop frequency for the sweep mode. `STOP` can be less than `STARt.`

This command is linked to the commands `[:SOUR]:FREQ:CENt` and `[:SOUR]:FREQ:SPAN`, i.e. changing these values causes the `STARt` value to change, and vice versa:

`STOP = (CENTer + SPAN/2)`

As with the "Frequency" value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

100 kHz + `OFFSet` + `MULTiplier` ... RF_{max} +`OFFSet` + `MULTiplier`

Parameters:

<Stop> float

Range: 100kHz to RFmax
Increment: 0.01Hz
*RST: 5 GHz
Default unit: Hz

Example: `FREQ:STOP 2 GHz`
sets the stop frequency for the frequency sweep to 2 GHz.
`FREQ:STAR 1 MHz`
sets the start frequency for the frequency sweep to 1 MHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:STEP[:INCRement] <Increment>

The command sets the step width for the frequency setting if the frequency values `UP/DOWN` are used and variation mode `SOUR:FREQ:STEP:MODE USER` is selected. The command is linked to "Variation Step" for manual control, i.e. the command also sets the step width of the rotary knob for "Variation Active" on.

Parameters:

<Increment>	float Range: 1 MHz to 10 GHz Increment: 0.01Hz *RST: 1MHz
Example:	`FREQ:STEP 50 kHz` sets the step width for the frequency setting to 50 kHz.

[:SOURce<hw>]:FREQuency:STEP:MODE <Mode>

This command activates (`USER`) or deactivates (`DECimal`) the user-defined step width used when varying the frequency value with the frequency values `UP/DOWN`. The command is linked to the command "Variation Active" for manual control, i.e. the command also activates/deactivates the user-defined step width used when varying the frequency value with the rotary knob.

Parameters:

<Mode>	DECimal|USER *RST: DECimal

Example:	`FREQ:STEP 50 kHz`
	sets the step width for the frequency setting to 50 kHz.
	`FREQ:STEP:MODE USER`
	actives this step width for frequency variation with the rotary knob (manual control) and with frequency values `UP/DOWN` (remote control).

[:SOURce<hw>]:FREQuency:MULTiplier <Multiplier>

The command sets the value for the multiplication factor of a subsequent downstream instrument.

Parameters:

<Multiplier>	float Range: 1 to 10000 *RST: 1
Example:	`FREQ:MULT 1` sets the multiplication factor to 1.

7.12.7 SOURce:INPut Subsystem

The `SOURce:INPut` subsystem contains the commands for configuring the inputs for external modulation signals. The instrument trigger setting influences all sweeps and is effective in the List mode (Instrument Trigger).

[:SOURce<hw>]:INPut:MODext:COUPling<ch> <Coupling>

The command selects the coupling mode for external feed via EXT 1 and/or EXT 2 input.

Parameters:

<Coupling> AC|DC

AC
The DC voltage component is disconnected from the modulation signal.

DC
The modulation signal is not changed.

*RST: AC

Example: `SOUR:INP:MOD:COUP1 AC`
selects the coupling mode AC for external modulation input EXT1.

Options: R&S SMF-B20

[:SOURce<hw>]:INPut:MODext:IMPedance<ch> <Impedance>

The commands set the impedance for external feed via the EXT 1 or EXT 2 input.

Parameters:

<Impedance> G50|G600|G100K

G100k
100 kOhm to ground

G600
600 Ohm to ground

G50
50 Ohm to ground

*RST: G100K

Example: `INP:MOD:IMP1 G50`
the EXT input is set to 50 Ohm to ground.

Options: R&S SMF-B20

[:SOURce]:INPut:TRIGger:SLOPe <Slope>

Sets the polarity of the active slope of an externally applied trigger signal at the trigger input (BNC connector at the rear of the instrument).

The setting is effective for both inputs at the same time.

Parameters:

<Slope>	NEGative|POSitive *RST: POSitive
Example:	`INP:TRIG:SLOP NEG` the active slope of the external trigger signal at the trigger input is the falling slope.

7.12.8 SOURce:LFOutput Subsystem

This subsystem contains the commands for setting the LF signal source in CW and Sweep mode as well as for analog modulation.

Two internal LF generators and a noise generator are available with option R&S SMF-B20.

The suffix for `LFOutput<ch>` denotes the selected LF generator. The source for the LF sweep (LF generator 1 or 2) is selected with command `SOURce:LFOutput:SWEep:FREQuency:SOURce`.

Example

The following example shows how to set an LF sweep.

1. Set the sweep range.
   ```
   LFOutput:FREQuency:STARt  4 kHz
   LFOutput:FREQuency:STOP  10 kHz
   ```
2. Select linear or logarithmic sweep spacing.
   ```
   LFOutput:SWEep[:FREQuency]:SPACing LIN
   ```
3. Set the step width and dwell time.
   ```
   LFOutput:SWEep[:FREQuency]:STEP[:LINear]  100 Hz
   LFOutput:SWEep[:FREQuency]:DWELl 20 ms
   ```
4. Determine the sweep mode.
   ```
   LFOutput:SWEep:MODE AUTO
   ```
5. Determine the trigger.
   ```
   TRIGger0:SOURce SINGle
   ```
6. Activate the sweep.
   ```
   LFOutput:FREQuency:MODE SWEep
   ```
7. Trigger the sweep (depending on the mode).
   ```
   LFOutput:SWEep:EXECute
   ```

[:SOURce]:LFOutput<ch>:BANDwidth <Bandwidth>

The command selects the bandwith for the external feed via the EXT 1 and/or EXT 2 input. Selection 200 kHz und 10 MHz are available.

Parameters:

<Bandwidth> BW0M2|BW10m

*RST: BW10M

Example: `SOUR:LFO1:BAND BW0M2`
selects the bandwith 200 kHz for the external feed.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:FREQuency <Frequency>

The command sets the frequency of the LF signal for CW mode (`:SOUR:MODE CW`). The setting is valid for all analog modulations (AM/FM/PhiM) with internal modulation source and for the LF Output.

In sweep mode (`SOUR:LFO:FREQ:MODE SWE`), the frequency is linked to the sweep frequency.

Correlation: `LFO:FREQ` for `LFO:FREQ:MODE SWE` linked to sweep frequency.

Parameters:

<Frequency> float

Increment: 0.1 Hz
*RST: 1KHz

Example: `LFO2:FREQ 5kHz`
sets the frequency of the LF generator 2 signal to 5 kHz.

Options: R&S SMF-B20

[:SOURce]:LFOutput:FREQuency:MANual <Manual>

In Sweep mode (`SOUR:LFO:FREQ:MODE SWE`) the command sets the frequency for the next sweep step in the "Step" sweep mode (`SOUR:LFO:SWE:MODE MAN`). Here only frequency values between the settings `SOUR:LFO:FREQ:STAR` and `...:STOP` are permitted. Each sweep step is triggered by a separate `SOUR:LFO:FREQ:MAN` command.

Parameters:

<Manual> float

Range: STARt to STOP
Increment: 0.1 Hz
*RST: 1 kHz
Default unit: Hz

Example: `LFO:SWE:MODE MAN`
sets the "Step" sweep mode.
`LFO:FREQ:MAN 5 kHz`
sets an LF frequency of 5 kHz for the next step in the "Step" sweep mode.
`LFO:FREQ:MODE SWE`
sets the LF Sweep mode. An LF frequency of 5 kHz is output.
`LFO:FREQ:MAN 5.1 kHz`
triggers the next sweep step with a frequency of 5.1 kHz.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput:FREQuency:MODE <Mode>

The command sets the instrument operating mode and therefore also the commands used to set the output frequency.

The source for the LF sweep is selected with command `[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource`.

Parameters:

<Mode> CW|FIXed|SWEep

CW|FIXed
The instrument operates in fixed-frequency mode. `CW` and `FIXed` are synonyms.
The output frequency is set with `[:SOURce]:LFOutput<ch>:FREQuency`.

SWEep
The instrument operates in SWEep mode. The frequency is set using the commands
`[:SOURce]:LFOutput:FREQuency:STARt`,
`[:SOURce]:LFOutput:FREQuency:STOP` or
`[:SOURce]:LFOutput:FREQuency:MANual`.

*RST: CW

Example: `LFO:FREQ:MODE SWE`
sets the SWEep mode. The settings under
`SOURce:LFOutput:FREQuency:STARt; STOP; MANual`
become effective.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput:FREQuency:STARt <Start>

This command sets the start frequency for the LF Sweep mode.

Parameters:

<Start> float

Range: 0.1 Hz to 1 MHz
Increment: 0.1 Hz
*RST: 1 kHz
Default unit: Hz

Example:

`RST*`
activates all presettings.
`LFO:SWE:MODE AUTO`
sets the `AUTO` sweep mode, i.e. each trigger triggers a complete sweep.
`TRIG0:SOUR SING`
sets the `SINGle` trigger mode, i.e. the sweep is triggered by the command `:LFOutput:SWEep:EXECute` or `*TRG`.
`LFO:FREQ:STAR 100 kHz`
sets the start frequency for the LF sweep to 100 kHz.
`LFO:FREQ:STOP 200 kHz`
sets the stop frequency of the LF sweep to 200 kHz.
`LFO:FREQ:MODE SWE`
sets the LF sweep mode.
`LFO:SWE:EXEC`
a one-off LF sweep from 100 kHz to 200 kHz is performed. The linear step width is 1 kHz with a dwell time of 15 ms (preset values).

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput:FREQuency:STOP <Stop>

This command sets the stop frequency for the LF sweep.

Parameters:

<Stop> float

Range: 0.1 Hz to 1 MHz
Increment: 0.1 Hz
*RST: 50 kHz
Default unit: Hz

Example:

`LFO:FREQ:STOP 200 kHz`
sets the stop frequency for the LF sweep to 200 kHz.
`LFO:FREQ:STAR 100 kHz`
sets the start frequency for the LF sweep to 100 kHz.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput:MONitor:MODE <Mode>

The command selects the LF output monitoring mode. The settings for the LF output are synchronized to amplitude modulation or frequency/phase modulation settings.

Parameters:

<Mode> OFF|AM|FMPM

*RST: OFF

Example: `SOUR:LFO:MON:MODE AM`
sets the LF output settings to be synchronized to the amplitude modulation signal.

Options: R&S SMF-B20

[:SOURce]:LFOutput:OFFSet <Offset>

The command sets a DC offset at the LF Output.

Parameters:

<Offset> float

Range: -4 to 4 V
Increment: 0.001 V
*RST: 0 V

Example: `LFO:OFFS 2 V`
sets a DC OFFSet of 2 V

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SOURce <Source>

The command selects the internal and/or external source to be used for the LF Output signal.

Parameters:

<Source> LF1|LF2|NOISe|EXT1|EXT2

Def. value: LF1

Example: `SOUR:LFO1:SOUR NOIS`
selects the noise generator as source for the LF output signal.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>[:STATe] <State>

The command activates/deactivates the LF output.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:LFO1 ON`
activates the LF output. The settings under `LFO:FREQ` and `LFO:SWE` become effective.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:DWELl <Dwell>

The command sets the dwell time for each frequency step of the sweep.

Parameters:

<Dwell> float

Range: 3 ms to 10 s
Increment: 0.1 ms
*RST: 10m

Example: `LFO:SWE:DWEL 20 ms`
sets a dwell time of 20 ms.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute

The command immediately starts an LF sweep.

The MODE setting determines which sweep is executed, e.g. `SOURce:LFOutput:SWEep:FREQuency:MODE STEP`. The command corresponds to the manual-control command `EXECUTE SINGLE SWEEP`.

The command corresponds to the manual-control Execute Single Sweep - LF Sweep.

Example: `LFO:SWE:MODE SING`
sets the single cycle mode of the LF sweep.
`LFO:SWE:EXEC`
starts one cycle of the LF sweep.

Usage: Event

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource <Lfsource>

The command selects the source for the LF sweep.

Parameters:

<LFSource> LF1|LF2

*RST: LF1

Example: `LFO:SWE:LFS LF2`
selects LF generator 2 as the LF frequency sweep source.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer:ACTive <Active>

The command activates the selected marker. The active marker is output with a higher voltage than all other markers.

Parameters:
<Active> NONE|M01|M02|M03|M04|M05|M06|M07|M08|M09|M10

*RST: NONE

Example: `SOUR:LFO:SWE:FREQ:MARKer:ACT M05`
switches on marker 5.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer:AMPLitude <Amplitude>

Sets the amplitude marker attenuation.This value is valid for all markers.

Correlation: The output level reduction is applied to a marker with `SOUR:LFO:SWE:MARK<[1]...10>:PST ON`

Parameters:
<Amplitude> float

Range: 0 to 3
*RST: 1

Example: `SOUR:LFO:SWE:FREQ:MARK:AMPL 1`
the output level is reduced by 1 dB on reaching the mark..

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer:AOFF

The command switches off all active frequency markers. The command triggers an event and therefore has no query form and no *RST value.

Example: `SOUR:LFO:SWE:FREQ:MARK:AOFF`
switches off all frequency markers.

Usage: Event

[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer<ch>:FREQuency <Frequency>

The command sets the frequency of the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the frequency mark.

Parameters:

<Frequency> float

*RST: 300 MHz

Example: `SOUR:LFO:SWE:MARK1:FRQ 200Hz`
sets the frequency mark for marker 1 to 200 Hz.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer<ch>:FSTate <Fstate>

The command activates or deactivates the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the frequency mark.

Parameters:

<Fstate> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:LFO:SWE:FREQ:MARK1:FST ON`
switches on marker 1.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:MARKer<ch>:VSTate <Vstate>

The command activates or deactivates the selected amplitude marker. If activated, the level is reduced by the amplitude entered with command `[SOURce:]LFOutput:SWEep[:FREQuency]:MARKer:AMPLitude` on reaching the mark.

Parameters:

<Vstate> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:LFO:SWE:FREQ:MARK1:VST ON`
the output level is reduced by a constant value if frequency marker 1 is executed.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:MODE <Mode>

The command sets the cycle mode of the LF sweep.

The assignment of the GPIB commands to the sweep modes is given in the description of the sweep menus.

Parameters:

<Mode> AUTO|MANual|STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each frequency step of the sweep is triggered individually, either by varying the "Current Frequency" value using the rotary knob under manual control or by means of a `:LFOutput:FREQ:MAN` command under remote control.
With manual control, the frequency increases or decreases (depending on the direction of the rotary encoder) by the value specified under `SOUR:LFO:SWE:FREQ:STEP:LIN` (linear spacing) or `...:STEP:LOG` (logarithmic spacing).
With remote control, the frequency increases by the value specified under `LFO:SWE:FREQ:STEP:LIN|LOG` which each sent `:LFO:FREQ:MAN` command, irrespective the value entered there.

STEP
Each trigger triggers one sweep step only. The frequency increases by the value entered under `[SOURce:]LFOutput:SWEep:STEP`.

*RST: AUTO

Example: !!ERROR: Document structure missing in rcexample > Must contain atleast one child

Example: `LFO:SWE:MODE AUTO`
selects Mode Auto.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:POINts <Points>

The command sets the number of steps in an LF sweep.

The command is linked to the command `:LFOutput:SWEep[:FREQuency]:STEP` as follows:

- for linear sweeps and `STARt < STOP`
  `POINts = ((STOP-STARt) / STEP:LIN) + 1`
- for logarithmic sweeps and `STARt < STOP`
  `POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `POINTs` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Two separate `POINts` values are used for linear or logarithmic sweep spacing (`LFOutput:SWEep[:FREQuency]:SPACing LIN | LOG`). The command is always effective for the currently set sweep spacing.

Note: The value indicated in the menu and the value set/retrieved by this command differ by 1 as a rule. This is caused by a different calculation of the value indicated in the menu (e.g. linear spacing): Count = (Stop - Start) / Step:Log. (i.e, the transitions are counted not the steps as in remote control). Also, the value is in any case an integer, thus may be rounded.

Parameters:

<Points> float

Increment: 1
*RST: 100

Example:
`LFO:FREQ:STAR`
sets the start frequency to 2 kHz.
`LFO:FREQ:STOP`
sets the stop frequency to 20 kHz
`LFO:SWE:SPAC LIN`
sets linear sweep spacing.
`LFO:SWE:POIN 11`
sets 11 sweep steps for linear sweep spacing. The sweep step width (`STEP`) is automatically set to 2 kHz.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:SHAPe <Shape>

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape> SAWTooth|TRIangle

SAWTooth
One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

*RST: SAWTooth

Example: `SOUR:LFO:SWE:SHAP TRI`
selects the sweep cycle with alternating ascending and descending sweep directions.

[:SOURce]:LFOutput:SWEep[:FREQuency]:SPACing <Spacing>

The command selects linear or logarithmic sweep spacing.

Parameters:

<Spacing> LINear|LOGarithmic

*RST: LINear

Example: `LFO:SWE:SPAC LIN`
selects linear sweep spacing.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] <Linear>

The command sets the step width for the linear sweep.

This command is linked to the command `:LFOutput:SWEep[:FREQuency]:POINts` as follow.

- for `STARt < STOP`:
  `POINts = (((STOP-STARt) / STEP:LIN) + 1`

If `STEP:LIN` changes, the value of `POINTs` is adjusted. The `STARt` and `STOP` value is retained.

Parameters:

<Linear> float

Range: 0 to STOP-STARt
Increment: 0.1 Hz
Default unit: Hz

Example:	`LFO:FREQ:STAR`
	sets the start frequency to 2 kHz.
	`LFO:FREQ:STOP`
	sets the stop frequency to 20 kHz.
	`LFO:SWE:SPAC LIN`
	sets linear sweep spacing.
	`LFO:SWE:STEP 2 kHz`
	sets the sweep step width to 2 kHz. The number of sweep steps for linear sweep spacing (`POINts`) is automatically set to 11.

Options:	R&S SMF-B20

[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

The command specifies the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated (for `STARt < STOP`) using the following formula:

New frequency = Old frequency + `STEP:LOG` x Old frequency

`STEP:LOG` therefore gives the fraction of the old frequency. The frequency is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in percent, whereby the suffix PCT must always be used.

The command is linked to the command `:LFOutput:SWEep[:FREQuency]:POINts` as follows:

- for logarithmic sweeps and `STARt < STOP`:
  `POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `STEP:LOG` changes, the value of `POINts` is adjusted. The `STARt` and `STOP` value is retained.

Parameters:

<Logarithmic>	float Range: 0.01 to 100 Increment: 0.01 *RST: 1 Default unit: PCT

Example:	`LFO:FREQ:STAR`
	sets the start frequency to 1 kHz.
	`LFO:FREQ:STOP`
	sets the stop frequency to 100 kHz.
	`LFO:SWE:SPAC LOG`
	sets logarithmic sweep spacing.
	`LFO:SWE:STEP:LOG 10PCT`
	sets the step width for logarithmic sweep spacing to 10% of the previous frequency in each instance.

Options:	R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:DWELl <Dwell>

The command sets the time taken for each level step of the sweep.

Parameters:

<Dwell> float

Increment: 0.1 ms
*RST: 15 ms

Example: `SOUR:LFO:SWE:VOLT:DWEL 12m`
sets a dwell time of 12 ms for a level sweep.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:EXECute

The command triggers a sweep. The sweep to be executed depends on the set sweep mode (`[:SOURce]:LFOutput:SWEep:VOLTage:MODE`). The command corresponds to the manual-control command **Execute Trigger**.

The command triggers an event and therefore has no query form and no `*RST` value.

Example: `SOUR:LFO:SWE:VOLT:MODE STEP`
sets the STEP trigger mode, i.e. a trigger starts the sweep initially, and then the sweep is generated continously.
`SOUR:LFO:SWE:VOLT:EXEC`
triggers a level sweep.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:LFSource <Lfsource>

The command selects the source for the LF level sweep.

Parameters:

<Lfsource> LF1|LF2

Example: `SOUR:SWE:LFO:VOLT:LFS LF2`
selects LF generator 2 as the LF frequency sweep source.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:MARKer:ACTive <Active>

The command activates the selected marker. The active marker is output with an higher voltage than all other markers.

Parameters:

<Active> NONE|M01|M02|M03|M04|M05|M06|M07|M08|M09|M10

*RST: NONE

Example: `SOUR:LFO:SWE:VOLT:MARK:ACT M05`
sets marker 5 to be the active marker.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:MARKer:AOFF

The command switches off all markers of level sweep. The command triggers an event and therefore has no query form and no *RST value.

Example: `SOUR:LFO:SWE:VOLT:MARK:AOFF`
switches off all level markers.

[:SOURce<hw>]:LFOutput:SWEep:VOLTage:MARKer<ch>:VOLTage <Voltage>

The command sets the voltage mark for the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the voltage mark.

Parameters:

<Voltage> float

Range: 0 to 6
*RST: 0 dBm

Example: `SOUR:LFO:SWE:VOLT:MARK1:VOLT -50`
sets the voltage mark of marker 1 to -50 dBm.

Options: R&S SMF-B20

[:SOURce<hw>]:LFOutput:SWEep:VOLTAGE:MARKer<ch>:VSTate <Vstate>

The command switches on or off the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the voltage mark.

Parameters:

<Vstate> 0|1|OFF|ON

*RST: OFF

Example: `SOUR:LFO:SWE:VOLT:MARK1:VST ON`
switches on marker 1.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:MODE <Mode>

The command sets the cycle mode of the LF level sweep.

Parameters:

<Mode> AUTO|MANual|STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each level step of the sweep is triggered individually, either by varying the **current level** value using the rotary knob under manual control or by means of a `:VOLT:MAN` command under remote control. With manual control, the level increases or decreases (depending on the direction of the rotary encoder) by the value specified under `VOLT:STEP`. With remote control, the level is set directly with the command `VOLT:MAN`.

STEP
Each trigger triggers one sweep step only. The level increases by the value entered under `:SWEep:VOLTage:STEP:LOGarithmic`.

Example: `LFO:SWE:VOLT:MODE AUTO`
selects mode "Auto" for a LF level sweep.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:POINts <Points>

The command defines the number of "LF Level" sweep steps.The command is linked to the command `:SWEep:POWer:STEP` as follows:

POINts = (STOP - STARt) / STEP:LOG) + 1

If `POINTs` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Note: The value indicated in the menu and the value set/retrieved by this command differ by 1 as a rule. This is caused by a different calculation of the value indicated in the menu: Count = (Stop - Start) / Step:Log. (i.e, the transitions are counted not the steps as in remote control) Also, the value is in any case an integer, thus may be rounded.

Parameters:

<Points> float

Example: `LFO:SWE:VOLT:POINts 25`
sets the number of sweep steps to 25.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:SHAPe <Shape>

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape> SAWTooth|TRIangle

SAWTooth
One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start level again.

Example: `SOUR:LFO:SWE:VOLT:SHAP TRI`
selects the sweep cycle with alternating ascending and descending sweep directions.

Options: R&S SMF-B20

[:SOURce]:LFOutput:SWEep:VOLTage:STEP[:LINear] <Linear>

The command sets the step width for the level setting if UP and DOWN are used as the level values and variation mode `:SOUR:LFO:POW:STEP:MODE USER` is selected. The command is linked to setting Variation Step for manual control, i.e. the command also sets the step width of the rotary knob for "Variation Active" on.

Parameters:

<Linear> float

Range: 0 to 6
*RST: 0.1 V

Example: `SOUR:LFO:SWE:VOLT:STEP:LIN 2 or VOLT:STEP 2`
sets the step width for entering the LF level to 2 V.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe <Shape>

The command selects the shape of the LF generator.

Parameters:

<Shape> SINE|SQUare | TRIangle|TRAPeze

*RST: SINE

Example: `LFO:SHAP SQU`
selects a rectangular shape for the signal of the LF generator.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:PULSe:DCYCle <Dcycle>

The command sets the duty cycle for the shape pulse.

Parameters:

<Dcycle> float

Range: 0 to 100
Increment: 0.001 PCT
*RST: 50 PCT

Example: `SOUR:LFO2:SHAP:PULS:DCYC 50PCT`
sets a duty cycle of 50% for the pulse shape of the signal of LF generator 1.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:PULSe:PERiod <Period>

The command sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period> float

Increment: 0.01 µs
*RST: 1 ms

Example: `SOUR:LFO2:SHAP:PULS:PER 10s`
sets a pulse period of 10s for the pulse shape of the signal of LF generator 2.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:PULSe:WIDTh <Width>

The command sets the width of the generated pulse. The width determines the pulse length.

Parameters:

<Width> float

Increment: 0.01 µs
*RST: 1 ms

Example: `SOUR:LFO2:SHAP:PULS:WIDT 10s`
sets a pulse width of 10 s for the pulse shape of the signal of LF generator 2.

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:FALL <Fall>

The command selects the fall time for the trapeze shape of the LF generator.

Parameters:

<Fall> float

Range: 0.2 us to 2.5 s
Increment: 200 ns
*RST: 0.25 ms

Example: `SOUR:LFO2:SHAP:TRAP:FALL 100s`
selects a fall time of 100 s for trapezoid shape of the signal of LF generator 2.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:HIGH <High>

The command sets the high time for the trapeze shape of the LF generator.

Parameters:

<High> float

Range: 0.2 us to 2.5 s
Increment: 200 ns
*RST: 1us

Example: `SOUR:LFO2:SHAP:TRAP:HIGH 100s`
selects a high time of 100 s for trapeze shape of the signal of LF generator 2.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:PERiod <Period>

The command sets the period of the generated trapezoid shape.

Parameters:

<Period> float

Increment: 0.01 µs
*RST: 1 ms

Example: `SOUR:LFO2:SHAP:TRAP:PER 100s`
sets a pulse period of 100 s for the trapezoid shape of the signal of LF generator 2.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:RISE <Rise>

The command selects the rise time for the trapeze shape of the LF generator.

Parameters:

<Rise> float

Range: 0.2 us to 2.5 s
Increment: 200 ns
*RST: 0.25 ms

Example: `SOUR:LFO2:SHAP:TRAP:RISE 100s`
selects a rise time of 100 s for trapeze shape of the signal of LF generator 2.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:TRIangle:PERiod <Period>

The command sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period> float

Increment: 0.01 µs
*RST: 1 ms

Example: `SOUR:LFO2:SHAP:TRIA:PER 100s`
sets a pulse period of 100 s for the pulse shape of the signal of LF generator 2.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:SHAPe:TRIangle:RISE <Rise>

The command selects the rise time for the triangle shape of the LF generator.

Parameters:

<Rise> float

Increment: 0.1 ns
*RST: 0.5 ms

Example: `SOUR:LFO1:SHAP:TRI:RISE 13s`
selects a rise time of 13 s for triangle shape of the signal of LF generator 1.

Options: R&S SMF-B20

[:SOURce]:LFOutput<ch>:VOLTage <Voltage>

The command sets the output voltage of the LF output.

Parameters:

<Voltage> float

Range: 0 to 5
*RST: 1 V

Example: `SOUR:LFO1:VOLT 3V`
sets the voltage of the LF output to 3 V.

Options: R&S SMF-B20

[:SOURce]:LFOutput:VOLTage:MANual <Manual>

In Sweep mode (`:SOUR:LFO:VOLT:MODE SWE`) the command sets the level for the next sweep step in the "Step" sweep mode (`:SOUR:LFO:SWE:VOLT:MODE MAN`). Here only level values between the settings `[:SOUR]:LFO:VOLT:STAR` and `...:STOP` are permitted. Each sweep step is triggered by a separate `:SOUR:LFO:VOLT:MAN` command.

As with the "Level" value entered in the "LF Level" dialog, the "OFFSet" value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other "OFFSet" values can be calculated using the following formula:

Minimum level + OFFSet ... Maximum level + OFFSet

Parameters:

<Manual> float

Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model. The values are given in the data sheet.

Range: 0 to 6

Example: `SOUR:LFO:SWE:VOLT:MODE MAN`
sets the Step sweep mode.
`SOUR:LFO:VOLT:MAN -5dBm`
sets an RF level of -5 dBm for the next setting in the Step sweep mode.
`SOUR:LFO:VOLT:MODE SWE`
sets the Level Sweep mode.
`SOUR:LFO:VOLT:MAN -5.5dBm`
triggers the next sweep step with a level of -5.5 dBm.

Options: R&S SMF-B20

[:SOURce]:LFOutput:VOLTage:MODE <Mode>

The command sets the instrument operating mode and therefore also the commands used to set the LF output level.

Parameters:

<Mode> CW|SWEep

CW
The instrument operates at a constant level. The output level is set with `:SOURce:LFOutput:POWer`.

SWEep
The instrument operates in SWEep mode. The level is set using the commands `SOURce:LFOutput:POWer:STARt; STOP; MANual`.

*RST: CW

Example: `SOUR:LFO:VOLT:MODE SWE`
sets the SWEep mode. The settings under `SOURce:LFOutput:POW:STARt; STOP; MANual` become effective.

Options: R&S SMF-B20

[:SOURce]:LFOutput:VOLTage:STARt <Start>

The command sets the LF start level in sweep mode.

As with the "Level" value entered in the "LF Level" dialog, the "OFFSet" value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:LFOutput:Sweep:POWer:OFFSet` is set to 0. The value range for other "OFFSet" values can be calculated using the following formula:

Minimum level + OFFSet ...Maximum level + OFFSet

Parameters:

<Start> float

Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model. The values are given in the data sheet.

Range: 0 to 6
Increment: 0.1 mV
*RST: 1 V

Example: `SOUR:LFO:VOLT:STAR 5V`
sets the start level for the LF level sweep to 5 V.

Options: R&S SMF-B20

[:SOURce]:LFOutput:VOLTage:STOP <Stop>

The command sets the stop level in LF sweep mode.

As with the "Level" value entered in the "LF Level" menu, the "OFFSet" value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:LFOutput:SWEep:POWer:OFFSet` is set to 0. The value range for other "OFFSet" values can be calculated using the following formula:

Minimum level + OFFSet ...Maximum level + OFFSet

Parameters:

<Stop> float

Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model. The values are given in the data sheet.

Range: 0 to 6
Increment: 0.1 mV
*RST: 1 V

Example: `SOUR:LFO:VOLT:STOP 6V`
sets the stop level for the LF level sweep to 6 V.

Options: R&S SMF-B20

7.12.9 SOURce:LIST Subsystem

This subsystem contains the commands for the List mode of the instrument.

The following settings are required to operate the instrument in List mode:

1. Create a list.
   If a list which does not exist is selected with the `:LIST:SEL` command, an empty list with the name of the selected list is created.
   `SOURce1:LIST:SEL "New_list"`
2. Fill the list with values.
   All list components must be of the same length. This does not apply to components of length 1. This is interpreted as if the component has the same length as the other components and as if all values are the same as the first value.
   `SOURce1:LIST:FREQ 100 MHz, 110 MHz, 120 MHz,...`
   `SOURce1:LIST:POW 2dBm, -1dBm, 0dBm,...`
3. Select a list.
   If a new empty file has been created with the `:LIST:SEL` command, this file is selected, otherwise an existing list must be selected before the List mode is activated.
   `SOURce1:LIST:SEL "Old_list"`
4. Set the dwell time.
   The dwell time determines the duration of the individual list steps.

`SOURce1:LIST:DWELl 3ms`

5. Set the List mode.
   The List mode determines the way in which the list is processed. In the example the list is processed once only or repeatedly depending on the trigger setting.
   `SOURce1:LIST:MODE AUTO`
6. Determine the trigger.
   In the example each trigger causes the list to be processed once from beginning to end.
   `SOURce:LIST:TRIGger:SOURce SINGle`
7. Activate the List mode.
   `SOURce1:FREQuency:MODE LIST`
8. Trigger the list (depending on the mode).
   `SOURce1:LIST:TRIGger:EXECute`
9. Deactivate the List mode.
   `SOURce1:FREQuency:MODE CW`

SCPI refers to the individual lists as segments.

[:SOURce<hw>]:LIST:CATalog?

The command requests a list of available lists. The individual lists are separated by commas.

The lists are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog> string

Example: `MMEM:CDIR '/var//Lists/Listmode'`
selects the directory for the list mode files.
`LIST:CAT?`
queries the available lists.
Response: `'list1,list2'`
the lists `list1` and `list2` are available.

Usage: Query only

[:SOURce<hw>]:LIST:DELete <Delete>

The command deletes the specified list.

The files are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. To access the files in this directory, only the file name has to be given, without the path and the file extension. A path can also be specified in command `:SOUR:LIST:CAT?`, in which case the file in the specified directory is deleted.

`*RST` does not affect data lists.

Setting parameters:

<Delete> <list file name>

Example: `MMEM:CDIR '/var//Lists/Listmode'`
selects the directory for the list mode files.
`LIST:DEL 'LIST1'`
deletes the list `list1`.

Usage: Setting only

[:SOURce<hw>]:LIST:DELete:ALL

The command deletes all lists in the set directory. The List mode must be deactivated beforehand to ensure that no lists are selected when this command is called (`SOUR:FREQ:MODE CW or SWE`).

The files are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:CAT?`, in which case all list mode files in the specified directory are deleted.

*RST does not affect data lists.

Example: `MMEM:CDIR '/var//Lists/Listmode'`
selects the directory for the list mode files.
`FREQ:MODE SWE`
deactivates the List mode for RF output and activates the Sweep mode.
`SOUR2:FREQ:MODE SWE`
deactivates the List mode for RF output and activates Sweep mode.
`LIST:DEL:ALL`
deletes all list mode files available in the set directory.

Usage: Event

[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of list mode data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:
<Catalog> string

Example: `MMEM:CDIR '/var//lists/listmode/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`LIST:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension `*.txt` are listed.
`LIST:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response:`'list1,list2'`
the ASCII files `list1.txt` and `list2.txt` are available.

Usage: Query only

[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension <Extension>

The command selects the file extension of the ASCII file to be imported or exported. Selection `TXT` (text file) or `CSV` (Excel file) is available.

Parameters:

<Extension> TXT|CSV

*RST: TXT

Example: `MMEM:CDIR '/var//lists/listmode/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`LIST:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension `*.txt` are listed.
`LIST:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response: `'list1,list2'`
the ASCII files `list1.txt` and `list2.txt` are available.

[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect <Select>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:DEXC:AFIL:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:

<Select> <ascii_file_name>

Example: `LIST:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.
`LIST:DEXC:AFIL:SEL '/var//user/listmode/import/list.csv'`
selects that ASCII file `list.csv` is imported.
`LIST:DEXC:SEL '/var//user/listmode/import/list_imp'`
selects that the ASCII file list.csv is imported into list mode list `list_imp`.

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn <Column>

The command selects the separator between the frequency and level column of the ASCII table.

Parameters:

<Column> TABulator|SEMicolon|COMMa|SPACe

*RST: COMMa

Example:

`LIST:DEXC:MODE EXP`

selects that the list mode list is exported into an ASCII file.

`LIST:DEXC:AFIL:SEL '/var//user/listmode/import/list.csv'`

selects ASCII file `list.csv` as destination for the list mode list data.

`LIST:DEXC:AFIL:SEP:COL TAB`

the pairs of frequency and level values are separated by a tabulator.

`LIST:DEXC:AFIL:SEP:DEC DOT`

selects the decimal separator dot.

`LIST:DEXC:SEL '/var//user/listmode/import/list_imp'`

selects that the list mode list `list_imp` is imported into ASCII file `list.csv`.

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal <Decimal>

The command the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Parameters:

<Decimal> DOT|COMMa

*RST: DOT

Example:

`LIST:DEXC:MODE EXP`

selects that the list mode list is exported into an ASCII file.

`LIST:DEXC:AFIL:SEL '/var//user/listmode/import/list.csv'`

selects ASCII file `list.csv` as destination for the list mode list data.

`LIST:DEXC:AFIL:SEP:COL TAB`

the pairs of frequency and level values are separated by a tabulator.

`LIST:DEXC:AFIL:SEP:DEC DOT`

selects the decimal separator dot.

`LIST:DEXC:SEL 'root/var//user/listmode/import/list_imp'`

selects that the list mode list `list_imp` is imported into ASCII file `list.csv`.

[:SOURce<hw>]:LIST:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected, the ASCII file is imported as list mode list. When export is selected, the list mode list is exported into the selected ASCII file.

Example:
`LIST:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.
`LIST:DEXC:AFIL:SEL '/var//user/listmode/import/list.csv'`
selects that ASCII file `list.csv` is imported.
`LIST:DEXC:SEL '/var//user/listmode/import/list_imp'`
selects that the ASCII file list.csv is imported into list mode list `list_imp`.
`LIST:DEXC:EXEC`
starts the import of the ASCII file data into the list mode file.

Usage: Event

[:SOURce<hw>]:LIST:DEXChange:MODE <Mode>

The command selects if list mode lists should be imported or exported. Depending on the selection her, the file select command define either the source or the destination for list mode lists and ASCII files.

Parameters:

<Mode> IMPort|EXPort

*RST: IMPort

Example:
`LIST:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.
`LIST:DEXC:AFIL:SEL '/var//user/listmode/import/list.csv'`
selects that ASCII file `list.csv` is imported.
`LIST:DEXC:SEL 'root/var//user/listmode/import/list_imp'`
selects that the ASCII file `list.csv` is imported into list mode list `list_imp`.

[:SOURce<hw>]:LIST:DEXChange:SELect <Select>

The command selects the list mode list to be imported or exported.

The list mode files are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:DEXC:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:

<Select> <list_name>

Example:
`LIST:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.
`LIST:DEXC:AFIL:SEL '/var//user/listmode/import/list.csv'`
selects that ASCII file `list.csv` is imported.
`LIST:DEXC:SEL '/var//user/listmode/import/list_imp'`
selects that the ASCII file `list.csv` is imported into list mode list `list_imp`.

[:SOURce<hw>]:LIST:DWELl <Dwell>

The command sets the time for which the instrument retains a setting.

Parameters:

<Dwell> float

Range: 0.1 ms to 100 s
*RST: 15 ms

Example:
`LIST:DWEL 15`
each setting in the list is retained for 15 ms.

Usage: SCPI conform

[:SOURce<hw>]:LIST:FREQuency <Frequency>

The command fills the `FREQuency` part of the selected list with data.

`*RST` does not affect data lists.

Parameters:

<Frequency> <Frequency#1>{, <Frequency#2>, ...} | block data

The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data. When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see `:FORMat[:DATA]` on page 240).

Range: 300 kHz to RFmax (RFmax depending on model)

Example:
`LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for editing. List3 is created if it does not yet exist.
`SOUR:LIST:FREQ 1.4GHz, 1.3GHz, 1.2GHz,...`
specifies the frequency values in list3. If the list already contains data, it is overwritten.

Usage: SCPI conform

[:SOURce<hw>]:LIST:FREQuency:POINts?

The command queries the length (in points) of the FREQuency component of the selected list.

Return values:

<Points> float

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for editing. List3 is created if it does not yet exist.
`LIST:FREQ:POIN?`
queries the number of frequency values in list3.
`Response: 327`
list3 has 327 frequency entries.

Usage: Query only

[:SOURce<hw>]:LIST:INDex <Index>

The command sets the list index in step mode (`LIST:MODE STEP`).

After the trigger signal the frequency and level settings of the selected index are processed in List mode.

Parameters:

<Index> float

*RST: 0

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for use in List mode.
`FREQ:MODE LIST`
activates List mode. `List3` is processed.
`LIST:MODE STEP`
selects manual, step-by-step processing of the list.
`LIST:IND 5`
the frequency/level value pair with index 5 is executed.
`TRIG:LIST:SOUR SING`
selects triggering by means of the single trigger. The list is executed once.
`SOUR:LIST:TRIG:EXEC`
triggers the processing of the selected list.

[:SOURce<hw>]:LIST:INDex:STARt <Start>

The command sets the start index of the index range which defines a subgroup of frequency/level value pairs in the current list. Only the values in the set index range (`:LIST:INDex:STARt ... :LIST:INDex:STOP`) are processed in List mode.

Parameters:

<Start> float

Range: 0 to list length
*RST: 0

Example:
`LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for use in List mode.
`LIST:IND:STAR 25`
sets 25 as start index of the index range.
`LIST:IND:STOP 49`
sets 49 as stop index of the index range.
`FREQ:MODE LIST`
activates List mode. The frequency/level value pairs from index 25 to index 49 in list3 are processed. All other entries of the list are ignored.

[:SOURce<hw>]:LIST:INDex:STOP <Stop>

The command sets the stop index of the index range which defines a subgroup of frequency/level value pairs in the current list. Only the values in the set index range (`:LIST:INDex:STARt ... :LIST:INDex:STOP`) are processed in List mode.

Parameters:

<Stop> float

Range: 0 to list length
*RST: 0

Example:
`LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for use in List mode.
`LIST:IND:STAR 25`
sets 25 as start index of the index range.
`LIST:IND:STOP 49`
sets 49 as stop index of the index range.
`FREQ:MODE LIST`
activates List mode. The frequency/level value pairs from index 25 to index 49 in list3 are processed. All other entries of the list are ignored.

[:SOURce<hw>]:LIST:LEARn

The command learns the selected list, i.e. it determines the hardware setting for the entire list. The data determined in this way is stored together with the list. When the list is activated for the first time, these settings are calculated automatically.

Example:
`LIST:SEL '/var//Lists/Listmode/list3'`
selects list3. List3 is created if it does not yet exist.
`LIST:LEAR`
starts learning of the hardware setting for list3 and stores the setting.

Usage: Event

[:SOURce<hw>]:LIST:MODE <Mode>

The command specifies how the list is to be processed (similar to `SOURce:SWEep:MODE`).

Parameters:

<Mode> AUTO|STEP

AUTO
Each trigger event triggers a complete list cycle. Possible trigger settings for `:LIST:TRIGger:SOURce` are `AUTO`, `SINGle` and `EXT`.

STEP
Each trigger event triggers only one step in the list processing cycle. The list is processed in ascending order.

*RST: AUTO

Example: `LIST:MODE STEP`
selects step-by-step processing of the list.

Usage: SCPI conform

[:SOURce<hw>]:LIST:POWer <Power>

The command fills the Level part of the selected list with data.

*RST does not affect data lists.

Parameters:

<Power> <Power#1>{, <Power#2>, ...} | block data

The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data. When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see `:FORMat[:DATA]` on page 240).

Range: Minimum level to Maximum level
Default unit: dBm

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for editing. List3 is created if it does not yet exist.
`LIST:POW 0dBm, 2dBm, 2dBm, 3dBm,..`
specifies the level values in `list3`. The number of level values must correspond to the number of frequency values. The previous data is overwritten.

Usage: SCPI conform

[:SOURce<hw>]:LIST:POWer:AMODe <Amode>

The command selects the ranges of level settings for the list mode. The level settings are either performed in the low level or in the high level ranges.

Parameters:

<Amode> NORMal|HPOWer

NORMal
The level settings are made in the range of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made in the range of the option. Only the high level range is available.

*RST: NORMal

Example: `LIST:POW:AMOD HPOW`
selects the high level ranges for List Mode.

[:SOURce<hw>]:LIST:POWer:POINts?

The command queries the length (in points) of the LEVel part of the selected list.

Return values:

<points> float

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for editing. List3 is created if it does not yet exist.
`LIST:POW:POIN?`
queries the number of levels in list3.
Response: `327`
LIST2 has 327 level entries.

Usage: Query only
SCPI conform

[:SOURce<hw>]:LIST:RESet

The command resets the list to the starting point.

Example: `LIST:RES`
resets the list to the starting point.

Usage: Event

[:SOURce<hw>]:LIST:SELect <Select>

The command selects the specified list. If a new list is to be created, the name can be entered here. The list is created if it does not yet exist. The list selected here is available for the further processing steps (editing) and is used in the instrument when the List mode is activated.

The files are stored with the fixed file extensions *.lsw in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. A path can also be specified in command `:SOUR:LIST:SEL` in which case the list mode file in the specified directory is selected.

*RST does not affect data lists.

Parameters:

<Select> '<list name>'

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
selects list3 for editing. List3 is created if it does not yet exist.

[:SOURce<hw>]:LIST:TRIGger:EXECute

The command immediately starts the processing of a list in list mode. It corresponds to the manual-control command "Execute Single."

Example: `SOUR:LIST:TRIG:EXEC`
triggers the processing of the selected list.

Usage: Event

[:SOURce<hw>]:LIST:TRIGger:SOURce <Source>

The command sets the trigger source for the LIST mode.

The names of the parameters correspond to those under sweep mode. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. An overview of the various names is given in the following table:

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	`MODE AUTO`
SINGle	BUS	`MODE SINGLE` or `STEP`
EXTernal	EXTernal	`MODE EXT TRIG SINGLE` or `EXT TRIG STEP`

Parameters:

<Source> AUTO|IMMediate | SINGle|BUS | EXTernal

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. The selected list in List mode is restarted as soon as it is finished.

SINGle|BUS
The list is triggered by the GPIB commands `[:SOURce<hw>]:LIST:TRIGger:EXECute`. The list is executed once.

EXTernal
The list is triggered externally via the INST TRIG connector. The list is executed once.

*RST: SINGle

Example: `LIST:TRIG:SOUR EXT`
selects triggering by means of the external trigger.

7.12.10 SOURce:MODulation Subsystem

This subsystem contains the command for switching on/off all modulations.

[:SOURce<hw>]:MODulation[:ALL]:STATe <State>

The command switches the modulations on and off.

The command `SOUR:MOD:ALL:STAT OFF` switches all modulations off. A subsequent command `SOUR:MOD:ALL:STAT ON` restores the status that was active before the last switch-off. "MOD OFF" is displayed in the info line of the header next to the "Level" field.

Parameters:

<State> 0|1|OFF|ON

Example: `MOD:STAT OFF`
switches off all modulations.

7.12.11 SOURce:NOISe Subsystem

The `SOURce:NOISe` subsystem contains the commands for setting the noise modulation signal. The noise generator is optional.

[:SOURce<hw>]:NOISe:BWIDth <Bwidth>

This command sets the noise level in the system bandwidth for enabled bandwidth limitation. Distinct bandwidth settings between 10 kHz and 10 MHz in 100 kHz steps (range 100 .. 1 MHz), 1 MHz (range 1 MHz .. 5 MHz) and 5 MHz (5 MHz … 10 MHz) are possible.

Parameters:

<Bwidth> float

Range: 100 kHz to 10 MHz
Increment: 100 kHz
*RST: 100 kHz

Example: `NOIS:BWID:STAT ON`
enables bandwidth limitation.
`NOIS:BWID 1 MHz`
sets a system bandwidth of 1 MHz.

Options: R&S SMF-B20

[:SOURce<hw>]:NOISe:DISTribution <Distribution>

Selects the noise power density distribution of the noise.

Parameters:

<Distribution> GAUSs|EQUal

*RST: GAUSs

Example: `NOIS:DIST GAUS ON`
selects Gaussian distribution.

Options: R&S SMF-B20

[:SOURce<hw>]:NOISe:LEVel:RELative?

This command queries the level of the noise signal per Hz in the total bandwidth.

Return values:

<Relative> float

Example: `NOIS:LEV:REL?`
queries the noise level

Usage: Query only

Options: R&S SMF-B20

[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?

This command queries the level of the noise signal in the system bandwidth for enabled bandwidth limitation.

Return values:

<Absolute> float

Example: `NOIS:BWID:STAT ON`

enables bandwidth limitation.

`NOIS:BWID 10 MHz`

sets a system bandwidth of 1 MHz.

`NOIS:LEV:ABS`

queries the noise level in the system bandwidth

Usage: Query only

Options: R&S SMF-B20

7.12.12 SOURce:PGEN Subsystem

This subsystem contains the commands for setting the pulse generator.

[:SOURce<hw>]:PGEN:OUTPut:POLarity <Polarity>

The command sets the polarity between modulating and modulated signal. This command is effective only for an internal modulation signal.

Parameters:

<Polarity> NORMal|INVerted

NORMal

The RF signal is suppressed during the pulse pause.

INVerted

The RF signal is suppressed during the pulse.

Example: `PGEN:OUTP:POL INV`

selects inverted polarity.

Options: R&S SMF-K23

[:SOURce<hw>]:PGEN:OUTPut[:STATe] <State>

The command activates/deactivates the pulse generator output.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `PGEN:OUTP ON`

activates pulse generator output.

Options: R&S SMF-K23

7.12.13 SOURce:PHASe Subsystem

This subsystem contains the commands for adjusting the phase of the RF output signal relative to a reference signal of the same frequency.

[:SOURce<hw>]:PHASe <Phase>

The command specifies the phase variation relative to the current phase. The variation can be specified in RADians.

Parameters:

<Phase> float

Range: -359.9 to 359.9
Increment: 0.1 deg
*RST: 0.0 deg

Example: `PHAS 2DEG`
changes the phase by 2 degrees relative to the current phase.
`PHAS:REF`
adopts the set phase as the current phase.

Usage: SCPI conform

[:SOURce<hw>]:PHASe:REFerence

The command adopts the phase set with `SOURce:PHASe:ADJust` as the current phase.

Example: `PHAS 0.1RAD`
changes the phase by 0.1 RAD relative to the current phase.
`PHAS:REF`
adopts the set phase as the current phase.

Usage: Event
SCPI conform

7.12.14 SOURce:PM Subsystem

The PM subsystem contains the commands for checking the phase modulation. The settings for the internal modulation source (LF generator) are made in the SOURce:LFOutput subsystem.

The external signal is input at the EXT1 and EXT2 connector.

For information about the required options, see chapter 5.5.4, "Phase Modulation (PhiM)", on page 148.

[:SOURce]:PM<ch>[:DEViation] <Deviation>

Sets the modulation deviation in RAD or degrees.

Parameters:

<Deviation> float

Example: `PM1:DEV 20RAD`

selects a deviation of 20 RAD for the selected modulation source for path 1.

Options: R&S SMF-B20

[:SOURce<hw>]:PM:MODE <Mode>

The command selects the mode for the phase modulation.

Parameters:

<Mode> HBANdwidth|HDEViation|LNOise

HBANdwidth
The maximum range for modulation bandwidth is available. However, phase noise is increased for low frequencies. The range for PhiM deviation is limited. This mode is recommended for high modulation frequencies.

HDEViation
The maximum range for PhiM deviation is available. Phase noise is improved for low frequencies. The range for modulation frequency is limited (see data sheet). This mode is recommended for low modulation frequencies and/or high PhiM deviation.

LNOise
Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and PM deviation is limited (see data sheet)

*RST: HBANdwidth

Example: `PM:MODE LNO`

selects Low Noise mode for external phase modulation.

Usage: SCPI conform

Options: R&S SMF-B20

[:SOURce<hw>]:PM:RATio <Ratio>

The command sets the path 1/path 2 ratio in percent.

Parameters:

<Ratio> float

Range: 0 to 100
Increment: 0.01
*RST: EXT1

Example: `PM:RAT 50PCT`
sets the path 1/path 2 ratio to 50 percent.

Options: R&S SMF-B20

[:SOURce<hw>]:PM<ch>:SOURce <Source>

Selects the source for the phase modulation signal.

Parameters:

<Source> LF1|LF2|NOISe|EXT1|EXT2

*RST: EXT1

Example: `PM1:SOUR LF2`
selects the LF generator 2 as internal modulation source for path 1.

Options: R&S SMF-B20

[:SOURce<hw>]:PM<ch>:STATe <State>

The command activates/deactivates phase modulation.

Activation of phase modulation deactivates frequency modulation.

Parameters:

<State> 0|1|OFF|ON

Example: `PM1:STAT ON`
activates PM modulation for path 1.

Options: R&S SMF-B20

7.12.15 SOURce:POWer Subsystem

This subsystem contains the commands for setting the output level, level control and level correction of the RF signal.

Other units can also be used instead of dBm:

- by entering the unit directly after the numerical value (example `:POW 0.5V`)
- by changing the DEFault unit in the `UNIT` system (see the command `:UNIT:POWer`).

[:SOURce<hw>]:POWer:ALC:PMETer:TYPE <Type>

The command selects the power meter used for external level control.

Parameters:

<Type> NRP|NRVD|HP436|HP437|HP438|ML2438|P44X

*RST: NRP

Example: `POW:ALC:PMET:TYPE HP438`

the specified power meter is used for external level control.

[:SOURce<hw>]:POWer:ALC:REFerence <Reference>

The command sets the reference voltage for external power control. See specification of the used instrument for external power control for details.

Parameters:

<Reference> float

Range: 0.0 to 2.5

*RST: 1.5

Example: `SOUR:POW:ALC:REF 0.37`

sets a refebrence voltage of 0.37 volt.

[:SOURce<hw>]:POWer:ALC:SONCe

The command briefly activates level control for correction purposes.

Example: `POW:ALC OFF`
deactivates automatic level control for RF output A.
`POW:ALC:SONC`
level control is performed once only.

Usage: Event

[:SOURce<hw>]:POWer:ALC:SOURce <Source>

The command selects the detector for level control.

Parameters:

<Source> INTernal|DIODe|PMETer

INTernal
The internal detector is switched on.

DIODe
A diode detector can be connected to the EXT ALC input.

PMETer
A power meter can be connected to the EXT ALC input.

*RST: INT

Example: `POW:ALC:SOUR INT`
sets the internal detector for level control.

[:SOURce<hw>]:POWer:ALC[:STATe] <State>

The command activates/deactivates automatic level control.

Parameters:

<State> ON|OFF

ON
Internal level control is permanently activated. This provides the highest level accuracy.

OFF
Internal level control is deactivated, **Sample & Hold** mode is activated.

*RST: ON

Example: `POW:ALC ON`
activates internal level control.

[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE <Mode>

The command selects the mode of the mechanical attenuator, when the RF signal is switched off.

The setting of the RF OFF mode is not affected by an instrument preset (PRESET key), `*RST` and the "Save/Recall" function. This parameter is influenced only by the Factory Preset.

Parameters:

<Mode> NORMal|ATTenuated

NORMal
The current attenuation remains when the RF signal is switched off and thus provides fast and wear-free switching.

ATTenuated
The attenuation is set to maximum when the RF signal is switched off. This setting is recommended for applications that require a high level of noise suppression.

Example: `SOUR:POW:ATT:RFOF:MODE ATT`
sets the RF OFF attenuator to maximum.

Options: R&S SMF-B26 or R&S SMF-B27

[:SOURce]:POWer:ATTenuation <Attenuation>

The command sets the attenuation.

Parameters:

<Attenuation> float

Range: 0.0 to 110.0
*RST: 0

Example: `SOUR:POW:ATT 20dB`
sets the power attenuation to 20 dB.

[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

The command sets the RF output level in CW mode. In addition to numerical values, it is also possible to specify `UP` and `DOWN`. The level is then increased or decreased by the value specified under `[SOURce<hw>:]POWer:STEP`.

As with the **Level** value entered in the header, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFSet` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

The keywords of this command are largely optional. Therefore, both the long and short form of the command are shown in the example.

Parameters:

<Amplitude> Minimum level ... Maximum level

The value range for the level setting varies according to the instrument model.
The values are given in the data sheet.

Increment: 0.01 dB
*RST: -30 dBm
Default unit: dBm

Example: `SOUR:POW:LEV:IMM:AMPL 15`
or
`:POW 15`
sets the RF level at output A to 15 dBm.

Usage: SCPI conform

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Note: The level offset is also effective for level sweeps!

The command specifies the constant level offset of a downstream attenuator/amplifier. If a level offset is entered, the level entered with `:POWer` no longer corresponds to the RF output level.

The following correlation applies:

`:POWer` = RF output level + `POWer:OFFSet`.

Entering a level offset does not change the RF output level, but rather the query value of `:POWer`.

For more information, see chapter 5.4.1.1, "RF level vs. RF output level", on page 80.

Only dB is permitted as the unit here. The linear units (V, W, etc.) are not permitted.

The keywords of this command are largely optional. Therefore, both the long and short form of the command are shown in the example.

Parameters:

<Offset> float

Range: -100 dB to 100 dB
Increment: 0.01 dB
*RST: 0 dB
Default unit: dB

Example: `SOURce:POWer:LEVel:IMMediate:OFFSet -10`
or
`POW:OFFS 10`
sets the RF level offset to 10 dB

Usage: SCPI conform

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL <Rcl>

The command determines whether the current level is retained or whether the stored level setting is adopted when an instrument configuration is loaded.

`*RST` does not affect this setting.

Parameters:

<Rcl> INCLude | EXCLude

INCLude
The stored level is also loaded when a stored instrument configuration is loaded.

EXCLude
The RF level is not loaded when a stored instrument configuration is loaded. The current level is retained.

*RST: no default

Example: `POW:RCL INCL`
the stored level is set if the Recall command is called.

Usage: SCPI conform

[:SOURce<hw>]:POWer:LIMit[:AMPLitude] <Amplitude>

The command limits the maximum RF output level in CW and SWEEP mode. It does not influence the "Level" display or the response to the `POW?` query command.

The value is not affected by an instrument preset (PRESET key), `*RST` and the Save/Recall function. This parameter is influenced only by the factory preset (`SYST:FPR`) and its factory value is equal to the upper limit.

Parameters:

<Amplitude> float

Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model.
The values are given in the data sheet.

Increment: 0.01 dB
*RST: 30 dBm
Default unit: dBm

Example: `SOURce:POWer:LIMit:AMPLitude 10`
or
`:POW:LIM 10`
limits the RF level to maximum +10 dBm.

Usage: SCPI conform

[:SOURce<hw>]:POWer:MANual <Manual>

In Sweep mode `(:SOUR:POW:MODE SWE)` the command sets the level for the next sweep step in the Step sweep mode (`:SOUR:SWE:POW:MODE MAN`). Here only level values between the settings `[:SOUR]:POW:STAR` and `[:SOUR]:POW:STOP` are permitted. Each sweep step is triggered by a separate `:SOUR:POW:MAN` command.

As with the "Level" value entered in the "RF Level" menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

Parameters:

<Manual> float

Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model
The values are given in the data sheet.

Increment: 0.01 dBm
*RST: -30 dBm
Default unit: dBm

Example: `POW:SWE:MODE MAN`
sets the Step sweep mode for RF output A.
`POW:MAN -5 dBm`
sets an RF level of -5 dBm for the next setting in the Step sweep mode for RF output A.
`POW:MODE SWE`
sets the Level Sweep mode for RF output A.
`POW:MAN -5.5 dBm`
triggers the next sweep step with a level of -5.5 dBm.

Usage: SCPI conform

[:SOURce<hw>]:POWer:MODE <Mode>

The command sets the instrument operating mode and therefore also the commands used to set the output level.

Parameters:

<Mode> CW|FIXed|SWEep

CW|FIXed
The instrument operates at a constant level. `CW` and `FIXed` are synonyms. The output level is set with `:SOURce:POWer`.

SWEep
The instrument operates in SWEep mode.
The level is set using the commands `SOURce:POWer:STARt; STOP; MANual`.

LIST
The instrument processes a list of frequency and level settings.
The List mode settings are made in the SOURce:LIST Subsystem subsystem.
The setting `SOURce:POWer:MODE LIST` also sets the command `SOURce:FREQuency:MODE` automatically to `LIST`.

*RST: CW

Example: `POW:MODE SWEep`
sets the SWEep mode. The settings under `SOURce:POW:STARt; STOP; MANual` become effective.

Usage: SCPI conform

[:SOURce<hw>]:POWer:POWer <Power>

Sets the RF level of the RF output connector.

The level entered with this command corresponds to the level at the RF output, i.e. any offset entry is not taken into consideration.

Note: The SCPI command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the the "Level" display, i.e. the level containing offset.

Parameters:

<Power> Minimum level ... Maximum level

The value range for the level setting varies according to the instrument model.
The values are given in the data sheet.

Increment: 0.01 dB
*RST: -30 dBm
Default unit: dBm

Example: `SOUR:POW:POW 15`
sets the RF level at output to 15 dBm.

[:SOURce<hw>]:POWer:RESolution <Resolution>

The command selects the resolution for the level settings.

Parameters:

<Resolution> R01|R1

*RST: R01

Example: `POW:RES R01`
sets the resolution for the level settings to 0.01 dB.

[:SOURce<hw>]:POWer:STARt <Start>

The command sets the RF start level in Sweep mode.

As with the "Level" value entered in the "RF Level" menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

Parameters:

<Start> float

Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model. The values are given in the data sheet.

Increment: 0.01 dB
*RST: -30 dBm
Default unit: dBm

Example: `POW:STAR -20 dBm`
sets the start level for the level sweep to -15 dBm for RF output A.

Usage: SCPI conform

[:SOURce<hw>]:POWer:STEP[:INCRement] <Increment>

The command sets the step width for the level setting if `UP` and `DOWN` are used as the level values and variation mode `:SOUR:POW:STEP:MODE USER` is selected. The command is linked to setting "Variation Step" for manual control, i.e. the command also sets the step width of the rotary knob for "Variation Active On".

Parameters:

<Increment> float

Range: 0 dB to 100 dB
Increment: 0.01 dB
*RST: 1 dB
Default unit: dB

Example: `SOURce:POWer:STEP:INCRement 2`
or
`POW:STEP 2`
sets the step width for entering the RF level to 2 dB.

[:SOURce<hw>]:POWer:STEP:MODE <Mode>

This command activates (`USER`) or deactivates (`DECimal`) the user-defined step width used when varying the level value with the level values `UP/DOWN`. The command is linked to setting "Variation Active" for manual control, i.e. the command also activates/deactivates the user-defined step width used when varying the level value with the rotary knob.

Parameters:

<Mode> DECimal|USER

*RST: DECimal

Example: `POW:STEP 2`
sets the step width for the level setting to 2 dB.
`POW:STEP:MODE USER`
actives this step width for level variation with the rotary knob (manual control) and with level values `UP/DOWN` (remote control).

[:SOURce<hw>]:POWer:STOP <Stop>

The command sets the stop level in Sweep mode.

As with the **Level** value entered in the **RF Level** menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

Parameters:

<Stop> float

Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model.
The values are given in the data sheet.

Increment: 0.01 dB
*RST: -10 dBm
Default unit: dBm

Example: `POW:STOP 3`
sets the stop level for the level sweep to 3 dBm for RF output A.

Usage: SCPI conform

7.12.16 SOURce:PULM Subsystem

This subsystem contains the commands for setting the pulse modulation.

The LF generator is used as the internal modulation source. The pulse frequency of the internal rectangular signal is therefore set in the `SOURce:LFOutput` subsystem.

The external signal is input at the PULSE IN connector. The connector can be used as trigger input for internal pulse modulation. The polarity and input impedance of the connector can be selected. The pulse modulation signal is output at the PULSE OUT connector.

[:SOURce<hw>]:PULM:DELay <Delay>

The command sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts. The pulse delay is not effective for double pulse generation.

Parameters:

<Delay> float

Range: 10 ns to 100 s
Increment: 20 ns
*RST: 20 ns
Default unit: ns

Example: `PULM:DEL 13 us`
13 us elapse after a trigger before the first pulse is generated.

Options: Option R&S SMF-K23

[:SOURce<hw>]:PULM:DOUBle:DELay <Delay>

The command sets the delay from the start of the first pulse to the start of the second pulse.

Parameters:

<Delay> float

Range: 10 ns to 100 s
Increment: 20 ns
*RST: 1 ms
Default unit: ns

Example: `PULM:DOUB:DEL 22 us`
22 us elapse between the beginning of the first pulse and the beginning of the second pulse in double-pulse mode.

Options: Option R&S SMF-K23

[:SOURce<hw>]:PULM:DOUBle:STATe <State>

The command enables/disables double pulse generation. The two pulses are generated in one pulse period.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `PULM:DOUB:STAT ON`

double-pulse mode is enabled.

Options: Option R&S SMF-K23

[:SOURce<hw>]:PULM:DOUBle:WIDTh <Width>

The command sets the width of the second pulse in case of double pulse generation.

Parameters:

<Width> float

Range: 5ns to 100s
Increment: 20ns
*RST: 1ms
Default unit: ns

Example: `PULM:DOUB:WIDT 33 us`

sets a width of 33 us for the second pulse.

Options: Option R&S SMF-K23

[:SOURce<hw>]:PULM:MODE <Mode>

Sets the mode of the pulse generator.

Parameters:

<Mode> SINGle|DOUBle | PTRain

SINGle
Enables single pulse generation.

DOUBle
Enables double pulse generation. The two pulses are generated in one pulse period.

PTRain
A user-defined pulse train is generated The pulse train is defined by value pairs of on and off times that can be entered in a pulse train list.

*RST: SINGle

Example: `PULM:MODE DOUB`

enables double pulse generation.

Options: R&S SMF-K23 and R&S SMF-K27

[:SOURce<hw>]:PULM:OUTPut:VIDeo:POLarity <Polarity>

The command sets the polarity between modulating and modulated signal.

Parameters:

<Polarity> NORMal|INVerted

NORMal
The RF signal is suppressed during the pulse pause.

INVerted
The RF signal is suppressed during the pulse.

*RST: NORMal

Example: `PULM:SOUR EXT`
selects the external modulation source.
`PULM:OUTP:VID:POL INV`
selects inverted polarity.

[:SOURce<hw>]:PULM:PERiod <Period>

The command sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period> float

Range: 5us | 20ns to 100 s
Increment: 1us | 20ns
*RST: 1ms

Example: `PULM:PER 220 us`
the pulse period is 220 us.

Options: The enhanced features require option R&S SMF-K23

[:SOURce<hw>]:PULM:POLarity <Polarity>

The command sets the polarity between modulating and modulated signal. This command is only effective for an external modulation signal.

Parameters:

<Polarity> NORMal|INVerted

NORMal
The RF signal is suppressed during the pulse pause.

INVerted
The RF signal is suppressed during the pulse.

*RST: NORMal

Example: `PULM:SOUR EXT`
selects the external modulation source.

Example: `PULM:POL INV`
selects inverted polarity.

Options: R&S SMF-K3

[:SOURce<hw>]:PULM:SOURce <Source>

The command selects the source for pulse modulation.

Parameters:

<Source> INTernal|EXTernal|RANDom

EXTernal
The signal applied externally via the PULSE IN connector is used for the pulse modulation.

INTernal
The internal pulse generator is used for the pulse modulation.
Note: This feature requires option R&S SMF-K23.

RANDom
Selects random pulses generated by the noise generator as the source for pulse modulation.

Example: `PULM:SOUR EXT`
selects the external modulation source.
`PULM:STAT ON`
activates the pulse modulation.

Options: R&S SMF-K23

[:SOURce<hw>]:PULM:STATe <State>

The command activates/deactivates the pulse modulation.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `PULM:STAT ON`
activates pulse modulation with the modulation source selected under `SOURce:PULM:SOURce`.

Usage: SCPI conform

Options: R&S SMF-K23

[:SOURce<hw>]:PULM:SYNC <Sync>

When enabled, the external modulation signal is synchronized to the internal 200MHz reference before it is passed to the pulse modulator. Since most instrument capabilities are timed by the same reference, the edges of the modulation signal can be synchronized e.g. to RF or to pulse modulator outputs if instrument is set up accordingly.

When disabled, the signal is passed asynchronously to the modulator.

Parameters:

<Sync> OFF|ON

Example: `PULM:SYNC OFF`
the signal is passed asynchronously to the modulator.

[:SOURce<hw>]:PULM:TRAin:CATalog?

The command requests a list of available pulse train files. The individual pulse train files are separated by commas.

The files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:
<Catalog> string

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:CAT?`
queries the available files.
`Response: 'P_CONS','P_INCR','P_DECR'`
the lists `P_CONS`, `P_INCR` and `P_DECR` are available.

Usage: Query only

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:DELete <Delete>

The command deletes the specified pulse train file.

The files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. To access the files in this directory, only the file name has to be given without the path and the file extension.

Setting parameters:
<Delete> <list file name>

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:DEL 'P_FIVE'`
deletes the list `P_FIVE`

Usage: Setting only

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:OFFTime <Offtime>

The command fills the Offtime part of the selected file with data.

*RST does not affect data lists.

Parameters:

<Offtime> Offtime#1{, Offtime#2, ...} | binary block data

The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data.
When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see the command `FORMat:DATA`).
The maximum length is 1023 values.

Range: 5ns to 5ms

Example:

`MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:OFFT 10ns,15ns,40ns,...`
specifies the offtime values in `P_INCR`. If the list already contains data, it is overwritten.

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts?

The command queries the length (in points) of the offtime component of the selected list.

Return values:

<Points> float

Example:

`MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:OFFT:POIN?`
queries the number of frequency values in `P_INCR`
`Response: 7`
`P_INCR` has 7 offtime entries.

Usage: Query only

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:ONTime <Ontime>

The command fills the Ontime part of the selected file with data.

Parameters:

<Ontime>	Onime#1{, Ontime#2, ...} | binary block data The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data. When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see the command `FORMat:DATA`). The maximum length is 1023 values. Range: 5ns to 5ms

Example:
`MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:ONT 10ns,15ns,40ns,...`
specifies the ontime values in `P_INCR`. If the list already contains data, it is overwritten.

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:ONTime:POINts?

The command queries the length (in points) of the ontime component of the selected list.

Return values:

<Points>	float

Example:
`MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:ONT:POIN?`
queries the number of frequency values in `P_INCR`
`Response: 7`
`P_INCR` has 7 ontime entries.

Usage: Query only

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:REPetition <Repetition>

The command sets the number of repetitions for each ontime/offtime value pair. The maximum number of repetitions for all value pairs is 1023 values.

*RST does not affect data lists.

Parameters:

<Repetition> Repetition#1{, Repetition#2, ...}

Range: 1 to max

Example:

`MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:ONT 10ns,15ns,40ns,...`
specifies the ontime values in `P_INCR`. If the list already contains data, it is overwritten.
`PULM:TRA:OFFT 10ns,15ns,40ns,...`
specifies the offtime values in `P_INCR`. If the list already contains data, it is overwritten.
`PULM:TRA:REP 10,15,40,...`
specifies the number of repetitions for each value pair.

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:REPetition:POINts?

The command queries the length (in points) of the repetition component of the selected list.

Return values:

<Points> float

Example:

`MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:REP:POIN?`
queries the number of repetition values in `P_INCR`
`Response: 7`
`P_INCR` has 7 repetition entries.

Usage: Query only

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRAin:SELect <Select>

The command selects the specified pulse train file. If a new file is to be created, the name can be entered here. The file is created if it does not yet exist. The file selected here is available for the further processing steps (editing) and is used in the instrument when the pulse train mode is activated.

The files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`.

`*RST` does not affect data lists.

Parameters:

<Select> string

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.

Options: R&S SMF-K27

[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity <Polarity>

Selects the polarity of the Gate signal.

The signal is supplied via the PULSE IN connector.

Parameters:

<Polarity> NORMal|INVerted

*RST: NORMal

Example: `PULM:TRIG:EXT:GAT:POL NORM`
The pulse signal is generated while the gate signal is high.

[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance <Impedance>

The command selects the impedance for external pulse trigger.

Parameters:

<Impedance> G50|G10K

*RST: G10K

Example: `SOUR:PULM:TRIG:EXT:IMP G50`
selects 50 Ohm as the trigger impedance for the external pulse trigger.

Usage: SCPI conform

[:SOURce<hw>]:PULM:TRIGger:EXTernal:LEVel <Level>

The command selects the external trigger level (threshold TTL, 0.5 V or -2.5 V).

Parameters:

<Level> TTL|M2V5|P0V5

*RST: POSitive

Example: `PULM:TRIG:EXT:LEV TTL`
selects TTL as external trigger level.

[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe <Slope>

The command sets the polarity of the active slope of an externally applied trigger signal at the TRIGGER input (BNC connector at the rear of the instrument).

Parameters:

<Slope> POS|NEG

*RST: POSitive

Example: `PULM:TRIG:EXT:SLOP NEG`
The pulse generator is triggered on the negative slope of the external trigger signal.

[:SOURce<hw>]:PULM:TRIGger:MODE <Mode>

The command selects the trigger mode for pulse modulation.

Parameters:

<Mode> AUTO|EXTernal|EGATe

AUTO
The pulse modulation is generated continuously.

EXTernal
The pulse modulation is triggered by an external trigger event. The trigger signal is supplied via the PULSE IN connector.

EGATe
The pulse modulation is triggered by an external trigger event. The trigger signal is supplied via the PULSE IN connector.

*RST: AUTO

Example: `PULM:TRIG:MODE EXT`
selects triggering by an external trigger event.

Usage: SCPI conform

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of pulse train data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog>	string

Example:	`MMEM:CDIR 'var/lists/pulsetrain/import'`
	selects the directory for the ASCII files with ontime/offtime/repetition values.
	`PULM:TRA:DEXC:AFIL:EXT TXT`
	selects that ASCII files with extension `*.txt` are listed.
	`PULM:TRA:DEXC:AFIL:CAT?`
	queries the available files with extension `*.txt`.
	`Response: 'train1','train2'`
	the ASCII files `train1.txt` and `train2.txt` are available.

Usage:	Query only

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension <Extension>

The command selects the file extension of the ASCII file to be imported or exported. Selection `TXT` (text file) or `CSV` (Excel file) is available.

Parameters:

<Extension>	TXT|CSV *RST: TXT

Example:	`MMEM:CDIR 'var/lists/pulsetrain/import'`
	selects the directory for the ASCII files with ontime/offtime/repetition values.
	`PULM:TRA:DEXC:AFIL:EXT TXT`
	selects that ASCII files with extension `*.txt` are listed.
	`PULM:TRA:DEXC:AFIL:CAT?`
	queries the available files with extension `*.txt`.
	`Response: 'train1','train2`
	the ASCII files `train1.txt` and `train2.txt` are available.

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect <Select>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Parameters:

<Select> string

Example:

`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files with ontime/offtime/repetition values.
`PULM:TRA:DEXC:MODE IMP`
selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects that ASCII file `train.csv` is imported.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the ASCII file `train.csv` is imported into pulse train list `train_imp`.

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn <Column>

Parameters:

<Column> TABulator|SEMicolon|COMMa|SPACe

*RST: SEMicolon

Example:

`PULM:TRA:DEXC:MODE EXP`
selects that the pulse train list is exported into an ASCII file.
`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files with ontime/offtime/repetition values.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects ASCII file train.csv as destination for the pulse train list data.
`PULM:TRA:DEXC:AFIL:SEP:COL TAB`
the ontime/offtime/repetition values are separated by a tabulator.
`PULM:TRA:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the pulse train list `train_imp` is imported into ASCII file `train.csv`.

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal <Decimal>

The command selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Parameters:

<Decimal> DOT|COMMa

*RST: DOT

Example:

`PULM:TRA:DEXC:MODE EXP`
selects that the pulse train list is exported into an ASCII file.
`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files with fontime/offtime/repetition values.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects ASCII file train.csv as destination for the pulse train list data.
`PULM:TRA:DEXC:AFIL:SEP:COL TAB`
the ontime/offtime/repetition values are separated by a tabulator.
`PULM:TRA:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the pulse train list `train_imp` is imported into ASCII file `train.csv`.

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected, the ASCII file is imported as pulse train list. When export is selected, the pulse train list is exported into the selected ASCII file.

Example:

`PULM:TRA:DEXC:MODE IMP`
selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists.
`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files withontime/offtime/repetition values.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects that ASCII file train.csv is imported.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the ASCII file `train.csv` is imported into pulse train list `train_imp`.
`PULM:TRA:DEXC:EXEC`
starts the import of the ASCII file data into the pulse train file.

Usage: Event

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE <Mode>

The command selects if pulse train lists should be imported or exported. Depending on the selection, the file select command define either the source or the destination for pulse train lists and ASCII files.

Parameters:

<Mode> IMPort|EXPort

*RST: IMPort

Example:
`PULM:TRA:DEXC:MODE IMP`
selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists.
`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files with ontime/offtime/repetition values.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects that ASCII file `train.csv` is imported.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the ASCII file `train.csv` is imported into pulse train list `train_imp`.

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect <Select>

The command selects the pulse train list to be imported or exported.

The pulse train files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Parameters:

<Select> string

Example:
`PULM:TRA:DEXC:MODE IMP`
selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists.
`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files with ontime/offtime/repetition values.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects that ASCII file train.csv is imported.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the ASCII file `train.csv` is imported into pulse train list `train_imp`.

[:SOURce<hw>]:PULM:WIDTh <Width>

The command sets the width of the generated pulse. The width determines the pulse length. The pulse width must be at least 20ns less than the set pulse period.

Parameters:

<Width> float

Range: 20ns | 5ns to 100s
Increment: 20ns
*RST: 1ms

Example:
`PULM:WIDT 33 us`
sets a width of 33 us for the pulse.

Options: The enhanced features require option R&S SMF-K23

7.12.17 SOURce:ROSCillator Subsystem

This subsystem contains the commands for setting the external and internal reference frequency.

The commands of this subsystem are not affected by an instrument reset (*RST on page 232).

[:SOURce]:ROSCillator:EFC:STATe <State>

The command activates/deactivates the electronic frequency control.

Parameters:

<State> 0|1|OFF|ON

Example: `ROSC:EFC:STAT ON`
activates the electronic frequency control.

Usage: SCPI conform

[:SOURce]:ROSCillator:EXTernal:FREQuency <Frequency>

The command informs the instrument of the frequency of the external reference. Entries are possible in 1 MHz steps.

Parameters:

<Frequency> float

Range: 1 to 20

Example: `ROSC:SOUR EXT`
selects the external source. The reference must be input at the REF IN input connector.
`ROSC:EXT:FREQ 5 MHz`
informs the instrument that the external reference frequency is 5 MHz.

[:SOURce]:ROSCillator:EXTernal:RFOFf:STATe <State>

The command determines if the RF output is switched off in case of a missing external reference signal for selection external source.

If enabled, this setting ensures that no improper RF signal due to the missing external reference signal is output and used for measurements.

In addition to the error message "Ext Ref missing", message "RF output deactivated' is generated.

Parameters:

<State> 0|1|OFF|ON

Example: `ROSC:SOUR EXT`

selects the external source. The reference must be input at the REF IN input.

Example: `ROSC:EXT:RFOF:STAT ON`

In case of a missing external signal, no RF signal is output.

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <Sbandwidth>

The command selects the synchronization bandwidth for an external reference signal.

Parameters:

<Sbandwidth> WIDE|NARRow

NARRow
Synchronization bandwidth is approx. 1 Hz.

WIDE
Synchronization bandwidth is approx. 750 Hz.
This mode is the standard mode, it is provided for using good reference sources of high spectral purity.

Example: `ROSC:SOUR EXT`

selects the external source.

`ROSC:EXT:FREQ 5 MHz`

informs the instrument that the external reference has a frequency of 5 MHz.

`ROSC:EXT:SBAN WID`

selects wideband setting for synchronization bandwidth.

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue <Value>

The command specifies the frequency correction value (adjustment value).

Parameters:

<Value> float

Range: 0 to 4095
Increment: 1

Example: `ROSC:ADJ:VAL 1400`
sets the adjustment value to 1400.

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] <State>

The command determines whether the calibrated (OFF) or a user-defined (ON) adjustment value is used for fine adjustment of the frequency. With STATe ON, the instrument is no longer in the calibrated state. However, the calibration value is not changed and the instrument resumes the calibrated state after switching the Adjustment State to Off.

Parameters:
<State> 0|1|OFF|ON

Example: `ROSC:SOUR INT`
selects the internal source.
`ROSC:ADJ ON`
activates use of a user-defined adjustment value.
`ROSC:ADJ:VAL 1400`
sets the adjustment value to 1400.

[:SOURce]:ROSCillator:SOURce <Source>

The command selects between internal and external reference frequency.

Parameters:
<Source> INTernal|EXTernal

INTernal
The internal reference oscillator is used.
The reference signal is provided at the REF OUT connector

EXTernal
An external reference signal is used. It must be input at the REF IN connector at the rear of the instrument.
The instrument is informed of the frequency of the external reference signal by means of the command
`[:SOURce]:ROSCillator:EXTernal:FREQuency`.

Example: `ROSC:SOUR EXT`
selects the external source.
`ROSC:EXT:FREQ 5 MHz`
informs the instrument that the external reference has a frequency of 5 MHz.

[:SOURce]:ROSCillator:OUTPut:SOURce <Source>

The command selects the source for the reference oscillator signal output. The external output is only available if the external reference frequency is 10 MHz.

Parameters:

<Source> INTernal|EXTernal

INTernal
The internal reference oscillator signal is output at the REF OUT connector.

EXTernal
The external reference oscillator signal is output at the REF OUT connector

Example: `ROSC:OUTP:SOUR EXT`
'the reference oscillator signal is output at the REF OUT connector.

7.12.18 SOURce:SWEep Subsystem

This subsystem contains the commands for checking the RF sweeps, i.e. the sweeps of the RF generators. Sweeps are always triggered, except for the `MANual` sweep mode. The frequency sweep is activated by the command `SOURce:FREQuency:MODE SWEep`, and the level sweep by the command `SOURce:POWer:MODE SWEep`. All sweeps, including the LF sweep, can be set independently of each other.

This example shows how to set up a frequency sweep.

1. Set the sweep range.
   ```
   [SOURce:]FREQuency:CENTer 200 MHz
   [SOURce:]FREQuency:SPAN 300 MHz
   ```
2. Select linear or logarithmic spacing.
   ```
   [SOURce:]SWEep[:FREQuency]:SPACing LIN
   ```
3. Set the step width and dwell time.
   ```
   [SOURce:]SWEep[:FREQuency]:STEP:LINear 20 MHz
   [SOURce:]SWEep[:FREQuency]:DWELl 12 ms
   ```
4. Select the trigger mode.
   ```
   TRIGger:]FSWeep:SOURce SINGle
   ```
5. Select the sweep mode and activate the sweep.
   ```
   [SOURce:]SWEep[:FREQuency]:MODE AUTO
   [SOURce:]FREQuency:MODE  SWEep
   ```
6. Trigger the sweep.
   ```
   [SOURce:]SWEep[:FREQuency]:EXECute
   ```

It is recommended to switch off the "GUI Update" for optimum sweep performance especially with short dwell times (`SYSTem:DISPlay:UPDate OFF`).

[:SOURce<hw>]:SWEep[:FREQuency]:DWELl <Dwell>

The command sets the time taken for each frequency step of the sweep.

The keyword [`:FREQuency`] can be omitted (see example). The command is then SCPI-compliant.

Tip: It is recommended to switch off the "GUI Update" for optimum sweep performance especially with short dwell times (`SYSTem:DISPlay:UPDate OFF`).

Parameters:

<Dwell> float

Range: 3ms to 10s
Increment: 0.1m
*RST: 10m
Default unit: s

Example: `SWE:DWEL 12 ms`
sets a dwell time of 12 ms for a frequency sweep at the RF output.

[:SOURce<hw>]:SWEep[:FREQuency]:EXECute

The command triggers a sweep.

The command is only valid for sweep mode Single (`SOURce:SWEep:FREQuency:MODE SINGle`). The command corresponds to the manual-control command "Execute Single Sweep".

Example: `SWE:FREQ:EXEC`
triggers a frequency sweep at the RF output.

Usage: Event

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:ACTive <Active>

The command activates the selected marker. The active marker is output with a higher voltage than all other markers.

Parameters:

<Active> NONE|M01|M02|M03|M04|M05|M06|M07|M08|M09|M10

*RST: NONE

Example: `SOUR:SWE:FREQ:MARK:ACT M05`
sets marker 5 to be the active marker.

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:AMPLitude <Amplitude>

The command sets the amplitude marker attenuation.This value is valid for all markers.

Correlation: The output level reduction is applied to a marker with command `SOUR:SWE:MARK<[1]...10>:PST ON`.

Parameters:

<Amplitude> float

Range: 0 to 3
Increment: 0.1
*RST: 1
Default unit: dB

Example: `SOUR:SWE:FREQ:MARK:AMPL 1`
the output level is reduced by 1 dB on reaching the mark.

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:AOFF

The command switches off all frequency markers. The command triggers an event and therefore has no query form and no *RST value.

Example: `SOUR:SWE:FREQ:MARK:AOFF`
switches off all frequency markers.

Usage: Event

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FREQuency <Frequency>

The command sets the frequency of the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the frequency mark.

Parameters:

<Frequency>	float
	*RST: 300 Default unit: MHz
Example:	`SWE:FREQ:MARK1:FREQ 15kHz` sets the frequency mark for marker 1 to 15kHz.

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:FSTate <Fstate>

The command switches on or off the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the frequency mark.

Parameters:

<Fstate>	0|1|OFF|ON
	*RST: OFF
Example:	`SWE:MARK1:FST ON` switches on marker 1.

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer<ch>:PSTate <Pstate>

Activates or deactivates the selected amplitude marker. If activated, the level is reduced by the amplitude entered with command `[SOURce:]SWEep[:FREQuency]:MARKer:AMPLitude` on reaching the mark.

Parameters:

<Pstate>	0|1|OFF|ON
	*RST: OFF
Example:	`SWE:MARK1:PST ON` the output level is reduced by a constant value if frequency marker 1 is active.

[:SOURce<hw>]:SWEep[:FREQuency]:MARKer:XFER

Copies the frequency value of marker 1 to the start frequency of the sweep and the frequency value of marker 2 to the stop frequency of the sweep.

The command is an event and thus has no *RST-value and no query form.

Dependencies: Sets the start and stop frequency of the sweep.

Example: SWE:MARK:XFER
used the frequency values of marker 1 and 2 to set the start and stop frequency, respectively.

Usage: Event

[:SOURce<hw>]:SWEep[:FREQuency]:MODE <Mode>

The command sets the sweep mode.

The keyword [:FREQuency] can be omitted (see example). The command is then SCPI-compliant.

Parameters:

<Mode> AUTO|MANual|STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each frequency step of the sweep is triggered individually, either by varying the "Current Frequency" value using the rotary knob under manual control or by means of a FREQ:MAN command under remote control. With manual control, the frequency increases or decreases (depending on the direction of the rotary encoder) by the value specified under FREQ:STEP:INCRement. With remote control, the frequency is set directly with the command :FREQ:MAN.

STEP
Each tcrigger triggers one sweep step only (Mode Single Step). The frequency increases by the value entered under SOUR:SWE:FREQ:STEP:LIN (linear spacing) or ...:STEP:LOG (logarithmic spacing).

*RST: AUTO

Example: SWE:MODE AUTO
selects **Mode Auto** for a frequency sweep at the RF output.

[:SOURce<hw>]:SWEep[:FREQuency]:POINts <Points>

The command sets the number of steps in an RF sweep.

The command is linked to the command `:SWEep[:FREQuency]:STEP` as follows:

- for linear sweeps
  `POINts = (SPAN / STEP:LIN) + 1`
- logarithmic sweeps and `STARt < STOP`:
  `POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `POINTs` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Two separate `POINts` values are used for linear or logarithmic sweep spacing (`:SWEep[:FREQuency]:SPACing LIN | LOG`). The command is always effective for the currently set sweep spacing.

Note: The value indicated in the menu and the value set/retrieved by this command differ by 1 as a rule. This is caused by a different calculation of the value indicated in the menu (e.g. linear spacing): Count = (Stop - Start) / Step:Log. (i.e, the transitions are counted not the steps as in remote control) Also, the value is in any case an integer, thus may be rounded.

Parameters:

<Points> float

Example:

`FREQ:STAR`
sets the start frequency to 100 MHz.
`FREQ:STOP`
sets the stop frequency to 500 MHz.
`SWE:SPAC LIN`
sets linear sweep spacing.
`SWE:POIN 401`
sets 401 sweep steps for linear sweep spacing. The sweep step width (`STEP`) is automatically set to 1 MHz.

[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe <Shape>

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape> SAWTooth|TRIangle

SAWTooth
One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

*RST: SAWTooth

Example: `SOUR:SWE:SHAP TRI`
selects the sweep cycle with alternating ascending and descending sweep directions.

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing <Spacing>

The command selects the sweep spacing.

The keyword `[:FREQuency]` can be omitted (see example). The command is then SCPI-compliant.

Parameters:

<Spacing> LINear|LOGarithmic | RAMP

LINear
With the linear sweep, the step width is a fixed frequency value which is added to the current frequency. The step width for linear sweep is entered in Hz (see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]` on page 416).

LOGarithmic
With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in % (see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic` on page 417).

RAMP
With the ramp sweep, a synthesized continuous analog frequency sweep is provided for a set sweep time. The sweep time is entered under `[:SOURce<hw>]:SWEep[:FREQuency]:TIME` on page 418.

*RST: LIN

Example: `SWE:SPAC LIN`
selects linear sweep spacing for a frequency sweep at the RF output.

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] <Linear>

The command sets the step width for linear sweeps.

This command is linked to the command `:SWEep[:FREQuency]:POINts` as follows:

`POINts = (SPAN / STEP:LIN) + 1`

If `STEP:LIN` changes, the value of `POINts` is adjusted. The `STARt` and `STOP` value is retained.

The keywords `[:FREQuency]` and `[:LINear]` can be omitted (see example). The command is then SCPI-compliant.

Parameters:

<Linear> float

Range: 0 to (STOP - STARt)
Increment: 0.1Hz
*RST: 1MHz
Default unit: Hz

Example: `FREQ:STAR`
sets the start frequency to 100 MHz.
`FREQ:STOP`
sets the stop frequency to 500 MHz.
`SWE:SPAC LIN`
sets linear sweep spacing.
`SWE:STEP 2 MHz`
sets the step width for linear sweep spacing to 2 MHz (RF sweep at the RF output. The number of sweep steps for linear sweep spacing (`POINts`) is automatically set to 201.

[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

The comman specifies the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated (for `STARt < STOP`) using the following formula:

New frequency = Old frequency + `STEP:LOG` x Old frequency

`STEP:LOG` therefore gives the fraction of the old frequency. The frequency is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in percent, whereby the suffix `PCT` must always be used.

The command is linked to the command `:SWEep[:FREQuency]:POINts` for `STARt < STOP` as follows:

```
POINts = ((log STOP - log STARt) / log STEP:LOG) + 1
```

If `STEP:LOG` changes, the value of POINTs is adjusted. The `STARt` and `STOP` value is retained.

Parameters:

<Logarithmic> float

Range: 0.01 to 9999
Increment: 0.01PCT
*RST: 1PCT

Example: `FREQ:STAR`
sets the start frequency to 100 MHz.
`FREQ:STOP`
sets the stop frequency to 500 MHz.
`SWE:SPAC LOG`
sets logarithmic sweep spacing.
`SWE:STEP:LOG 10PCT`
sets the step width for logarithmic sweep spacing to 10% of the previous frequency in each instance (for a frequency sweep).

[:SOURce<hw>]:SWEep[:FREQuency]:TIME <Time>

The command sets the sweep time for ramp sweep.

Parameters:

<Time> float

Increment: 0.1
*RST: 15E-3
Default unit: ms

Example: `SOUR:FREQ:TIME 10ms`
sets a sweep time of 10 ms for a ramp sweep.

Options: R&S SMF-K4

[:SOURce<hw>]:SWEep:MARKer:OUTPut:POLarity <Polarity>

The command selects the polarity of the marker signal.

Parameters:

<Polarity> NORMal|INVerted

NORMal
The marker level switches to HIGH after reaching the mark.

INVerted
The marker level switches to LOW after reaching the mark.

*RST: NORMal

Example: `SWE:FREQ:MARK:OUTP:POL NORM`
sets the marker output polarity to normal.

Options: R&S SMF-B20

[:SOURce<hw>]:SWEep:POWer:AMODe <Amode>

The command selects the ranges of level settings for the level sweep. The sweep is either performed in the low level or in the high level ranges.

Parameters:

<Amode> NORMal|HPOWer

NORMal
The level settings are made in the range of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made in the high level range.

*RST: NORMal

Example: `SWE:POW:AMOD HPOW`
selects the high level ranges for level sweep.

[:SOURce<hw>]:SWEep:POWer:DWELl <Dwell>

The command sets the time taken for each level step of the sweep.

Tip: It is recommended to switch off the "GUI Update" for optimum sweep performance especially with short dwell times (`SYSTem:DISPlay:UPDate OFF`).

Parameters:

<Dwell> float

Range: 3ms to 10s
Increment: 0.1ms
*RST: 10ms

Example: `SWE:POW:DWEL 12 ms`
sets a dwell time of 12 ms for a level sweep at the RF output.

[:SOURce<hw>]:SWEep:POWer:EXECute

The command triggers a sweep.

Example: `SWE:POW:EXEC`
triggers a level sweep at the RF output.

Usage: Event

[:SOURce<hw>]:SWEep:POWer:MARKer:ACTive <Active>

The command activates the selected marker. The active marker is output with an higher voltage than all other markers.

Parameters:

<Active> NONE|M01|M02|M03|M04|M05|M06|M07|M08|M09|M10

*RST: NONE

Example: `SWE:POW:MARK:ACT M05`
sets marker 5 to be the active marker.

[:SOURce<hw>]:SWEep:POWer:MARKer:AOFF

The command switches off all level markers. The command triggers an event and therefore has no query form and no *RST value.

Example: `SOUR:SWE:POW:MARK:AOFF`
switches off all level markers.

Usage: Event

[:SOURce<hw>]:SWEep:POWer:MARKer<ch>:POWer <Power>

The command sets the level of the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the level mark.

Parameters:

<Power> float

*RST: 0
Default unit: dBm

Example: `SOUR:SWE:POW:MARK1:POW -50`
sets the power mark for marker 1 to -50 dBm.

[:SOURce<hw>]:SWEep:POWer:MARKer<ch>:STATe <State>

The command switches on or off the selected marker. If the marker is switched on, the signal level at the MARKER output changes on reaching the level mark.

Parameters:

<State> 0|1|OFF|ON

*RST: OFF

Example: `SWE:POW:MARK1:STAT ON`
switches on marker 1.

[:SOURce<hw>]:SWEep:POWer:MODE <Mode>

The command sets the cycle mode of the level sweep.

Parameters:

<Mode> AUTO|MANual|STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each level step of the sweep is triggered individually, either by varying the "Current Level" value using the rotary knob under manual control or by means of a `POW:MAN` command under remote control.
With manual control, the level increases or decreases (depending on the direction of the rotary encoder) by the value specified under `SOUR:SWE:POW:STEP`. With remote control, the level increases by the value specified under `SWEep:POW:STEP` which each sent `:POW:MAN` command, irrespective the value entered there.

STEP
Each trigger triggers one sweep step only. The level increases by the value entered under `:SWEep:POWer:STEP`.

*RST: AUTO

Example: `SWE:POW:MODE AUTO`
selects Mode Auto for a level sweep at RF output.

[:SOURce<hw>]:SWEep:POWer:POINts <Points>

The command sets the number of steps in a level sweep. The command is linked to the command `:SWEep:POWer:STEP` as follows:

`POINts = ((STOP - STARt) / STEP:LOG) + 1`

If `POINTs` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Note: The value indicated in the menu and the value set/retrieved by this command differ by 1 as a rule. This is caused by a different calculation of the value indicated in the menu: Count = (Stop - Start) / Step:Log (i.e, the transitions are counted not the steps as in remote control). Also, the value is in any case an integer, thus may be rounded.

Parameters:

<Points> float

*RST: 20dB

Example: `POW:STAR - 30 dBm`
sets the start frequency to -30 dBm.
`POW:STOP - 10 dBm`
sets the stop frequency to -10 dBm.
`SWE:POW:POIN 20`
sets 20 sweep steps. The sweep step width (`STEP`) is automatically set to 1 dB.

[:SOURce<hw>]:SWEep:POWer:SHAPe <Shape>

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape> SAWTooth|TRIangle

SAWTooth
One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle.Each subsequent sweep starts at the start level again.

*RST: SAWTooth

Example: `SOUR:SWE:POW:SHAP TRI`
selects the sweep cycle with alternating ascending and descending sweep directions.

[:SOURce<hw>]:SWEep:POWer:SPACing:MODE?

The command queries the sweep spacing. The sweep spacing for level sweeps is always linear.

Example: `SWE:POW:SPAC:MODE?`
queries the sweep spacing for a level sweep at RF output.
`Result: LIN`
linear spacing

Usage: Query only

[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] <Logarithmic>

The command sets the step width factor for logarithmic sweeps. The next level value of a sweep is calculated (for `STARt` < `STOP`) using the following formula:

New level = Old level + `STEP:LOG` x Old level

`STEP:LOG` therefore gives the fraction of the old level. The level is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in decibels, whereby the suffix dB must always be used.

The command is linked to the command `:SWEep:POWer:POINts` for `STARt < STOP` as follows:

POINts = ((`STOP` - `STARt`) / `STEP:LOG`) + 1

If `STEP:LOG` changes, the value of `POINTs` is adjusted. The `STARt` and `STOP` value is retained.

Parameters:

<Logarithmic> float

Range: 0.01 to 165 dB
Increment: 0.01dB
*RST: 1
Default unit: dB

Example: `SWE:POW:STEP 10dB`
sets the step width for logarithmic sweep spacing to 10 dB of the previous level in each instance (for a level sweep).

[:SOURce<hw>]:SWEep:RESet[:ALL]

The command resets all active sweeps to the starting point.

Example: `SWE:RES`
resets all active sweeps to the starting point.

7.13 STATus Subsystem

This system contains the commands for the status reporting system. `*RST` on page 232 has no effect on the status registers.

Queries return the current value of the respective register, which permits a check of the device status. A decimal value between 0 and 32767 (=2^{15}-1) is returned.

The configuration commands set the respective register thus determining which status changes of the R&S SMF causes the status registers to be changed. A decimal value between 0 and 32767 (= 2^{15}-1) is set.

STATus:OPERation:CONDition? <Condition >

The command queries the content of the CONDition part of the STATus:OPERation register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Parameters:

<Condition > string

Example: `STAT:OPER:COND`
queries the Status:Operation:Condition register.

Usage: Query only
SCPI conform

STATus:OPERation:ENABle <Enable>

The command sets the bits of the ENABle part of the STATus:OPERation register. This setting determines which events of the Status-Event part are forwarded to the sum bit in the status byte. These events can be used for a service request.

Parameters:

<Enable> string

Example: `STAT:OPER:ENAB 32767`
all events are forwarded to the sum bit of the status byte.

Usage: SCPI conform

STATus:OPERation[:EVENt]? <EVENt>

The command queries the content of the EVENt part of the STATus:OPERation register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:

<EVENt> string

Example: `STAT:OPER:EVEN`
queries the STATus:OPERation:EVENt register.

Usage: Query only
SCPI conform

STATus:OPERation:PTRansition <Ptransition>

The command sets the bits of the PTRansition part of the STATus:OPERation register. If a bit is set, a transition from 0 to 1 in the condition part causes an entry to be made in the EVENt part of the register. A new event in the hardware is thus registered, e.g. the start of an adjustment.

Parameters:

<Ptransition> string

Example: `STAT:OPER:PTR 32767`

all transitions from 0 to 1 in the condition part of the Status:Operation register cause an entry to be made in the EVENt part.

Usage: SCPI conform

STATus:OPERation:NTRansition <Ntransition>

The command sets the bits of the NTRansition part of the STATus:OPERation register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register. The disappearance of an event in the hardware is thus registered, e.g. the end of an adjustment.

Parameters:

<Ntransition> string

Example: `STAT:OPER:NTR 0`

a transition from 1 to 0 in the condition part of the Status:Operation register does not cause an entry to be made in the EVENt part.

Usage: SCPI conform

STATus:PRESet <Preset>

The command resets the status registers. All PTRansition parts are set to FFFFh (32767), 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 parts of STATus:OPERation and STATus:QUEStionable are set to 0, i.e. all events in these registers are not passed on.

Parameters:

<Preset> string

Example: `STAT:PRES`

resets the status registers.

Usage: Event

SCPI conform

STATus:QUEStionable:CONDition? <Condition >

The command queries the content of the CONDition part of the STATus:QUEStionable register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Parameters:

<Condition > string

Example: `STAT:OPER:COND`
queries the Status:Questionable:Condition register.

Usage: Query only
SCPI conform

STATus:QUEStionable:ENABle <Enable>

The command sets the bits of the ENABle part of the STATus:QUEStionable register. This setting determines which events of the Status-Event part are enabled for the sum bit in the status byte. These events can be used for a service request.

Parameters:
<Enable> string

Example: `STAT:OPER:ENAB 1`
problems when performing an adjustment cause an entry to be made in the sum bit.

Usage: SCPI conform

STATus:QUEStionable:NTRansition <Ntransition>

The command sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Parameters:
<Ntransition> string

Example: `STAT:OPER:NTR 0`
A transition from 1 to 0 in the condition part of the Status:Questionable register does not cause an entry to be made in the EVENt part.

Usage: SCPI conform

STATus:QUEStionable:PTRansition <Ptransition>

The command sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Parameters:
<Ptransition> string

Example: `STAT:OPER:PTR 32767`
All transitions from 0 to 1 in the condition part of the Status:Questionable register cause an entry to be made in the EVENt part.

Usage: SCPI conform

STATus:QUEStionable[:EVENt]? <EVENt>

The command queries the content of the EVENt part of the `STATus:QUEStionable` register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:

<EVENt> string

Example: `STAT:QUES:EVEN?`

queries the Status:Questionable:Event register.

Usage: Query only

SCPI conform

STATus:QUEue[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI. If the error queue is empty, 0 ("No error") is returned. The command is identical to `SYSTem:ERRor?`

Return values:

<NEXT> string

Example: `STAT:QUE`

queries the oldest entry in the error queue.

`Response: 0, 'no error'`

No errors have occurred since the error queue was last read out.

Usage: Query only

SCPI conform

7.14 SYSTem Subsystem

The SYSTem subsystem contains a series of commands for general functions which do not directly affect signal generation.

:SYSTem:BEEPer:STATe <State>

This command switches the key beep on or off.

Parameters:

<State>	0|1|OFF|ON *RST: OFF
Example:	`SYST:BEEP:STAT OFF` No acoustic signal is output when a key on the front panel is pressed.
Usage:	SCPI conform

:SYSTem:COMMunicate:GPIB:LTERminator <Lterminator>

The command sets the terminator recognition for remote control via the IEC/IEEE bus.

Parameters:

<Lterminator> STANdard|EOI

EOI
The terminator must be sent together with the line message EOI (End of Line). This setting is recommended for binary block transmissions where a character could coincidentally have the value LF (Line Feed) but is not intended as the terminator. This setting must be selected for block data with undefined length.

STANdard
An LF (Line Feed) is recognized as the terminator regardless of whether it is sent with or without EOI.

*RST: STANdard

Example: `SYST:COMM:GPIB:LTER EOI`
only a character which is sent simultaneously with the line message EOI is accepted as the terminator.

Usage: SCPI conform

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

The command sets the GPIB address.

Parameters:

<Address> float

Range: 1 to 30
*RST: 28

Example: `SYST:COMM:GPIB:ADDR 14`
sets GPIB address.

Usage: SCPI conform

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

The command enters the individual computer name of the R&S Microwave Signal Generator. The entry is only activated after sending command `SYST:COMM:NETW:COMM:SET`.

Note: The hostname can only be changed after deactivating protection level 1 (command `SYSTem:PROTect<n>:STATe OFF`, password)

Parameters:

<Hostname> string

Example: `SYST:COMM:NETW:HOST 'SIGGEN'`
enters the individual computer name of the R&S Microwave Signal Generator.

Example: `SYST:COMM:NETW:COMM:SET ON`
activates the change of the hostname.

:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup <Workgroup>

The command enters the individual workgroup name of the instrument.

Parameters:

<Workgroup> string

Example: `SYST:COMM:NETW:COMM:WORK 'TEST_09'`
enters the workgroup name 'TEST_09'.

:SYSTem:COMMunicate:NETWork:IPADdress:MODE <Mode>

The command selects if the IP address is assigned automatically or manually. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Parameters:

<Mode> AUTO|STATic

AUTO
The IP address is assigned automatically. The network used must support automatic assignment of address (DHCP) in order to use this function.

STATic
The IP address is assigned manually.

*RST: AUTO

Example: `SYST:COMM:NETW:IPAD:MODE AUTO`
the IP address is assigned automatically (DHCP).
`SYST:COMM:NETW:IPAD:SET ON`
activates DHCP.

:SYSTem:COMMunicate:NETWork:IPADdress <Ipaddress>

The command enters the IP address. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Parameters:

<Ipaddress> string

Range: 0.0.0.0. to ff.ff.ff.ff

Example: `SYST:COMM:NETW:IPAD 7.8.9.10`
enters the IP address of the instrument.

Example: `SYST:COMM:NETW:IPAD:SET`
activates all changes of the IP address settings.

:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway <Gateway>

The command enters the IP address of the default gateway. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Parameters:
<Gateway> string

Range: 0.0.0.0 to ff.ff.ff.ff

Example: `SYST:COMM:NETW:GAT 1.2.3.4`
enters the IP address of the default gateway.
`SYST:COMM:NETW:IPAD:SET`
activates all changes of the IP address settings.

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

The command enters the Subnet mask. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Parameters:
<Mask> string

Example: `SYST:COMM:NETW:SUBN:MASK 255.255.255.0`
enters the Subnet mask.
`SYST:COMM:NETW:IPAD:SET`
activates all changes of the IP address settings.

:SYSTem:COMMunicate:NETWork:RESource? <Resource>

The command queries the visa resource string. This string is used for remote control of the instrument.

Parameters:
<Resource> string

Example: `SYST:COMM:NETW:RES`
queries the VISA resource string.
`Response: TCPIP::192.1.2.3::INSTR`

Usage: Query only

:SYSTem:COMMunicate:USB:RESource?

The command queries the visa resource string for remote control via the USB interface.

Return values:
<Resource> string

Example: `SYST:COMM:USB:RES`
queries the VISA resource string for remote control via the USB interface.
`Response: USB::72::000000::INSTR`

Usage: Query only

:SYSTem:COMMunicate:GPIB:RESource?

The command queries the visa resource string for remote control via the GPIB interface. This string is used for remote control of the instrument.

To change the GPIB address, use the command `SYST:COMM:GPIB:ADDR`.

Return values:

<Resource> string

Example: `SYST:COMM:GPIB:RES`
queries the VISA resource string.
`Response: GPIB::28::INSTR`

Usage: Query only

:SYSTem:COMMunicate:SERial:RESource?

The command queries the visa resource string for the serial remote control interface. This string is used for remote control of the instrument.

Return values:

<Resource> string

Example: `SYST:COMM:SER:RES`
queries the VISA resource string.
`Response: ASRL1::INSTR`

Usage: Query only

:SYSTem:COMMunicate:SERial:BAUD <Baud>

The command enters the baudrate for the serial remote control interface.

Parameters:

<Baud> 2400|4800|9600|19200|38400|57600|115200

*RST: 115200

Example: `SYST:COMM:SER:BAUD 115200`
enters the baudrate 115200.

Usage: SCPI conform

:SYSTem:COMMunicate:SERial:PARity <Parity>

The command enters the parity for the serial remote control interface.

Parameters:

<Parity> NONE|ODD|EVEN

*RST: NONE

Example: `SYST:COMM:SER:PAR NONE`
selects parity NONE.

Usage: SCPI conform

:SYSTem:COMMunicate:SERial:SBITs <Sbits>

The command enters the number of stop bits for the serial remote control interface.

Parameters:

<Sbits> 1|2

*RST: 1

Example: `SYST:COMM:SER:SBIT 2`
selects 2 stop bits.

Usage: SCPI conform

:SYSTem:DATE <Date>

The command sets the date for the instrument-internal calendar.

Parameters:

<Date> <year>,<month>,<day>

Example: `SYST:DATE 2003,05,01`
sets May 1, 2003.

Usage: SCPI conform

:SYSTem:DISPlay:UPDate <Update>

The command switches the update of the display on/off. A switchover from remote control to manual control always sets the status of the update of the display to ON.

Parameters:

<Update> 0|1|OFF|ON

*RST: ON

Example: `SYST:DISP:UPD OFF`
switches update of displayed parameter values off.

:SYSTem:DLOCk <Dlock>

This command (**D**isplay **LOC**k) disables the manual operation via the display, or enables it again (OFF).

The command disables also the front panel keyboard of the instrument including the LOCAL key.

Parameters:

<Dlock> 0|1|OFF|ON

Example: `SYST:DLOC ON`
activates the display lock. The instrument cannot be operated via the display until it has been enabled with `SYST:DLOC OFF`.

SYSTem:ERRor:ALL? <All >

The command queries all entries in the error queue and then deletes them.

Return values:

<All > string

0
"No error", i.e the error queue is empty.

positive value
Positive error numbers denote device-specific errors.

negative value
Negative error numbers denote error messages defined by SCPI

Example: `SYST:ERR:ALL`
queries all entries in the error queue.
`Response: 0, 'no error'`
No errors have occurred since the error queue was last read out.

Usage: Query only
SCPI conform

SYSTem:ERRor:CODE:ALL?

The command queries all entries in the error queue and then deletes them. Only the error numbers are returned and not the entire error text.

Return values:

<All> string

0
"No error", i.e. the error queue is empty

positive value
Positive error numbers denote device-specific errors

negative value
Negative error numbers denote error messages defined by SCPI
(see section chapter 9, "Error Messages", on page 451)

Example: `SYST:ERR:CODE:ALL`
queries all entries in the error queue.
`Response: 0`
no errors have occurred since the error queue was last read out.

Usage: Query only
SCPI conform

SYSTem:ERRor:CODE[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it. Only the error number is returned and not the entire error text.

Return values:

<Next> string

0
"No error", i.e. the error queue is empty

positive value
Positive error numbers denote device-specific errors

negative value
Negative error numbers denote error messages defined by SCPI (see section chapter 9, "Error Messages", on page 451)

Example: `SYST:ERR:CODE`
queries the oldest entry in the error queue.
`Response: 0`
No errors have occurred since the error queue was last read out.

Usage: Query only
SCPI conform

SYSTem:ERRor:COUNt?

The command queries the number of entries in the error queue. If the error queue is empty, '0' is returned.

Return values:

<Count> string

Example: `SYST:ERR:COUN`
queries the number of entries in the error queue.
`Response: 1`
One error has occurred since the error queue was last read out.

Usage: Query only
SCPI conform

SYSTem:ERRor[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it.

The command is identical to the command `STATus:QUEue:NEXT`.

Return values:

<Next> string

0
"No error", i.e. the error queue is empty

positive value
Positive error numbers denote device-specific errors

negative value
Negative error numbers denote error messages defined by SCPI (see section chapter 9, "Error Messages", on page 451)

Example:
`SYST:ERR?`
queries the oldest entry in the error queue.
`Response: 0, 'no error'`
No errors have occurred since the error queue was last read out.

Usage: Query only
SCPI conform

:SYSTem:IDENtification <Identification>

Enables/disables selection of user defined "IDN String" and "OPT String" for the selected instrument (`:SYST:LANG`).

Note: While working in a emulation mode, the R&S SMF specific command set is disabled, i.e. the SCPI command `SYST:IDEN` will be discarded.

Parameters:

<Identification> AUTO|USER

*RST: AUTO

Example:
`SYST:IDEN USER`
selects the user defined identification string.
`SYST:IRES "Test Device"`
defines the identification string 'test device'
`*IDN?`
`Response: 'test device'`
`SYST:LANG 'HP8373'`
selects command set of the HP generator. The R&S SMF's command set is disabled.
To return to the SCPI command set of the R&S SMF, use the HP command `EX`.

:SYSTem:IRESponse <Iresponse>

The command defines the identification string for selection user defined (`SYST:IDEN USER`).

Note: While working in a emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command `SYST:IRES` will be discarded.

Parameters:

<Iresponse> string

Example:

`SYST:IDEN USER`
selects an user-defined identification
`SYST:IRES "Test Device"`
defines the identification string 'test device'
`*IDN?`
`Response: 'test device'`

:SYSTem:KLOCk <Klock>

This command (**K**eyboard **LOC**k) disables the front panel keyboard of the instrument including the LOCAL key, or enables it again (OFF).

Parameters:

<Klock> 0|1|OFF|ON

*RST: OFF

Example:

`SYST:KLOC ON`
activates the keyboard lock. The keyboard cannot be operated again until it has been enabled with `SYST:KLOC OFF`.

Usage: SCPI conform

:SYSTem:LANGuage <Language>

The command selects the command set to be used. The GPIB command set of the R&S SMF no longer works after the selection of one of the HP generator command sets. See Application Note 1G71 on the user documentation CD-ROM (included in delivery).

The HP command `EX` returns to the instrument-specific GPIB command set.

Note: Selecting a command set automatically activates the use of the identification string of the associated instrument.

While working in a emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command `SYST:LANG` will be discarded.

Parameters:

<Language> string

*RST: SCPI

Example:

`SYST:LANG 'HP8373'`
selects command set of the HP generator.

:SYSTem:OREResponse <Oresponse>

The command defines the OPT string for selection user defined (`SYST:IDEN USER`).

Note: While working in a emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command `SYST:ORES` will be discarded.

Parameters:

<Oresponse> string

Example:
`SYST:IDEN USER`
selects an user-defined identification
`SYST:ORES "Test Option"`
defines the OPT string 'test option'
`*OPT?`
`Response: 'test option'`

:SYSTem:PROTect<ch>[:STATe] <State>,<password>

The command activates and deactivates the specified protection level.

Suffix:

<ch> Indicates the protection level.
There are several protection levels which disable specific service functions (authorized personnel of R&S Service Departments only).

Parameters:

<State> 0|1|OFF|ON

<password> The respective functions are disabled when the protection level is activated. No password is required for activation. A password must be entered to deactivate the protection level. The password for the first level is 123456. This protection level can be used to lock-out internal adjustments.

Example:
`SYST:PROT1 ON`
activates protection level 1. Internal adjustments are only possible after deactivating the lock-out.
`SYST:PROT1 OFF, 123456`
deactivates protection level 1. Internal adjustments are enabled again.

Usage: SCPI conform

SYSTem:SERRor?

This command returns a list of all errors existing at the time when the query is started. This list corresponds to the display on the info page under manual control.

Return values:

<Serror> string

Example: `SYST:SERR`
queries all errors existing in the error queue.

Example: `Response: -221, 'Settings conflict', 153, 'Input voltage out of range'`
The two returned errors have occurred since the error queue was last queried.

Usage: Query only

:SYSTem:STARtup:COMPlete?

The command queries if the startup of the instrument is completed.

Return values:
<Complete> 0|1|OFF|ON

Example: `SYST:STAR:COMP`
`Response: 1`
The startup of the instrument is completed.

Usage: Query only

:SYSTem:TIME <Time>

The command sets the time for the instrument-internal clock.

Parameters:
<Time> 0...23,0...59,0...59

Example: `SYST:TIME 12,0,0`
sets the time to precisely 12 pm.

SYSTem:VERSion? <Version >

The command queries the SCPI version with which the instrument complies.

Return values:
<Version > string

Example: `SYST:VERS`
queries the SCPI version.
`Response: 1996`
The instrument complies with the version from 1996.

Usage: Query only
SCPI conform

7.15 TEST Subsystem

The TEST system contains the commands for performing the routines as well as for direct manipulation of the hardware assemblies (`:TEST:DIRect`).

The self tests return a "0" if the test is performed successfully, otherwise a value other than "0" is returned. None of the commands of this system have an `*RST` value.

NOTICE

Improper use could destroy the assembly!

The respective hardware assembly responds directly to the `:TEST:DIRect` command; any safety mechanisms are bypassed. The command is used for servicing purposes and should not be applied by the user.

:TEST<hw>:DIRect <HW_assembly>,<subadress>,<hex data string>
:TEST<hw>:DIRect? <HW_assembly>,<subadress>

The respective hardware assembly responds directly to the command; any safety mechanisms are bypassed. This function is only available via remote control.

Example:

```
TEST:DIR 'SSYN',0,#H12345678
TEST:DIR? 'SSYN',0
```
Response: `#H12345678`

7.16 TRIGger Subsystem

The `TRIGger` system contains the commands for selecting the trigger source for the RF and LF sweep. The trigger input connectors are configured in the `SOURce:INPut` subsystem.

The trigger system of the R&S SMF is a simplified implementation of the SCPI trigger system. The `TRIGger` system differs from the SCPI system as follows:

- No `INITiate` command; the instrument behaves as if `INITiate:CONTinuous ON` were set.
- Under `TRIGger` several sweep subsystems exist.

Other commands associated with the trigger system of the R&S SMF can be found in the modulation and RF signal subsystems.

TRIGger<hw>

- Suffix `TRIGger<1|2>` is not permitted
- !!ERROR: Document structure missing in li > Must contain atleast one child

Table 7-1: Cross-reference between the manual and remote control

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	"Auto" mode
SINGle	BUS	"Single" mode.
EXTernal	EXTernal	"Ext Single" and "Ext Step" mode. Use command `:SWEep:FREQ:MODE` to select between the two sweep modes.
EAUTo	-	"Ext Start/Stop" mode.

:TRIGger<hw>:LFFSweep:SOURce <Source>

The command sets the trigger source for the LF sweep. The trigger is triggered by the command `:SOURce:LFOutput:SWEep[:FREQuency]EXECute`.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in the table 7-1.

Parameters:

<Source> AUTO|IMMediate | SINGle|BUS| EXTernal | EAUTo

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle|BUS
One complete sweep cycle is triggered by the GPIB commands `[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute` or `*TRG`.
The mode has to be set to `AUTO` (`[:SOURce]:LFOutput:SWEep[:FREQuency]:MODE`).

EXTernal
The sweep is triggered externally via the TRIGGER connector or the AUX connector at the rear of the instrument.

EAUTo
The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: SINGle

Example: `TRIG:LFFS:SOUR EXT`
selects triggering with an external trigger.

:TRIGger<hw>:FSWeep[:IMMediate]

The command immediately starts an RF frequency sweep cycle.

The command is only effective for sweep mode "Single" (`SOUR:SWE:FREQ:MODE AUTO` in combination with `TRIG:FSW:SOUR SING`).

The command corresponds to the manual control "Execute Single Sweep".

Example: `SWE:FREQ:MODE AUTO`
sets the triggered sweep mode, i.e. a trigger is required to start the sweep.
`TRIG:FSW:SOUR SING`
sets the "Single" trigger mode, i.e. a trigger starts a single sweep.
`TRIG:FSW`
starts a single RF frequency sweep.

Usage: Event

:TRIGger<hw>:FSWeep:SOURce <Source>

The command sets the trigger source for the RF frequency sweep.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in table 7-1.

Parameters:

<Source> AUTO|IMMediate | SINGle|BUS| EXTernal | EAUTo

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle|BUS
One complete sweep cycle is triggered by the GPIB commands `[:SOURce<hw>]:SWEep[:FREQuency]:EXECute`, `:TRIGger<hw>:FSWeep[:IMMediate]` or `*TRG`. The mode has to be set to `AUTO` (`:SOURce:SWEep:FREQuency:MODE AUTO`).

EXTernal
The sweep is triggered externally via the TRIGGER connector or the AUX connector at the rear of the instrument.

EAUTo
The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: SINGle

Example: `TRIG:FSW:SOUR EXT`
selects triggering with an external trigger.

:TRIGger<hw>:LFVSweep:SOURce <Source>

The command sets the trigger source for the LF level sweep.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in the table 7-1.

Parameters:

<Source> AUTO|IMMediate|SINGle|BUS|EXTernal

AUTO | IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle
One complete sweep cycle is triggered by the GPIB bus commands `[:SOURce]:LFOutput:SWEep:VOLTage:EXECute` or `*TRG`. The mode has to be set to "AUTO" (`:SOURce:LFOutput:SWEep:VOLTage:MODE AUTO`).

EXTernal
The sweep is triggered externally via the TRIGGER connector or the AUX connector at the rear of the instrument.

*RST: SINGle

Example: `TRIG:LFVS:SOUR EXT`
selects triggering with an external trigger. The trigger is input via the TRIGGER connector or the AUX connector at the rear of the instrument.

:TRIGger<hw>:PSWeep[:IMMediate]

The command immediately starts an RF level sweep.

The command is only effective for sweep mode "Single" (`SOURce:SWEep:POWer:MODE AUTO` in combination with `TRIG:PSW:SOUR SING`).

The command corresponds to the manual control "Execute Single Sweep".

Example: `SWE:POW:MODE AUTO`
selects the triggered sweep mode, i.e. a trigger is required to start the sweep.
`TRIG:PSW:SOUR AUTO`
sets the Single trigger mode, i.e. a trigger starts a single sweep.
`TRIG:PSW`
starts a single RF level sweep.

Usage: Event

:TRIGger<hw>:PSWeep:SOURce <Source>

The command sets the trigger source for the RF level sweep.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in table 7-1.

Parameters:

<Source> AUTO|IMMediate | SINGle|BUS| EXTernal |EAUTo

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle|BUS
One complete sweep cycle is triggered by the GPIB commands `[:SOURce<hw>]:SWEep:POWer:EXECute`, `:TRIGger<hw>:PSWeep[:IMMediate]` or `*TRG`. The mode has to be set to `AUTO` (`:SOURce:SWEep:LEVel:MODE AUTO`).

EXTernal
The sweep is triggered externally via the TRIGGER connector or the AUX connector.

EAUTo
The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: SINGle

Example: `TRIG:PSW:SOUR EXT`
selects triggering with an external trigger.

:TRIGger<hw>[:SWEep][:IMMediate]

The command starts all sweeps which are activated for the respective path. The command starts all sweeps which are activated.

The sweep to be executed depends on the respective MODE setting (`:SOUR:SWEep:POW|FREQ:MODE` and `:SOUR:LFO:SWEep[:FREQ]:MODE`).

The command corresponds to the manual-control command "Execute Trigger".

Example: `TRIG`
starts all active sweeps.

Usage: Event

:TRIGger<hw>[:SWEep]:SOURce <Source>

The command sets the trigger source for all sweeps.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in the table 7-1.

Parameters:

<Source> AUTO|IMMediate | SINGle|BUS| EXTernal | EAUTo

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle|BUS
One complete sweep cycle is triggered by the GPIB commands `:SOURce:SWEep:POWer|FREQuency:EXEC`, `TRIGger:PSWeep|FSWeep:IMMediate` or `*TRG`.
If `:SOURce:SWEep:POWer:MODE` is set to `STEP`, one step is executed.
The mode has to be set to `AUTO`.

EXTernal
The sweep is triggered externally via the INST TRIG connector.

EAUTo
The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: SINGle

Example: `TRIG0:SOUR EXT`
selects triggering with an external trigger. The trigger is input via the INST TRIG connector.

Usage: Setting only

7.17 UNIT Subsystem

The UNIT subsystem contains the commands specifying which units are valid if no unit is indicated in a command. These settings are valid for the entire instrument.

:UNIT:ANGLe <Angle>

The command defines the default unit for the phase modulation angle. It is not valid for other commands which determine angle values, e.g. RF phase. It does not influence the manual control parameter unit and the display.

Parameters:

<Angle> DEG|RAD

*RST: RAD

Example: `UNIT:ANGL DEG`
sets default unit DEG for all commands which determine angle values.

Usage: SCPI conform

:UNIT:POWer <Power>

The command defines the default unit for power. It is valid for all commands which determine power values. It does not influence the manual control parameter unit and the display.

Parameters:

<Power> V|DBUV|DBM

*RST: DBM

Example: `UNIT:POW V`
sets default unit V for all commands which determine power values.

Usage: SCPI conform

8 Maintenance

The instrument does not need a periodic maintenance. Only the cleaning of the instrument is essential. The outside of the instrument is suitably cleaned using a soft, line-free dust cloth. Make sure that the air vents are not obstructed.

WARNING

Shock hazard

Before cleaning the instrument, make sure that the instrument is switched off and disconnected from all power supplies.

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument, e.g. cleaning agents that contain a solvent may damage the front panel labeling or plastic parts.

Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances.

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

Follow the instructions in the service manual and the safety instructions when exchanging modules or ordering spares. The order no. for spare parts is included in the service manual. The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) and alignment.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

8.1 Storing and Packing

The storage temperature range of the instrument is given in the data sheet. If the instrument is to be stored for a longer period of time, it must be protected against dust.

Repack the instrument as it was originally packed when transporting or shipping. The two protective foam plastic parts prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.

If you do not use the original packaging, use a sturdy cardboard box of suitable size and provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

9 Error Messages

This chapter describes the error messages of the R&S SMF. The error messages are output in the "Info" line on the screen and entered in the error error/event queue of the status reporting system.

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. Some error messages require that the error must be eliminated before correct instrument operation can be ensured. The info window with a list of current messages and a detailed description of each message can be opened with the INFO key.

In the remote control mode, error messages are entered in the error/event queue of the status reporting system and can be queried with the command `SYSTem:ERRor?`. If the error queue is empty, 0 ("No error") is returned.

9.1 Status Information

The status messages are displayed in the header section of the screen. The status information gives the user an overview of the main operating states and settings of the instrument. The states are indicated for information only and do not necessitate any action by the user. Status information is displayed between the frequency and level fields, at the left of the info line or in the info line itself.

9.1.1 Status information displayed between the frequency and level fields

This chapter gives an overview of the status messages displayed between the frequency and level fields.

RF OFF
The RF output is switched off

MOD OFF
All modulations are switched off

FREQ OFFSET
A frequency offset is set.

The frequency entered and displayed in the "Frequency" field takes any set frequency offset into consideration, e.g. an offset set for a downstream instrument. This means that with a frequency offset the frequency displayed in the header does not correspond to the frequency at the RF output, but rather to the frequency at the output of the downstream instrument.

This allows the target frequency at the output of a downstream instrument to be entered in the frequency field. The signal generator changes the RF output frequency according to the entered offset.

However, the frequency entered and displayed in the "Frequency/Phase" dialog of the "RF" function block always corresponds to the RF output frequency. Any frequency offset is not taken into consideration.

The correlation is as follows:

Freq in header = RF output frequency (= Freq in dialog) + Freq offset (= Offset in dialog)

LEVEL OFFSET
A level offset is set.

The level entered and displayed in the "Level" field takes the offset of any downstream attenuators/amplifiers into consideration by way of calculation. This means that with a level offset the level displayed in the header does not correspond to the level at the RF output, but rather to the level at the output of the downstream instrument.

This allows the target level at the output of downstream instruments to be entered. The signal generator changes the RF output level according to the set offset.

However, the level entered and displayed in the "Level" dialog of the "RF" function block always corresponds to the RF output level. Any level offset is not taken into consideration.

The correlation is as follows:

Level in header = RF output level (= Level in dialog) + Level offset

EXT REF
An external reference is used.

The external signal with selectable frequency and defined level must be input at the REF IN connector. It is output at the REF OUT connector.

BUSY
A setting or calculation is executed.

9.1.2 Status information displayed to the left of the Info line

This chapter gives an overview of the status messages displayed to the left of the Info line.

REMOTE
The instrument is remote controlled.

The keys on the front panel are usable, but all parameters are in read only mode.

The LOCAL key switches the instrument from remote control to manual operation. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

REM-LLO
The instrument is remote (**REM**ote) controlled. The LOCAL key is disabled by remote control with the command `LLO` (**L**ocal**L**ock**O**ut).

The keys on the front panel are usable, but all parameters are in read only mode.

The instrument can be switched from remote control to manual operation by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)` or by `&NREN`).

9.1.3 Status information displayed in the Info line

This chapter gives an overview of the status messages displayed in the Info line.

RFSweep / LevelSweep / LFSweep
The indicated sweep is enabled.

ALC On / Auto / S&H
The status of the automatic level control is indicated:
- ON
  automatic level control permanently on
- Auto
  automatic level control is automatically adapted to the operating states
- S&H
  automatic level control off, recalibration of the level whenever the level or frequency is set (sample and hold mode)

ListMode
List mode is active.

The values of the frequency/level pairs in the selected list are set for the chosen dwell time.

AttFixed
Attenuator fixed mode is active.

The uninterrupted level settings are made in a fixed range without attenuator switching. The variation range is set automatically when this mode is activated. The range is displayed under "Attenuator Fixed Range" in the "Level" dialog.

UCorr
User Correction is active.

The level is corrected by the given values in the selected user correction list. Correction is performed by the user-defined list values being added to the output level for the respective RF frequency. With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

OvenCold
The reference oscillator has not yet reached its nominal frequency.

When switching on from the STANDBY mode, the specified frequency accuracy is reached immediately. If the power switch was switched off, the reference oscillator needs some warm-up time to reach its nominal frequency. During this period of time, the output frequency does not yet reach its final value either.

9.2 Error Messages

Messages indicate errors in the instrument. They are displayed in the info line in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

9.2.1 Volatile messages

Volatile messages report automatic settings in the instrument (e.g. switching off of incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.

Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

SCPI command: `SYSTem:ERRor:ALL` or `SYSTem:ERRor[:NEXT]`

9.2.2 Permanent messages

Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent message must be eliminated before correct instrument operation can be ensured.

The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

SCPI command: `SYSTem:SERRor`

9.3 SCPI-Error Messages

The SCPI error messages are the same in all SCPI instruments. Detailed information and an overview of all error messages as defined in SCPI standard can be found in the corresponding documentation.

The errors are assigned negative numbers. The error text being entered into the error/ event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation as to the respective error.

9.4 Device-Specific Error Messages

The following table contains all error messages specific for the instrument in alphabetical order, as well as an explanation of the error situtaion. The positive error codes mark the errors specific of the instrument.

The device-specific error messages set bit 3 in the ESR register.

The index provides a list of the error messages sorted according to their error codes.

Error Code	Error	Description	Remedy
50	Extern reference out of range or disconnected	External reference is selected but no external signal is applied or the signal is out of range.	• Check the selected reference signal source (internal or external) in the "Setup > Reference Oscillator" dialog. • Change setting to 'internal' if no appropriate external source is available.
180	Adjustment failed	Adjustment could not be executed	The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the device (see chapter 5.2.3.1, "Internal Adjustments", on page 22.
182	Adjustment data missing	Adjustment data are missing.	The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the instrument.
183	Adjustment data invalid	Adjustment data are invalid and must be restored.	The adjustment data have to be generated again by an internal or external adjustment or to be loaded into the instrument.
200	Cannot access hardware	The data transmission to a module was unsuccessful.	The module is not installed, not properly installed or missing.
201	Hardware revision out of date	A later version of certain parts of the instrument is necessary to execute the function selected.	The driver does not support the installed version of a module.
202	Cannot access the EEPROM	A error occurs when writing or reading a EEPROM.	The EEPROM might be defect and has to be replaced.
203	Invalid EEPROM data	Reading a EEPROM is possible, however the data are inconsistent.	
204	Driver initialization failed	Initialization of a driver fails when booting the instrument firmware.	The driver is not compatible with the hardware or software configuration of the instrument.
241	No current list	There is no list selected. To execute the required operation, a list has to be selected in the related menu.	If no list is available, a new list must be created.
242	Unknown list type specified	The list type selected is not valid for the required operation. For instanse, the file extension for waveform list files is *.wv. It is not possible to enter another file extension when selecting a list.	Check the selected list type.

Error Code	Error	Description	Remedy
460	Cannot open file	The selected file can not be opened.	Check the path and file name.
461	Cannot write file	The file can not be written.	Check if the file is read-only.
462	Cannot read file	The file can not be read.	Check if the file contents are compatible with the file type.
463	Filename missing	The required operation cannot be executed because the file name is not specified.	A file name has to be entered when creating a new list.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extenssion. For instanse, the file extension for waveform list files is `*.wv`. It is not possible to enter another file extension when storing a list.
465	File contains invalid data	The selected file contains data that is not valid for the file type. The file extension determines the data that is valid for this file type. If the file extension is changed the lists are no longer recognized and the data are therefore invalid. Example: the extension of a waveform file (= `*.wv`) was changed to `*.txt`	Check the file extension.

A Hardware Interfaces

This section covers hardware related topics, like pin assignment of the GPIB bus interface, monitor and AUX I/O connectors.

The remote control interfaces are described in detailes in chapter 6, "Remote Control Basics", on page 189.

For specifications refer to the data sheet.

A.1 GPIB Bus Interface

Pin assignment

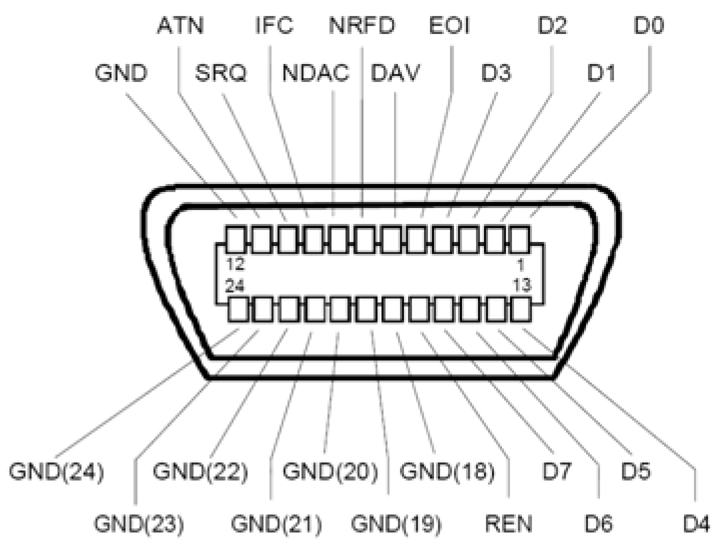


Fig. 1-1: Pin assignment of GPIB bus interface

Bus lines

- Data bus with 8 lines D0 to D7:
  The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.
- Control bus with five lines:
  IFC (Interface Clear): active LOW resets the interfaces of the instruments 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 the connected device to send a service request to the controller.
  REN (Remote Enable): active LOW permits switchover to remote control.

EOI (End or Identify): has two functions in connection with ATN:
- ATN=HIGH active LOW marks the end of data transmission.
- ATN=LOW active LOW triggers a parallel poll.

- 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 connected devices is not ready for data transfer.
  NDAC (Not Data Accepted): active LOW signals that the instrument connected is accepting the data on the data bus.

Interface Functions

Instruments which can be controlled via GPIB bus can be equipped with different interface functions. The interface function for the R&S SMF are listed in the following table.

Table 1-1: GPIB bus 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, de-addressed by MTA.
T6	Talker function, full capability, ability to respond to serial poll, deaddressed by 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

List of Commands

Index

Symbols

A

B

C

D