# R&S®SMB100A
# Signal Generator
# Operating Manual




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Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the R&S®SMB100A, stock no. 1406.6000K02/K03 and its options.

- R&S®SMB-B1/B1H
- R&S®SMB-B5
- R&S®SMB-B30/B31/B32
- R&S®SMB-B101/B102/B103/B106
- R&S®SMB-B112/B112L/B120/B120L/B140/B140L
- R&S®SMB-K21
- R&S®SMB-K22
- R&S®SMB-K23
- R&S®SMB-K27

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.

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The following abbreviations are used throughout this manual: R&S®SMB100A is abbreviated as R&S SMB.

# 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<br>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.




indicates a hazardous situation which, if not avoided, will result in death or serious injury.




indicates a hazardous situation which, if not avoided, could result in death or serious injury.




indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.




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<br>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) |

| | | | | | |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| 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 identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.




ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.




ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.




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.

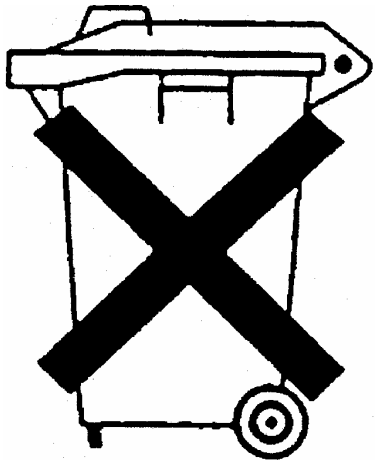
## Kundeninformation zur Batterieverordnung (BattV)

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)

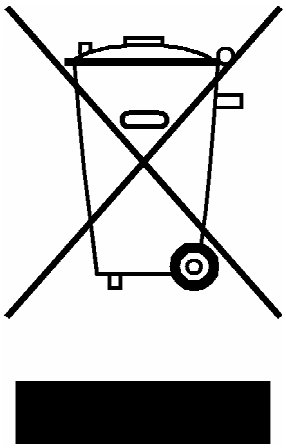
Cet appareil est équipé d'une pile comprenant des substances nocives. Ne jamais la jeter dans une poubelle pour ordures ménagéres.

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

ROHDE&SCHWARZ

1171.0200.11 V 04.01

ROHDE&SCHWARZ

EC Certificate of Conformity

CE

Certificate No.: 2009-72

This is to certify that:

| Equipment type | Stock No. | Designation |
|---|---|---|
| SMB100A | 1406.6000.xx | Signal Generator |

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: 2007 + A2: 2007
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 B equipment as well as the immunity to interference for operation in industry have been used as a basis.

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

Munich, 2009-12-15 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.


**Europe, Africa, Middle East**

Phone +49 89 4129 12345
customersupport@rohde-schwarz.com

**North America**

Phone 1-888-TEST-RSA (1-888-837-8772)
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ROHDE&SCHWARZ

1171.0200.22-06.00

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# 1 Preface

## 1.1 Documentation Overview

The user documentation for the R&S SMB 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 SMB 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 is 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 Typographical Conventions

The following text markers are used throughout this documentation:

| 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 quotation marks. |
| 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 quotation marks. |

# 2 Preparing for Use

The following topics will help you to get familiar with the instrument and perform the first steps:

- Front Panel Tour
- Rear Panel Tour
- Putting into Operation

This section explains the control elements and connectors of the Signal Generator R&S SMB with the aid of the front and rear views and describes how to put the instrument into operation. It also describes the connection of peripherals such as printer, keyboard or mouse. Specifications of interfaces can be found in the data sheet.

The chapter 3, "Getting Started", on page 43 of this manual provides an overview of the generator functions and introduces the operating concept. Detailed operating instructions and an overview of menus follow in chapter 4, "Manual Operation", on page 53.

For all reference information concerning manual and remote control of the instrument refer to the online help system or its printed/printable version. A more detailed description of the hardware connectors and interfaces is also part of the help system.

## 2.1 Front Panel Tour

The front panel of the R&S Signal Generator consists of the VGA display, some utility keys (left side) and the hardkey area with connectors and control interfaces (right side). The subsequent sections provide brief explanations on the controls and connectors, the hardkey area and the front panel.

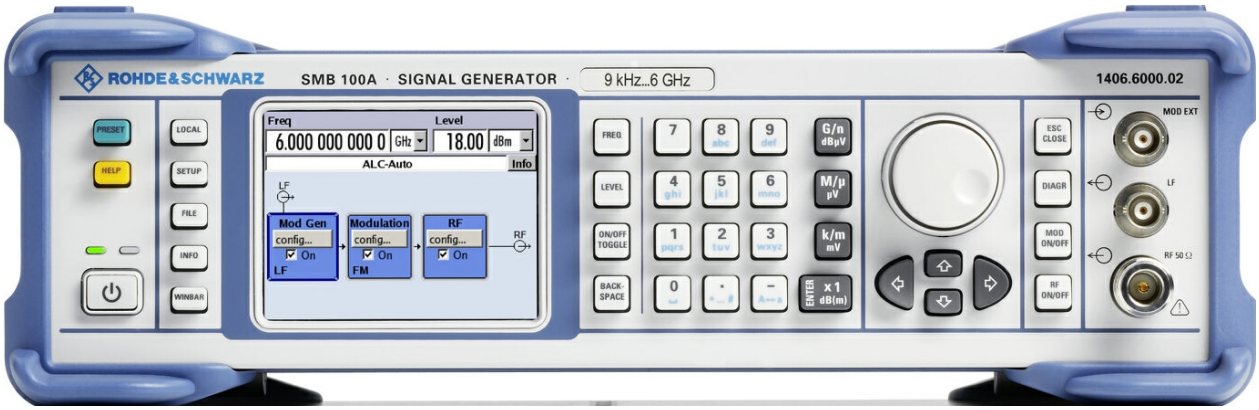



*Fig. 2-1: Front panel view*

### 2.1.1 Utility Keys




The keys to the left of the display cause the R&S SMB to return to a definite instrument state and provide information on the instrument and assistance.

For more information refer to chapter "Instrument Settings".

**PRESET**
Sets the instrument to a defined state (see chapter 2.3.4.4, "Default Settings", on page 28).

**LOCAL**
Switches from remote control to local (manual) control.

**SETUP**
Opens the "Setup" dialog for configuring presettings.

For more information, see chapter 5.2.3, "General Configuration of Instrument - Setup Key", on page 81.

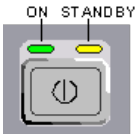
**FILE**
Activates the menu for storing or loading files (see chapter 4.7, "File Management", on page 71).

**INFO**
Displays status messages, error messages and warnings.

**WINBAR**
Toggles between the diagram and active menus.

**HELP**
Displays context-sensitive help text.

### 2.1.2 Standby LEDs and Standby Key




The standby LEDs and the ON/STANDBY key are located in the bottom left corner of the front panel.

The ON/STANDBY key toggles the instrument between standby and ready state (indicated by the standby LEDs).

The standby LEDs indicate the instrument states as follow:

- the green LED (left) is on when the instrument is ready for operation,
- the yellow LED (right) is on in the standby mode.

See also chapter 2.3.4.1, "Standby and Ready state", on page 27.

### 2.1.3 Display

The display clearly shows all main settings and signal generator states.

The display is divided into the following sections:

- Frequency and level display with info line
  - Frequency and level settings containing offset.
  - Status messages
  - Brief error messages.
    To access an window with detailed information for a message, use the INFO key.
- Block diagram
  The block diagram shows the current configuration and the signal flow in the generator with the aid of function blocks containing an on/off switch. Selecting a function block opens a list of associated setting menus. Active menus, info windows and graphs are displayed on top of the block diagram. The block diagram can be displayed in the foreground anytime with the DIAGRAM key.

For detailed information, see chapter 4.2, "Display", on page 56.

### 2.1.4 Setup Keys

The keys to the right of the display set parameters, select views and control the windows.

#### 2.1.4.1 Keys for Setting Paramters




These keys provide direct access to the settings in the header of the instrument for fast setting the RF signal.

For more information refer to chapter "Instrument Functions".

**FREQ**
Activates frequency entry.

**LEVEL**
Activates level entry.

**ON/OFF TOGGLE**
- Switches highlighted elements or a function block on and off.
- Switches between two or more settings, e.g. items of selection lists. At the end of a list, the cursor is set on the first entry again.

**BACKSPACE**
Deletes the character to the left of the cursor.

### 2.1.4.2 Display Keys




The keys assigned right to rotary knob arrange different windows on the display, and turn the RF signal and the modulation on and off.

**DIAGRAM**
Brings the block diagram to the foreground. Active menus are minimized.

**ESC**
The function of this key depends on the current cursor position.

- Calls the next higher selection level.
- Closes the open window without accepting new entries; the old value or parameter is retained.
- In dialog boxes that contain a "Cancel" button it activates that button.
- Closes all kinds of dialog boxes, if the edit mode is not active.
- Quits the edit mode, if the edit mode is active.
- Switches between different entry fields of a menu.
- Shifts the entry cursor from the header display to the previously active menu, or to the previously highlighted block in the block diagram if no menu is active.

**MOD ON/OFF**
Switches the modulations on and off.

"MOD OFF" is displayed in the info line of the header next to the "Level" field.

**RF ON/OFF**
Switches the RF signal on and off.

"RF OFF" is displayed in the header next to the "Frequency" field.

## 2.1.5 Keypad for data entry

The keys in the data entry keypad are used to enter alphanumeric data and units.

Data entry keys are only enabled while the cursor is placed on a data input field in a dialog. Their function depends on the data type of the input field.




| Keys | Description |
|---|---|
| **0...9/abc** | Enters the corresponding numbers (in numeric input fields) or characters (character input fields). |
| . | Inserts a decimal point (numeric input fields) or dot (character input fields) at the cursor position. Multiple decimal points are not allowed. |
| Unit keys | Selects a unit and thus determine the absolute value, or changes the unit, i.e. trigger a recalculation without changing the absolute value. The function depends on the time at which the UNIT key is used during parameter entry (see chapter 4.4.5, "Working with Units ", on page 65).<br>For unit-free values, the X1 key is equivalent to ENTER. It confirms the previous entry and deactivates the input field. |
| **_** | Adds a blank in a character input field. |
| ***... #** | Enters special characters. Toggles through the available characters if the key is pressed several times in a row. |
| **A <-> a** | Toggles between uppercase and lowercase characters. |
| **A, B, C, D, E, F** | Enters hexadecimal values. The letters assigned to the keys are automatically active when an entry field with a hexadecimal value is active. |

**ENTER**
Pressing the rotary knob has the same effect.

- Concludes the entry of dimensionless entries. For other entries, this key can be used instead of the default unit key. The new value is accepted.
- Confirms ("OK") and closes open input windows.
- In a dialog box, selects the default or focused button.
- In a dialog box, activates the edit mode for the focused area, if available.
- In a dialog box, activates or deactivates the selected option of the focused area, if the edit mode is active.
- Calls the next menu level.

### 2.1.6 Rotary Knob and Navigation Keys

The rotary knob and the arrow keys are alternative control elements for data variation and navigation in the graphical user interface.



**ROTARY KNOB**

The rotary knob has several functions:

- Increases (clockwise direction) or decreases (counter-clockwise direction) numeric values at a defined step width in editing mode
- Moves the cursor, e.g. to a function block in the block diagram
- Scrolls within lists, tables or tree views
- Acts like the ENTER key, when it is pressed.
- Shifts the selection bar within focused areas (e.g. lists), if the edit mode is activated.

**Note:** Turning or pressing the rotary knob is equivalent to pressing the UP and DOWN keys or the ENTER key in the keypad.

**NAVIGATION KEYS**



The navigation keys consist of 4 arrow keys which are used for navigation, alternatively to the rotary knob.

| | |
|---|---|
| UP/ DOWN KEYS | The up and down arrow keys do the following:<br>• In a numeric edit dialog box, increase or decrease the instrument parameter.<br>• In a list, table, window or dialog box, scroll vertically. |
| LEFT/ RIGHT KEYS | The left and right arrow keys do the following:<br>• In an alphanumeric edit dialog box, move the cursor forward and back.<br>• In a list, table, window or dialog box, scroll horizontally. |

## 2.1.7 Front Panel Connectors

The RF and LF output connectors and a connector for external modulation signals are located on the front panel.

**MOD EXT**




Input for external modulation signals.

**LF**




Output for internal LF modulation generator signal.

See also data sheet and chapter 5.5.1, "LF Generator Overview", on page 178, chapter 5.5.3, "LF Output", on page 184.

**RF 50 Ohm**
Depending on the equipped frequency option, the RF output connectors vary:

<table>
<tr><td colspan="2"> 
</td><td colspan="2"> 
</td></tr>
<tr><td colspan="4">Frequency options / Connector type:</td></tr>
<tr><td>R&S SMB- B101</td><td rowspan="4">N female</td><td>R&S SMB-B112/-112L</td><td rowspan="2">PC 3.5 mm</td></tr>
<tr><td>R&S SMB-B102</td><td>R&S SMB-B120/-B120L</td></tr>
<tr><td>R&S SMB-B103</td><td>R&S SMB-B140/-140L</td><td>PC 2.92 mm</td></tr>
<tr><td>R&S SMB-B106</td><td></td><td></td></tr>
</table>

Output for RF signal.

**NOTICE!** Maximum Input Levels. Do not overload the RF output. The maximum permissible back-feed is specified in the data sheet.

## 2.2 Rear Panel Tour

This section gives an overview of connectors on the rear panel of the instrument. Each connector is briefly described and a reference is given to the chapters containing detailed information. For technical data of the connectors refer to the data sheet.



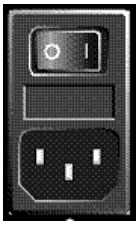

*Fig. 2-2: Rear panel view*

### 2.2.1 Description of the Connectors




**FUSES**
The R&S SMB is fully fused by two fuses IEC60127-T3.15H/250 V.

The fuses are accommodated in the fuse holders next to the power connector. Use only fuses of the mentioned type.



**AC SUPPLY AND POWER SWITCH**
When the R&S SMB is connected to the AC supply, it automatically sets itself to the correct range for the applied voltage (range: see type label). There is no need to set the voltage manually or change fuses.

The power switch can be set to two positions:

- **0**
  The instrument is disconnected from the mains.
- **I**
  The instrument is power-supplied. It is either ready for operation (STANDBY) or in operating mode, depending on the position of the ON/STANDBY switch on the instrument front.

See also data sheet and chapter 2.3.3, "Connecting the Instrument to the AC Supply", on page 27.




**USB IN**
USB (universal serial bus) interface of type B (device USB).

This interface can be used for remote control of the instrument.




**USB CONNECTORS TYPE A**
USB (universal serial bus) interfaces of type A (host USB).

- Connection of peripherals such as mouse, keyboard, etc.
- Connection of memory stick for file transmission
- Firmware update

See also chapter 2.4.1, "Connecting USB Devices", on page 31.




**LAN CONNECTOR**
Ethernet interface

- For integrating signal generators in a network
- Remote control of signal generator
- Remote access to the signal generator
- Firmware update

See also:

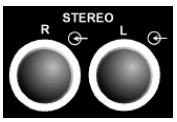
- chapter 2.6, "Setting Up a Network (LAN) Connection", on page 33
- chapter 6.1.3, "LAN Interface", on page 195




**IEC 625/IEEE 488**
IEC-bus (IEEE 488) interface for remote control of the instrument.

See also chapter A.1, "GPIB Bus Interface", on page 419 and chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 198.

**Note:** In order to avoid electromagnetic interference (EMI) caused by open lines, always terminate any connected IEC-bus cable with an instrument or a controller.




**STEREO R/L**
Inputs for analog stereo modulation signals. External modulation sources or the internal LF generator can be used (stereo modulation is available with option R&S SMB-B5).

See also chapter 5.4.6, "Stereo Modulation", on page 172.




**S/P DIF**
Input for digital stereo signals (stereo modulation is available with option R&S SMB-B5).

See also chapter 5.4.6, "Stereo Modulation", on page 172.




**SIGNAL VALID**
Output of valid signal. This signal marks the valid signal times (valid level and frequency indication). The signal is generated automatically.




**INSTR TRIG**
Input for external trigger for sweeps and list mode.

See also chapter 5.3.9.4, "List Mode", on page 152 and chapter 5.3.9.1, "Overview", on page 140.




**PULSE VIDEO**
Output of internal pulse generator signal or external pulse signal fed in via the PULSE EXT connector (video signal).

See alsochapter 5.4.5, "Pulse Modulation (PM)", on page 170 .




**PULSE EXT**
Input of external pulse signal or input of external trigger/gate signal for internal pulse generator.

See alsochapter 5.4.5, "Pulse Modulation (PM)", on page 170 .




**REF OUT**
Output of internal reference signal.

See also chapter 5.3.4, "Reference Oscillator", on page 117.




**REF IN**
Input for external reference signal.

See also chapter 5.3.4, "Reference Oscillator", on page 117.

**OCXO**
- Oven-controlled reference oscillator (option R&S SMB-B1)
  or
- high performance oven-controlled reference oscillator (option R&S SMB-B1H)



The OCXO generates a very precise 10 MHz reference signal. It needs some minutes of warm-up time to reach its nominal frequency.

Refer also to the data sheet for detailed information.

## 2.3 Putting into Operation

This section describes the basic steps to be taken when setting up the R&S SMB for the first time.

**WARNING**

**Risk of injury and instrument damage**

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury, or damage.

- Do not open the instrument casing.
- Read and observe the "Basic Safety Instructions" at the beginning of this manual or on the documentation CD-ROM, in addition to the safety instructions in the following sections. Notice that the data sheet may specify additional operating conditions.

**NOTICE**

**Risk of instrument damage**

Note that the general safety instructions also contain information on operating conditions that will prevent damage to the instrument. The instrument's data sheet may contain additional operating conditions.

**NOTICE**

**Risk of instrument damage during operation**

An unsuitable operating site or test setup can cause damage to the instrument and to connected devices. Ensure the following operating conditions before you switch on the instrument:

- All fan openings are unobstructed and the airflow perforations are unimpeded. The minimum distance from the wall is 10 cm.
- The instrument is dry and shows no sign of condensation.
- The instrument is positioned as described in the following sections.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are correctly connected and are not overloaded.

**NOTICE**

**Risk of electrostatic discharge**

Protect the work area against electrostatic discharge to avoid damage to electronic components in the modules. For details, refer to the safety instructions at the beginning of this manual.

**EMI impact on measurement results**

Electromagnetic interference (EMI) can affect the measurement results. To avoid any impact, make sure that the following conditions are met:

- Use suitable double-shielded cables.
- Do not use USB connecting cables exceeding 1 m in length.
- Use only USB devices that remain within the permissible EMI limits.
- Always terminate any connected IEC-bus cables with an instrument or controller.

Outputs and lines have to be terminated properly with 50 Ohms.

For digital interfaces only the cable R&S SMB-Z6 is permitted for connection. The associated cable is available under part number 1415.0201.02.

### 2.3.1 Unpacking and Checking the Instrument

To remove the instrument from its packaging and check the equipment for completeness proceed as follows:

1. Pull off the polyethylene protection pads from the instrument's rear feet and then carefully remove the pads from the instrument handles at the front.
2. Pull off the corrugated cardboard cover that protects the rear of the instrument.
3. Carefully unthread the corrugated cardboard cover at the front that protects the instrument handles and remove it.
4. Check the equipment for completeness using the delivery note and the accessory lists for the various items.
5. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. Make sure not to discard the box and packing material.

**Packing material**

Retain the original packing material. If the instrument needs to be transported or shipped at a later date, you can use the material to protect the control elements and connectors.

### 2.3.2 Placing or Mounting the Instrument

The R&S SMB is designed for use under laboratory conditions, either on a bench top or in a rack using a rack adapter kit (order number see data sheet).

#### Bench Top Operation

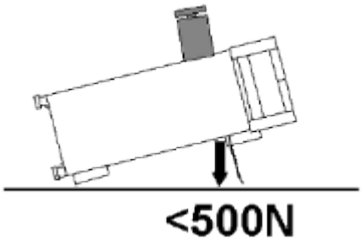
If the R&S SMB is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

**⚠ CAUTION**

**Risk of injury at the operating site**

The feet may fold in if they are not folded out completely or if the instrument is shifted. This may cause damage or injury.

- Fold the feet completely in or completely out to ensure stability of the instrument. Never shift the instrument when the feet are folded out.
- When the feet are folded out, do not work under the instrument or place anything underneath.
- The feet can break if they are overloaded. The overall load on the folded-out feet must not exceed 500 N.




#### Rackmounting

The R&S SMB can be installed in a rack using a rack adapter kit (Order No. see data sheet). The installation instructions are part of the adapter kit.

**NOTICE**

**Risk of instrument damage in a rack**

An unsufficient airflow can cause the instrument to overheat, which may disturb the operation and even cause damage.

Make sure that all fan openings are unobstructed, that the airflow perforations are unimpeded, and that the minimum distance from the wall is 10 cm.

### 2.3.3 Connecting the Instrument to the AC Supply

The R&S SMB is automatically adapted to the AC voltage supplied. There is no need to set the voltage manually or change fuses. The AC SUPPLY AND POWER SWITCH is at the rear of the unit.

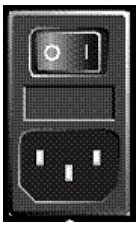
► Connect the instrument to the AC power source using the AC power cable delivered with the instrument.

**Note:** The instrument is in compliance with safety class EN61010-1.
Connect the instrument only to a socket with earthing contact.

### 2.3.4 Starting the Instrument

Switching off the AC power

You can leave the AC power on permanently to preserve your last instrument settings. Switching off is required only if the instrument must be completely disconnected from all power supplies.

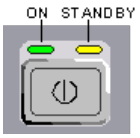


**Starting up instruments with power switch**

1. Connect the instrument to the AC supply.
2. To turn the power on, press the main power switch to position I (On).

   After power-up, the instrument is in standby or ready state, depending on the state of the ON/STANDBY key at the front panel of the instrument when the instrument was switched off for the last time.
3. In case the instrument is in standby mode, i.e. the yellow LED is on, press the ON/STANDBY key to switch the instrument to ready state.

#### 2.3.4.1 Standby and Ready state




The ON/STANDBY key is located in the bottom left corner of the front panel.

**Switching between standby and ready state**

► Press the ON/STANDBY key briefly to switch the instrument from the standby to ready state or vice versa.

In ready state, the left, green LED is on. The instrument is ready for operation. All modules are power-supplied and the R&S SMB initiates its startup procedure.
In standby state, the right, yellow LED is on. The standby power only supplies the power switch circuits and the oven-controlled crystal oscillator to keep it at its operating temperature. In this state it is safe to switch off the AC power and disconnect the instrument from the power supply.

### 2.3.4.2 Start Display and Booting

The instrument boots the operating system, starts the instrument firmware and automatically performs a selftest. If the previous session was terminated regularly, the instrument uses the last setup with the relevant instrument settings.

Once the startup procedure has been terminated, the block diagram opened in the previous session is displayed and the instrument is ready for operation.



Use the PRESET key to return the instrument to its definite reset/preset state, if the current setup is not anymore relevant.

To customize the start settings, use the "File" dialog.



**Rebooting the instrument**

Press the STANDBY key for approx. 5 s. to reboot the instrument, if the software stops unexpectedly.

### 2.3.4.3 Function Check

The signal generator automatically monitors the main functions when the instrument is switched on and continuously during operation.

A detected fault is indicated by a "ERROR" message displayed in the info line together with a brief error description. For in-depth identification of the error, press the INFO key. In response, a description of the error(s) is displayed.

For more information, refer to chapter 9, "Error Messages", on page 411.

Additionaly to the automatic monitoring, the R&S SMB offers the following capabilities to ensure correct functioning:

- Internal Adjustments
  Press the SETUP key and select "System > Internal Adjustments" to access the dialog for preforming and configuring of the adjustments settings. A maximum level accuracy can be obtained, for instance.
- Selftest
  A selftest is provided for service purposes. The selftest is a protected test procedure, which can be accessed if protection level 1 is disabled.

### 2.3.4.4 Default 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 off. It is also recomended that you use the PRESET key to return the instrument to its defined preset state every time a new configuration is required or the current setup is not anymore relevant.

The R&S SMB offers a two-stage preset concept:

- Preset the instrument to a predefined state

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 bus address or reference oscillator source settings.

- Preset the instrument to its factory settings
  The instrument can also be forced to load its default factory settings. To access the corresponding dialog box, press the SETUP key and select the "Factory Preset".
  For more information and an overview of the settings affected by the factory preset function, see chapter 5.2.3.16, "Factory Preset", on page 101.

**Overview of the Most Important Preset 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
- "Level" = 30 dBm for instruments including an attenuator
  "Level" = -5 dBm for instruments with no attenuator
- "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

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)



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

### 2.3.5 Shutting Down the Instrument

To shut down the R&S SMB, proceed as described below.

**NOTICE**

**Risk of losing data**

If you switch off the running instrument using the rear panel switch or by disconnecting the power cord, the instrument loses its current settings. Furthermore, program data may be lost.

Press the ON/STANDBY key first to shut down the application properly.

1. Press the ON/STANDBY key to save the current setup, shut down the operating system and set the instrument to standby state.

   The yellow LED must be on.

2. To switch off the power, press the main power switch to position 0 (Off).

   None of the front-panel LEDs should be on.

### 2.3.6 Power Fuses

The R&S SMB is fully fused by two fuses IEC60127-T3.15H/250 V.

The fuses are accommodated in the fuse holders next to the power connector. Use only fuses of the mentioned type.

**⚠ WARNING**

**Shock hazard**

Before replacing a fuse, make sure that the instrument is switched off and disconnected from all power supplies.

Always use fuses supplied by Rohde & Schwarz as spare parts, or fuses of the same type and rating.

## 2.4 Connecting External Accessories

The equivalent USB ports on the front and/or rear panel of the R&S SMB can be used to connect a variety of accessories.

In addition the instrument provides interfaces for network integration (see chapter 2.6, "Setting Up a Network (LAN) Connection", on page 33).

### 2.4.1 Connecting USB Devices

The USB interfaces on the front and (optionally) rear panels of the R&S SMB allow you to connect USB devices directly to the instrument. This number can be increased as necessary by using USB hubs. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S SMB.

The following list shows various USB devices that can be useful:

- Memory stick for easy transfer of data to/from a computer (e.g. firmware updates)
- CD-ROM drives for easy installation of firmware applications
- Keyboard or mouse to simplify the entry of data, comments, file names, etc.
- Power sensors, e.g. of the NRP Zxy family

Installing USB devices is easy under Linux, because all USB devices are plug&play. After a device is connected to the USB interface, the operating system automatically searches for a suitable device driver.

If Linux does not find a suitable driver, it will prompt you to specify a directory that contains the driver software. If the driver software is on a CD, connect a USB CD-ROM drive to the instrument before proceeding.

When a USB device is subsequently disconnected from the R&S SMB, the operating system immediately detects the change in hardware configuration and deactivates the corresponding driver.

All USB devices can be connected to or disconnected from the instrument during operation.

#### Connecting a memory stick or CD-ROM drive

If installation of a memory stick or CD-ROM drive is successful, the operating system informs you that the device is ready to use. The device is made available as a new drive (`/usb`). The name of the drive is manufacturer-dependent.

#### Connecting a keyboard

The keyboard is detected automatically when it is connected. The default keyboard layout is English – US.

Use the "Setup > Keyboard Settings" dialog to configure the keyboard properties.

#### Connecting a mouse

The mouse is detected automatically when it is connected.

## 2.5 Linux Operating System

The instrument contains the Linux operating system. To ensure that the instrument software functions properly, certain rules must be adhered to concerning the operating system.

**NOTICE**

**Risk of causing instrument unusability**

The instrument is equipped with the Linux operating system. Additional software can therefore be installed on the instrument. The use and installation of additional software may impair instrument function. Thus, run only programs that Rohde & Schwarz has tested for compatibility with the instrument software.

The drivers and programs used on the instrument under Linux have been adapted to the instrument. Existing instrument software must always be modified using only update software released by Rohde & Schwarz.

The configuration of the operating system is optimally adapted to signal generator functions in the factory. Changes in the system setup are only required when peripherals like keyboard are installed or if the network configuration does not comply with the default settings (see chapter 2.6.1, "Connecting the Instrument to the Network", on page 33). After the R&S SMB is started, the operating system boots and the instrument firmware is started automatically.



**Accessing Operating System**

The operating system cannot be accessed.

All necessary system settings can be made in the "Setup" dialog.

The R&S SMB provides an internal flash memory, it does not contain a disk drive. The flash memory holds the operating system, the firmware and the stored data. Data transfer is possible via a memory stick connected to a USB interface. The memory stick and the flash memory are accessed via the "File Manager".

### Accsessing the File System

The instrument also supports two standard methods to access the file system form a remote client:

- FTP (file transfer protocol)
- File sharing according to the SAMBA/SMB (server message block) protocol.

Both methods allow the access to the folder `/var/user/share`.



**Default password**

The FTP and SAMBA file access use the user "instrument" with default password "instrument".

In is highly recomended to change this password in the Setup > Security > Change User Password dialog before connecting the instrument to the network!

### Screen saver

A screen saver can be activated in the R&S SMB. When active, the display is shut off when no entries via front panel, external mouse or external keyboard are made for a period of time. The screen saver prolongs the life time of the display.

Use the "Setup > Display Settings" dialog to switch on or off the screen saver and to adjust the screen saver settings.

## 2.6 Setting Up a Network (LAN) Connection

The R&S SMB is equipped with a network interface and can be connected to an Ethernet LAN (local area network). Provided the appropriate rights have been assigned by the network administrator and the Linux firewall configuration is adapted accordingly, the interface can be used, for example:

- To transfer data between a controller and the tester, e.g. in order to run a remote control program.
  See chapter 6, "Remote Control Basics", on page 193.
- To access or control the measurement from a remote computer using the "Remote Desktop" application, the Ultr@VNC program (or a similar tool)
- To connect external network devices (e.g. printers)
- To transfer data from a remote computer and back, e.g. using network folders

This section describes how to configure the LAN interface. It includes the following topics:

- chapter 2.6.1, "Connecting the Instrument to the Network", on page 33
- chapter 2.6.2, "Assigning the IP Address", on page 34



**Accessing Operating System**

The operating system cannot be accessed.

All necessary system settings can be made in the "Setup" dialog.

### 2.6.1 Connecting the Instrument to the Network

There are two methods to establish a LAN connection to the instrument:

- A non-dedicated network (Ethernet) connection from the instrument to an existing network made with an ordinary RJ-45 network cable. The instrument is assigned an IP address and can coexist with a computer and with other hosts on the same network.
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer made with a (crossover) RJ-45 network cable. The computer must be equipped with a network adapter and is directly connected to the instrument. The use of hubs, switches, or gateways is not required, however, data transfer is still performed using the TCP/IP protocol.

In both cases, an IP address has to be assigned to the instrument and the computer, see chapter 2.6.2, "Assigning the IP Address", on page 34.

The R&S SMB uses the IP addresses 192.168.xxx.yyy for this purposes, where xxx and yyy may take values between 1...254; the subnet mask is always 255.255.255.0.

**NOTICE**

**Risk of network failure**

Before connecting the instrument to the network or configuring the network, consult your network administrator. Errors may affect the entire network.

► To establish a non-dedicated network connection, connect a commercial RJ-45 cable to one of the LAN ports.
To establish a dedicated connection, connect a (crossover) RJ-45 cable between the instrument and a single PC.

If the instrument is connected to the LAN, the operating system automatically detects the network connection and activates the required drivers.

The network card can be operated with a 10/100 Mbps Ethernet IEEE 802.3u interface.

### 2.6.2 Assigning the IP Address

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

- If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.
- If the network does not support DHCP, the instrument tries to obtain the IP address via Zeroconf (APIA) protocol. If this attempt does not succeed or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

**NOTICE**

**Risk of network errors**

Connection errors can affect the entire network. If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN. Contact your network administrator to obtain a valid IP address.

**Assigning the IP address on the instrument**

1. Press the SETUP key and select the "Network Settings" dialog.
2. Set the "Address Mode" to Static.
3. Select the "IP Address" and enter the IP address, for example *192.168.0.1.*. The IP address consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.

4. Select the "Subnet Mask" and enter the subnet mask, for example *255.255.255.0*. The subnet mask consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.

**Assigning the IP address manually on a PC**

1. Obtain the IP address and subnet mask for the R&S SMB and the IP address for the local default gateway from your network administrator. If necessary, also obtain the name of your DNS domain and the IP addresses of the DNS and WINS servers on your network. If you use more than one LAN connector, you need separate address information for each connector.
2. Press the "Windows" key to access the operating system.
3. Open the "Control Panel" by selecting "Start > Settings > Control Panel".
4. Select "Network Connections".
5. Right-click "Local Area Connection" and select "Properties" from the context-sensitive menu, or
   click "Local Area Connection" and then "File > Properties".
6. On the "General" tab, click "Internet Protocol (TCP/IP)" and then select "Properties".
7. Select "Use the following IP address" and enter the address information as obtained from the network administrator.
8. If necessary, you can also select "Use the following DNS server addresses" and enter your own DNS addresses.

   For more information refer to the Windows XP Help.

### 2.6.3 Using Computer Names

Alternatively to the IP address, each PC or instrument connected in a LAN can be accessed via an unambiguous computer name. Each instrument is delivered with an assigned computer name, but this name can be changed.

**Querying and changing a computer name**

1. Press the "Setup" key and select "Network Settings".

   The computer name is displayed under "Hostname".
2. Press the "Setup" key, select "Protection" and enable the "Protection Level 1".

   The parameter "Hostname" in the "Network Settings" dialog is now enabled for configuration.
3. Change the "Hostname".

## 2.7 Remote Access via an External Controller

The R&S SMB can be remote accessed from a remote computer (external controller) via a network link. This allows convenient operation of the instrument from the desktop although the instrument is integrated in a rack somewhere else.



For an overview of the instrument's operating concept and the different ways to control and operate the instrument, see chapter 3.1, "Brief Introduction to the Instrument's Concept", on page 43.

There are different ways to establish a remote access connection to the signal generator but all of them require an established LAN connection between the instrument and the remote computer. The simplest way to remote access the instrument is to use a Web browser, such as Windows Internet Explorer or Mozilla Firefox for instance. Alternatively a remote access via a special application can be used.

The free-of-charge program Ultr@VNC for PCs with Linux/Unix or Windows operating system is available for setting up the remote access connection. Using this application requires additional installation.

See the following table for an overview of the different ways to establish a remote access connection to the signal generator.

***Table 2-1: Remote access via an external computer***

| Remote access via | LAN connection | Installation of the additional application | |
|---|---|---|---|
| | | on the instrument | on the remote computer |
| Web Browser<br>e.g. Windows Internet Explorer or Mozilla Firefox<br>see chapter 2.7.1, "Using a Web Browser for Remote Access", on page 37 | required | no | no |
| Ultr@VNC<br>for PCs with Linux/Unix or Windows operating system<br>see chapter 2.7.2, "Remote Access via Ultr@VNC", on page 38 | required | required | VNC Viewer required |

When the connection is set up with Ultr@VNC, direct control on the instrument is possible while remote access is established.

For return to direct operation on the instrument, the connection must be cut. After cutting the connection, it is still enabled and can be established again any time. The connection is disabled only after deactivation of the program.

This section gives an information on how to use the Web browser for remote access, how to install the applications for remote access and how to establish the connection between the instrument and an external computer with Windows operating system. Remote access via an external computer with Linux/Unix operating system is performed accordingly.

**Default password**

Remote-access and file access require the user "instrument" with default password "instrument".

**NOTICE**

**Changing the default user and security passwords**

It is highly recommended to change the default user and security passwords in the menu "Setup > Security" before connecting the instrument to the network (see section chapter 5.2.3.14, "Security", on page 97).

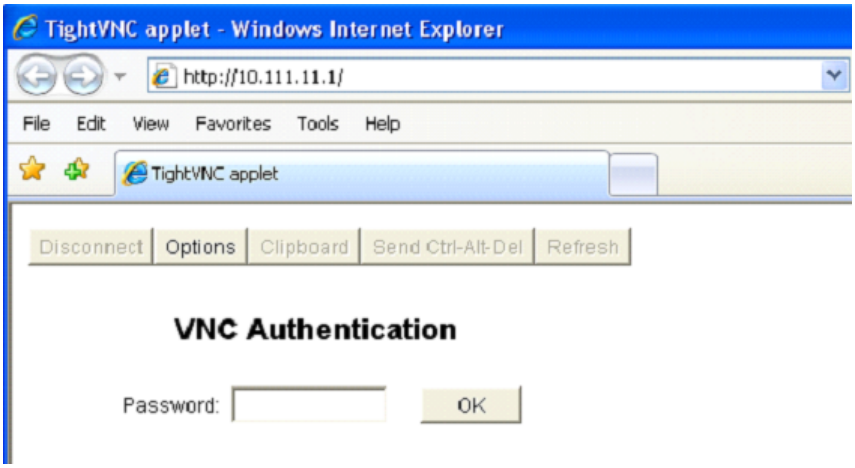
### 2.7.1 Using a Web Browser for Remote Access

The instrument can be remote-accessed via any Web browser, like Windows Internet Explorer or Mozilla Firefox for instance.

To remote access the instrument via Web browser:

1. Connect the instrument and the remote computer to a LAN, see chapter 2.6.1, "Connecting the Instrument to the Network", on page 33.
2. Instal the Java Runtime Environment JRE on the remote computer.
3. Type the instruments' IP address in the address field of the Web browser on your PC, e.g. *http://10.111.11.1*

   The "VNC Authentication" screen appears.




4. Enter the password and select "OK".
   The default password is "instrument".

   After the connection is established, the current signal generator screen with the block diagram is displayed and the instrument can be remote-accessed from the remote computer.

### 2.7.2 Remote Access via Ultr@VNC

Ultr@VNC is an application which can be used to access and control the instrument from a remote computer through a LAN connection. The program is included in operating system Linux/Unix. It is available as a free-of-charge download on the internet for operating system Window XP (http://www.uvnc.com/download/index.html) and on the instrument's CD-ROM.

**NOTICE**

**Risk of Unauthorized Access**

If the VNC application is enabled on the instrument, any user in the network who knows the computer name and login data can access it. To prevent this, make sure that the VNC server service on the instrument is disabled.

**Setting up a VNC connection**

1. Connect the instrument and the remote computer to a LAN, see chapter 2.6.1, "Connecting the Instrument to the Network", on page 33.
2. Install the Ultr@VNC application and enable it on the instrument.
3. In the ICF firewall, enable communication on the network via Ultr@VNC program.
4. Install the VNC Viewer on the remote computer with Windows operating system, see "Installing the VNC Viewer on a Windows PC" on page 40.
5. Set up the VNC connection between the instrument and:
   a) the remote computer with Linux/Unix operating system, see "Setting up the VNC connection on the Linux/Unix remote computer" on page 40;
   b) the remote computer with Windows operating system, see "Setting up the VNC connection on the Windows remote computer" on page 41.



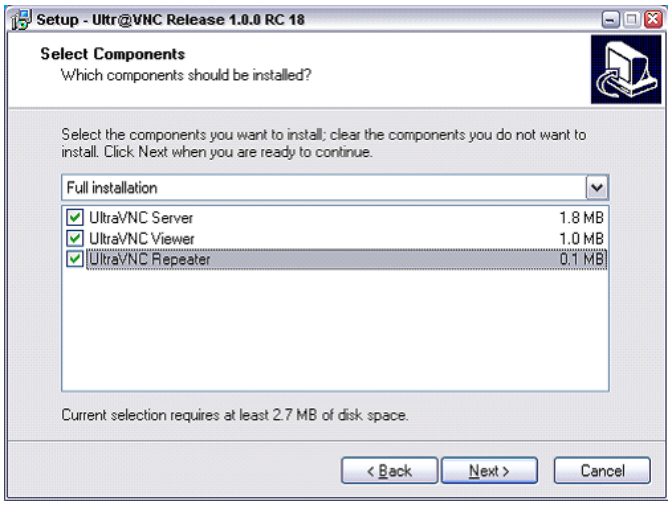
**Enabled Direct Control**

The direct control of the instrument is not disabled and the instrument can be controlled from the front panel and via the remote computer alternately.

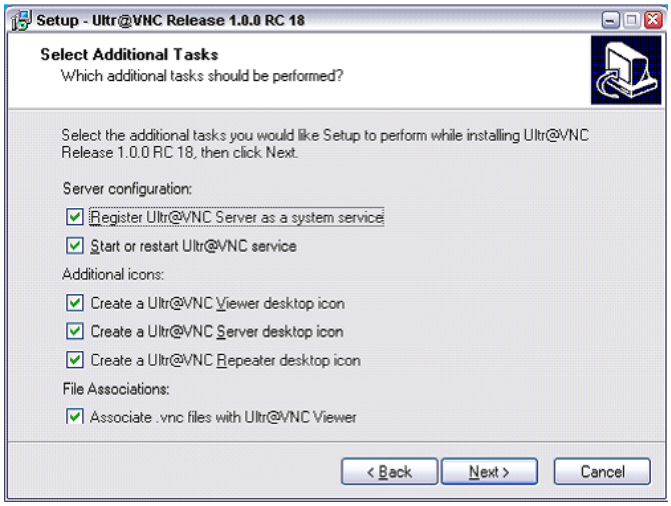
**Installing the Ultr@VNC application**

1. Download the program from the internet and copy it to a directory that can be accessed.
2. On the instrument, shut down firmware using the ALT+F4 key combination.
3. Double click on the setup file to start the installation.
   The setup wizard leads through the installation. This description focus only on the relevant settings.

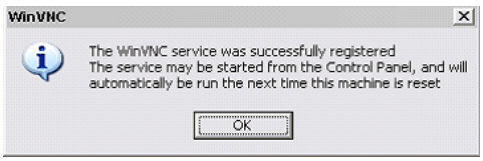
a) Select installation of all components.




b) In the "Additional Task Panel", enable all entries.




A successful installation is indicated by a message.

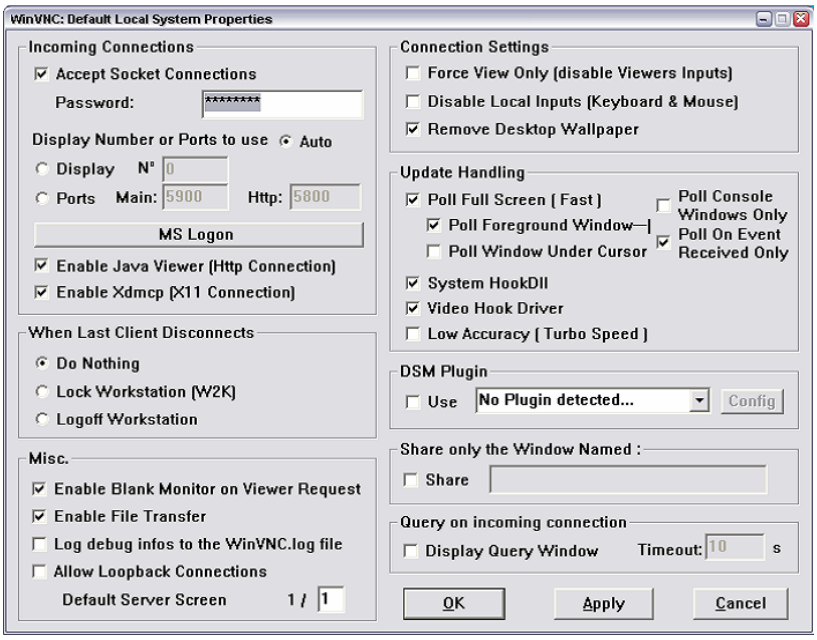



At the same time a warning is displayed stating that a password must be set.




4. Select "OK".

   The "Default Local System Properties" panel opens.




5. Enter a password with a length of at least five digits.
   This password is used on the remote computer to access the instrument. Other settings may be changed according to the user-specific security requirements.

   After the installation the Ultr@VNC program is automatically started together with the operating system. On mouse over, the IP address of the instrument is indicated. This IP address and the user-defined password are the prerequisites to enable remote access on the remote computer. Terminated connection is indicated by changed icon color.

### Installing the VNC Viewer on a Windows PC

1. Download the Ultr@VNC program form internet and follow the installation instructions.
   Only the program component VNC Viewer is required.

   **Note:** The VNC Viewer program is included in the download for the installation of the Ultr@VNC program on the signal generator if "Full installation" was selected in the "Select Component" panel. In this case, the program `ultr@vncviewer.exe` can be copied to the Windows PC.

2. Install VNC Viewer program component on the remote computer.

### Setting up the VNC connection on the Linux/Unix remote computer

The VNC program is available per default for Linux/Unix operating systems.

1. Start a Web browser on the remote computer and enter the IP address of the instrument.

2. Enter the following address:
   vnc://<IP-address of the instrument>, e.g. *vnc://192.168.1.1*.

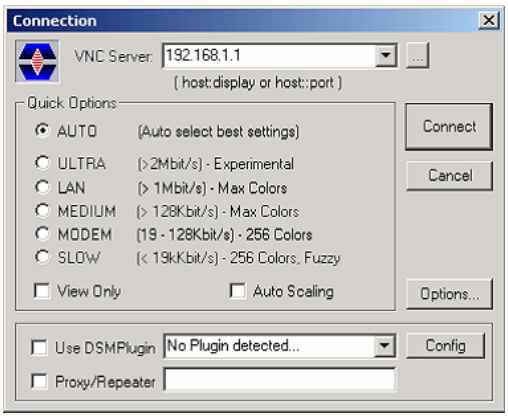
   A dialog is opened and the password for the remote VNC connection is requested.

3. Enter the password as defined in the "Default Local System Properties" panel of the Ultr@VNC program and select "Log On".

   The connection is established, the instrument is remote accessed and the current signal generator screen with the block diagram is displayed. The individual functions are operated using the mouse and keyboard.
   In contrast to remote access via Remote Desktop, the direct control of the instrument is not disabled and the instrument can be controlled from the front panel and via the remote computer alternately.

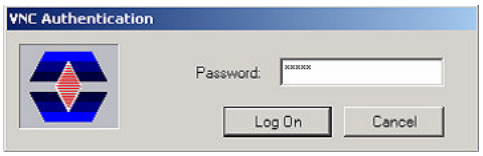
**Setting up the VNC connection on the Windows remote computer**

1. Start VNC Viewer program component on the PC, select "VNC Server" and enter IP address of the instrument.




2. To initialize the connection, select "Connect".

   A message requesting the password appears.




3. Enter the password as defined in the "Default Local System Properties" panel of the Ultr@VNC program and select "Log On".

   The connection is established, the instrument is remote accessed and the current signal generator screen with the block diagram is displayed. The individual functions are operated using the mouse and keyboard.

**Enabled Direct Control**

The direct control of the instrument is not disabled and the instrument can be controlled from the front panel and via the remote computer alternately.

### Terminating VNC Connection

The remote access via VNC connection can be terminated either on the R&S SMB or on the external PC. Terminating the connection does not disable it. It can be established again any time. See the notice above concerning unauthorized access due to VNC connection!

1. Terminate the connection on the R&S SMB
   a) Press the "Windows" key to access the operating system.
   b) Right-click on the VNC icon on the task bar and select "Kill all clients".
2. To terminate the connection on the external Linux/Unix PC, close the internet browser or close the signal generator window.
3. To terminate the connection on the external Windows PC, close the VNC Viewer program.

   The connection is terminated. The color of the VNC icon in the status bar of the instrument changes.
   A message on the external PC indicates the disconnection.

### Disabling Remote Access via Ultr@VNC

The VNC connection can be disabled by removing the program on the instrument or by deactivating the VNC Server service.

1. Remove the VNC program
   a) Press the "Windows" key to access the operating system and open the "Add or Remove Programs" by selecting "Start > Settings > Control Panel > Add or Remove Programs".
   b) Remove the VNC program.
2. Deactivate the VNC Server service
   a) Press the "Windows" key to access the operating system and open the "Services" by selecting "Start > Settings > Control Panel > Services".
   b) Deactivate the VNC Server service.

   The connection is disabled, the VNC icon disappears from the task bar of the instrument.

# 3 Getting Started

This section helps you to get familiar with the R&S SMB and provides an introduction to the general concept of the instrument with a sample of the possible application fields as well as a description of the main blocks in the signal generation flow.

This section also explains the operating concept in general and includes a brief introduction to operation by a step-by-step description of the configuration. The example is intended to provide a quick overview of the settings provided. No additional equipment is required.

## 3.1 Brief Introduction to the Instrument's Concept

The **operating concept** of the R&S SMB employs the following three ways of instrument control:

- Manual operation
- Remote control
- Remote access

### Manual Operation

The R&S SMB can be entirely operated from the front panel. Peripherals such as mouse or keyboard can be connected but are not essential.

The R&S SMB is equipped with an intuitive user interface. The central element of the display is the block diagram that shows the signal flow and processing from the left on the display to most right, i.e. the generated signal can be seen at a glance.

Each block represents a functional unit of the instrument. Thus the user always knows the position at which a parameter has an effect in the signal flow. The main settings of a block are indicated in the block. The interconnection of employed inputs and outputs is also shown. The user is thus always informed about the connection of inputs and outputs in the signal flow and where they can be configured. A window is opened for each menu where parameters can be set. When the window is opened, an entry is made in the "Winbar" below the display. All open menus are of equal priority (not modal) and can be accessed any time.

The block diagram in the figure below shows a fully equipped instrument.

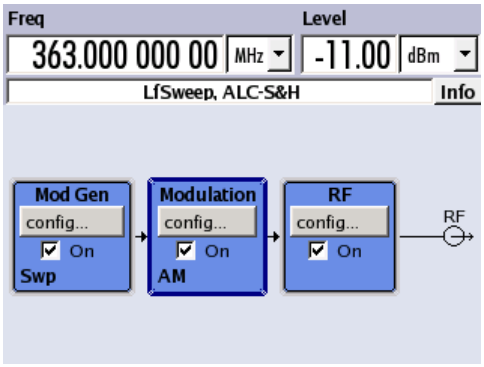



*Fig. 3-1: Block diagram of a fully equipped R&S Signal Generator*

With the aid of the rotary knob, the user can navigate in the block diagram and the dialogs, and can operate the instrument with one hand. The cursor is moved line by line through the block diagram or dialog. Turning the button clockwise advances the cursor. The selected block can be activated or deactivated with the TOGGLE key. Active blocks are highlighted by a colored background.

The instrument comprises a comprehensive info and help system. Context-sensitive help can be called any time with the HELP (F1) key. The help system indicates the currently selected parameter and offers additional services such as cross references, index and contents. The content of the help system corresponds to the operating manual of the instrument.

Warning and conflict messages caused by incorrect operation as well as further information are displayed in the "Info" line. A complete list of existing conflicts is displayed when the INFO (CTRL+I) key is pressed. Additional information on entries can be requested from the help system. The history function permits display of all messages.

Assistants simplify the completion of tables. After data entry in the assistant, the table is modified only after the "Accept" button has been pressed. Pressing the "Accept" button also stores the assistant data.

For an introduction into the manual operating of the instrument, detailed operating instructions and an overview of menus refer to chapter 4, "Manual Operation", on page 53.

For an indepth description of the dialog boxes and the instrument functions refer to section chapter 5.1, "Overview of Instrument Functions", on page 79.

### Remote Control

Remote control is an operation of the instrument by means of remote control commands or programs that automatize repeating settings. The instrument is connected to a computer running the program.

This way of operation and the instructions how to set up a connection for remote control are described in the chapter 6, "Remote Control Basics", on page 193. The description of the remote control commands is provided in chapter 7, "Remote Control Commands", on page 233.

**Remote Access**

Remote access is the operating of the instrument from a remote computer. Both the R&S SMB and the computer are connected in a LAN.

**Remote access** in contrast to **remote control** does not use remote-control commands but a separate software which is installed on the remote computer. After its start, the software simulates the user interface of the instrument. The instrument can thus be operated from the remote computer as on the unit itself. The individual functions are operated using the mouse and keyboard. Specific instrument functions can be executed using specific key combinations on the keyboard or a front panel key emulation that can be operated with the mouse.

This way of operation and the instructions how to set up a connection for remote access are described in chapter 2.7, "Remote Access via an External Controller", on page 36.

## 3.2 Application Field of the Instrument

The main field of application of the R&S SMB is the generation of sine wave signals with very high spectral purity. These signals are needed e.g. for adjacent channel or phase noise measurements. In addition, the RF signal can be modulated with the internal modulations waveforms sine waves and rectangular signals.

## 3.3 Description of Individual Diagram Blocks

The signal path of the instrument is configured by installing a frequency option that comprises all required modules.

One of the following options must be installed.

- R&S SMB-B101 (9 kHz to 1.1 GHz)
- R&S SMB-B102 (9 kHz to 2.2 GHz)
- R&S SMB-B103 (9 kHz to 3.2 GHz)
- R&S SMB-B106 (9 kHz to 6 GHz)
- R&S SMB-B112 (100 kHz to 12,75 GHz)
- R&S SMB-B112L (100 kHz to 12,75 GHz, without attenuator)
- R&S SMB-B120 (100 kHz to 20 GHz)
- R&S SMB-B120L (100 kHz to 20 GHz, without attenuator)
- R&S SMB-B140 (100 kHz to 40 GHz)
- R&S SMB-B140L (100 kHz to 40 GHz, without attenuator)

Instruments without step attenuator provide a restricted level range at the RF output. Refer to the data sheet for detailed information.

For high-frequency instruments, additional high output power options are available. These are R&S SMB-B31, available with R&S SMB-B120/-B120L and R&S SMB-B32 accordingly with R&S SMB-140/-B140L. See data sheet for detailed information.

Up-to-date information is available at R&S SMB homepage on the internet http://www2.rohde-schwarz.com/products/smb100a.html.




**Mod Gen block**
The internal modulation sources are configured in this block. Also, the "LF frequency sweep" can be activated here.

An internal LF generator is available as the internal source for the analog modulations AM, FM and PHiM. Available modulation shapes are sine and rectangle.

The internal modulation signals are provided at the LF output at the front of the instrument. The LF output signal and the modulations sources for the analog modulations AM, FM and PhiM can be selected independently from each other.

A pulse generator provides single and double pulse modulation with selectable pulse widths and periods. Additionally, an option is available to generate pulse train signals.

The R&S SMB offers three different sweep types (frequency sweep, level sweep and LF sweep) to be activated alternatively. Each type has 6 modes which differ with respect to the sweep cycle mode (continuous, individual and step-by-step) and triggering mode (automatic, internal and external). In the "Mod Gen" block, the LF sweep is configured. Frequency and level sweep settings are accessed via the "RF" block.

The status display in the block shows whether LF generator and/or a sweep are active. The selected internal LF generator and/or noise source are switched on or off with the TOGGLE ON/OFF key.




**Modulation block**
The internal and external analog modulations are configured and activated in this block. The MOD ON/OFF key switches the active modulation(s) on/off.

The internal modulation sources are configured in the "Mod Gen" block. External amplitude, frequency or phase modulation signals can be fed in at the input connector MOD EXT at the front of the instrument. An external pulse signal is fed in via the BNC connector PULSE EXT at the rear of the instrument. AC or DC coupling for external feed is possible.

Modulation signals of up to two sources (internal and external source) can be combined for AM/FM and PhiM modulation.

Available internal and external analog modulation modes are:

- Amplitude modulation (AM)
- Frequency modulation (FM)
- Phase modulation (PhiM)
- Pulse modulation (Pulse)
- Stereo modulation (Stereo)

**Note:** For modulation modes that can be simultaneously used, refer to the R&S SMB data sheet.

The status display in the block shows the active modulation(s). Use the TOGGLE ON/OFF key to switch the active modulation of the block on or off.




**RF block**
In this block, the RF parameters and frequency/level sweep settings are set.

The active sweep is displayed in the block. The RF ON/OFF key switches the RF signal on and off. When the signal is switched off, the switch before the RF output symbol is open.

RF settings include:

- Frequency and reference frequency
- Level settings; if required.
- NRP-Z Power Viewer using power sensors
- Frequency and level sweep
- List Mode settings. In this mode, extremely fast frequency and level settings can be made.

The RF 50 OHM output connector at the front of the instrument provides the RF signal. An external trigger/gate signal for sweeps is input via the INST TRIG connector at the rear of the instrument

**Note:** Frequency and level are set fast with the aid of the FREQ and LEVEL keys.

Use the TOGGLE ON/OFF key to switch the RF output on or off.

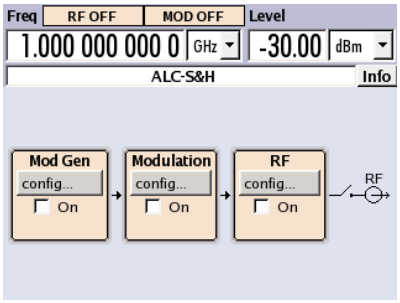
## 3.4 Example of Setup

This section provides an example on how to configure the instrument for generating of an amplitude modulated signal.

### Generation of an Amplitude-Modulated Signal

To generate a simple AM-modulated signal, proceed as follow:

1. Activate default (preset) state
   Press the PRESET key to set a defined instrument state.

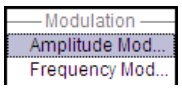



2. Select and activate AM modulation

   a) Turn the rotary knob and select the "Modulation" block.

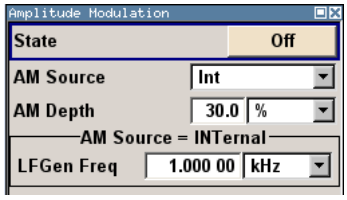



   b) Press the rotary knob to open the dialog where the modulation can be selected.
   **Note:** Different modulation modes are available depending on the options installed.

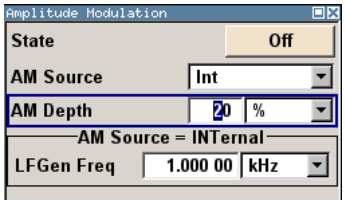



   The "Amplitude Mod..." menu is the first menu and is highlighted per default.

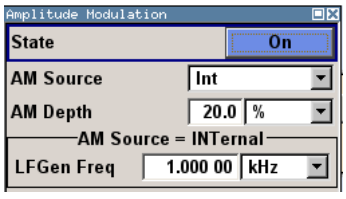
   c) Turn the rotary knob and highlight "Amplitude Mod...".
   Press the rotary knob to open the "Amplitude Modulation" dialog.




   d) Turn the rotary knob to select parameter "AM Depth", press the rotary knob to allow editing and enter the preferred AM depth with the aid of the numeric keypad and the unit keys.




   e) Finally, select "State" and press the rotary knob to switch on the AM modulation.

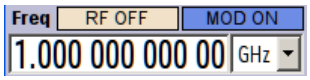



   f) Press the DIAGRAM key to display the complete block diagram.

To indicate the active state, the "Modulation" block is displayed in blue. The "RF" is not yet active, which means that no RF signal is output.

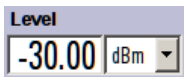
3. Set frequency and level and activate RF signal

   a) Press the FREQ key to activate the editing mode for frequency entry. The "Frequency" entry field in the header section of the display is highlighted.

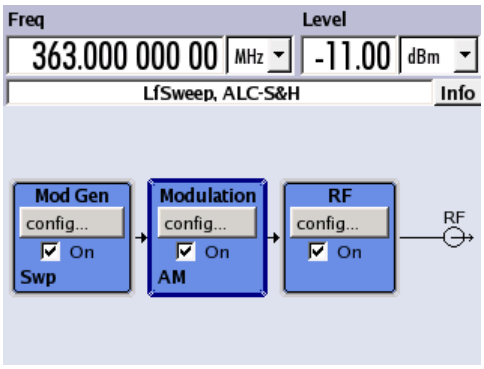
   Enter the frequency using the numeric keypad and terminate the entry by pressing a unit key.

   b) Press the LEVEL key and enter the level settings in the same way.

   c) Press the DIAGRAM key to display the complete block diagram.
   d) Turn the rotary knob to select the "RF" block.
   Press the RF ON/OFF key to activate the "RF" block.

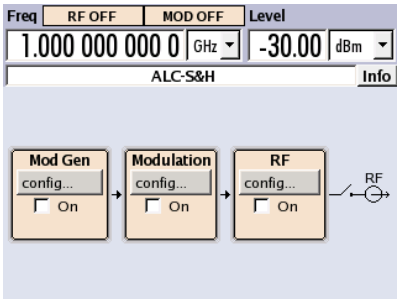
   The AM modulation signal is now present at the RF output.




**Generation of an RF Frequency Sweep Signal**

In the example, an RF frequency sweep is configured. Proceed as follow:

1. Activate default (preset) state
   Press the PRESET key to set a defined instrument state.

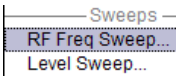



2. Configure and activate RF frequency sweep.

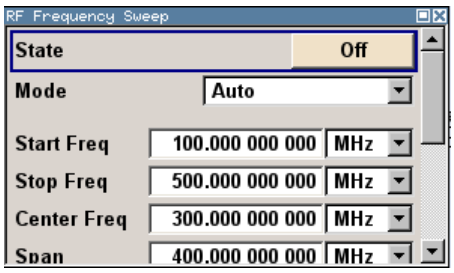
a) Turn the rotary knob and select the "RF" block.




b) Press the rotary knob to open the dialog where the RF frequency sweep can be selected.

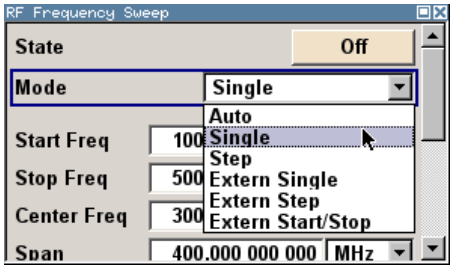



c) Turn the rotary knob and highlight "RF Frequency Sweep...".
Press the rotary knob to open the "RF Frequency Sweep" dialog.



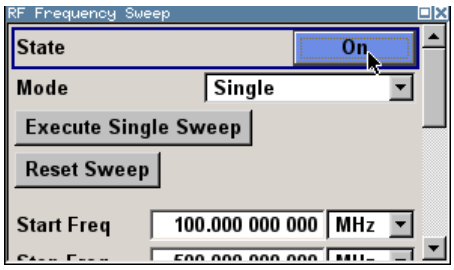

All sweep parameters are default except for the sweep mode. The default settings are not changed.

d) Turn the rotary knob to select parameter "Mode", press the rotary knob to open the selection list and select "Single".




e) Press the rotary knob to apply the selection.
For triggering, the "Execute Single Sweep" and "Reset Sweep" buttons are displayed.

f) Finally, select "State" and press the rotary knob to switch on the RF frequency sweep.




g) Press the DIAGRAM key to display the complete block diagram.

The "RF" is not yet active, which means that no RF signal is output.

3. Activate RF signal.

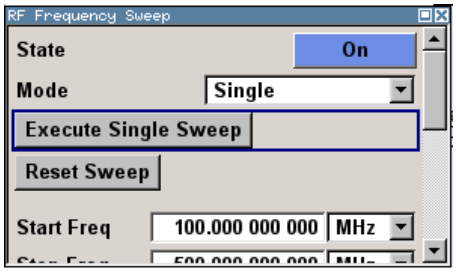
   a) Turn the rotary knob to select the "RF" block.
   b) Press the RF ON/OFF key to activate the "RF" signal output.




   To indicate the active state, the RF block is displayed in blue. An RF signal with the default frequency and level settings is output, i.e. 1 GHz and -30 dBm.
   The sweep is not yet active, it must be triggered in the sweep dialog.

4. Trigger RF frequency sweep

   a) Press the WINBAR key to switch to the "RF Frequency Sweep" dialog.
      Turn the rotary knob to select the "Execute Single Sweep" button.




      Press the rotary knob to trigger (start) the frequency sweep.

   A linear single sweep signal is now present at the RF output, starting at 100 MHz. The sweep is processed in 1 MHz steps with dwell time of 10 ms per step up to the stop frequency of 500 MHz.
   The sweep starts at 100 MHz, stops at 500 MHz in 1 MHz steps is output with a dwell time of 10 ms per step.

# 4 Manual Operation

The R&S SMB can be operated intuitively either via the interactive block diagram or via a menu tree. All menus are in the form of windows that can be operated in the same way. Rotary knob, keys and softkeys, or alternatively a mouse, allow direct and therefore convenient access to entries and settings.

The clear-cut display shows the current signal generator state. Numerous help functions support the user in signal configuration.

This section describes the concept of manual operation of the signal generator. This includes a description of the general structure of a dialog box, working with dialog boxes and the block diagram and the setting of parameters.

For an in-depth description of the dialog boxes and the instrument functions refer to section "Instrument Functions".

## 4.1 Key Features

The manual operating concept of the R&S SMB enables the user to make settings as intuitively as possible and at the same time gives a permanent overview of characteristics of the generated signal and of the current instrument state. Numerous online help functions support user settings.

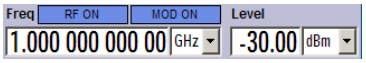
### Block diagram

The block diagram is the core of the operating concept.

A graphics display shows the current configuration and the signal flow in the form of a block diagram. All graphical elements can be accessed for operation. An element is selected by means of the arrow keys and the associated setting function is called by pressing Enter. Required menus and graphs are displayed on the block diagram which is displayed again in the foreground whenever the DIAGRAM (CTRL+D) key is pressed.

### Permanent frequency and level display

The main characteristics of the RF signal, frequency and level, are permanently displayed in the header section of the screen and can be directly set in the display fields after the FREQ (CTRL+F) or LEVEL (CTRL+L) key is pressed. Status messages for the output signal are displayed in addition to frequency and level.

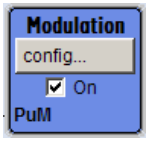



### Operation via Graphical User Interface

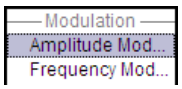
- **Functional blocks**
  Menus are assigned to the specific function blocks in the block diagram. The function blocks represent elements of signal generation. Function blocks displayed with a blue frame can be directly switched on and off by means of the TOGGLE ON/OFF (CTRL

+T) key. The menus of the highlighted function blocks can be called by pressing the ENTER key.

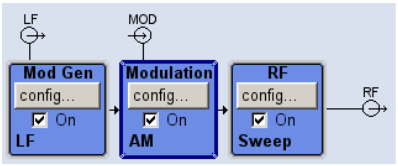
– **Example:**
The "Modulation" block contains all menus required for modulation signal configuration.



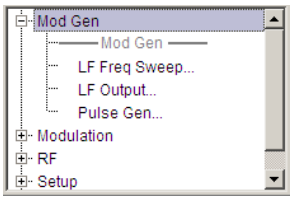

In this block all modulations can be selected.




- **Signal flow**
The signal flow between the function blocks and the employed inputs and outputs are also shown.




- **Menu tree**
The menu tree can be opened and closed with the MENU (CTRL+M) key. The menu tree is organized in the same way as the directories under Windows. The function blocks correspond to the first directory level, the menus to subdirectories.




### Operation corresponds to the Windows concept

To offer the user a familiar environment, operation is very similar to operation of Windows user interfaces. All menus and tables are made up of known elements, such as selection lists, check boxes and entry fields.

A blue frame indicates that the selected item is active. In the highlighted element, entries can be made.

### Rotary knob



Operation is possible via front-panel keys, an external keyboard and the mouse. However, most of the settings can be easily made with the rotary knob:

- Turning the rotary knob shifts the entry focus to the target element.



- Pressing the rotary knob activates the selected entry field.
  Depending on the parameter, the submenu is called, the numeric value varied, the list entry selected or the check box activated or deactivated.
- If a value is entered, the entry is stored by another click on the rotary knob and the editing mode is exited.

**Clear settings with the aid of independent subdialogs**

A separate window is opened for each dialog and subdialog. The dialogs can be operated independently of each other, i.e. none of the dialogs requires that settings in other dialogs be completed before it can be closed. This ensures flexible operation at all times.

**Keys with assigned simple functions**

Most keys on the front panel of the R&S SMB directly perform a simple function.

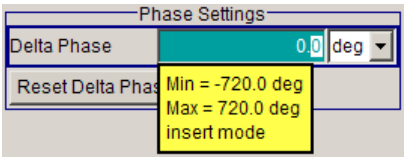
Since a great number of settings can thus be made by a keystroke, operation is easy. For instance, the CLOSE (ESC) key closes the active menu; with the RF ON/OFF (CTRL +R) key the RF output signal can be switched on or off.

An exception are keys that call a menu such as the MENU (CTRL+M) key which opens the complete menu tree of the instrument, the SETUP (CTRL+E) key which opens the menus for general instrument settings or the FILE (CTRL+S) key which opens the menu for file management.

**Help functions for user support**

Numerous help functions support the user in signal configuration.

- **Value ranges**
  The valid setting range is displayed for each numeric parameter. This requires a short wait after activation of the entry field. The range is then displayed automatically after a few seconds.

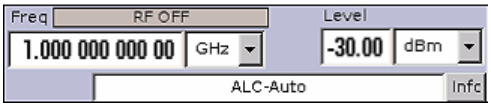



  If the entered value is outside the permissible range, the next permissible value is automatically set and a message is output.
- **Context-sensitive help**
  Context-sensitive help for each parameter can be called with the HELP or F1 key.
- **Comprehensive online help**
  Each help page is part of a comprehensive online help function which can be called by means of an index, a content tree or the "Previous/Next" buttons.

**Info line with messages for indication of the current instrument state**

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. With the aid of the INFO (CTRL+I) key, help pages can be called for most of the messages. They provide background information on the message and indicate operating steps that may be

required. All messages are explained in the online help which can be called with the HELP (F1) key.




## 4.2 Display

The display shows the current signal generator state and offers graphical elements for direct operation. It is divided into three sections:

- The frequency and level display with info line indicates the main output signal parameters and reports the current state with status, error and warning messages.
- The block diagram shows the instrument configuration, the signal characteristic as well as the inputs and outputs used and permits interactive operation via graphics elements. Active menus and graphs are displayed on top of the block diagram.
- Winbar with labelled softkeys for menu display.

The block diagram in the figure below shows a fully equipped instrument.

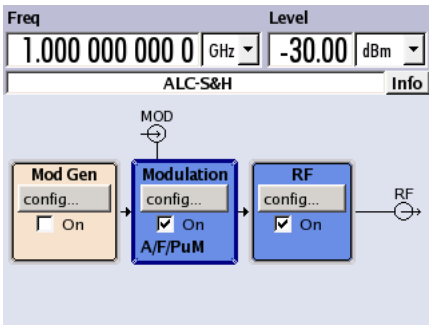



***Fig. 4-1: Block diagram of a fully equipped R&S Signal Generator***

### 4.2.1 Settings Displayed in the Header Section

Frequency/level settings and a few status messages (see chapter 4.2.2, "Status Information and Messages", on page 57) are displayed in the header field of the screen. The display may vary depending on the instrument's operating mode:

- In the sweep mode, the current frequency or level of the output signal is displayed. The status message "SweepMode" is displayed in the info line.
- In the list mode, neither the current frequency nor level is displayed, the indication is dimmed.
- If user correction is active, the status message "UCorr" is displayed in the info line.

The value displayed in the "Freq" and "Level" field does not consider any offset set or multiplier factor.

For more information see chapter 5.3.2, "RF Frequency Settings", on page 114 and chapter 5.3.6, "Overview RF Level Settings", on page 125.

The frequency and level indication can be enlarged so that it covers the complete display of the R&S SMB by using the DIAGR key. This key toggles between block diagram, magnified frequency and level indication and the display of the active dialog. This requires the "Summary Screen Toggle" to be enabled.

See also "Toggle Summary Screen" on page 93.

## 4.2.2 Status Information and Messages

The status information and messages are displayed in the header section of the screen. The messages differ with respect to their importance (errors, warnings, info) and the time of their appearance (brief and permanent messages). They require different treatment by the user. Further information on all messages can be called in the info window (see chapter 4.2.3, "Info Window", on page 58).

Refer to chapter 9, "Error Messages", on page 411 for an overview of all status information and messages as well as instructions for error elimination.

### 4.2.2.1 Status Information

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.

### 4.2.2.2 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).

### 4.2.2.3 Volatile messages

Brief 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.

These messages can be read from remote using SYST:ERR? or SYST:ERR:ALL?.

#### 4.2.2.4 Permanent Messages

Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signalled by a permanent message must be eliminated before correct instrument operation can be ensured.

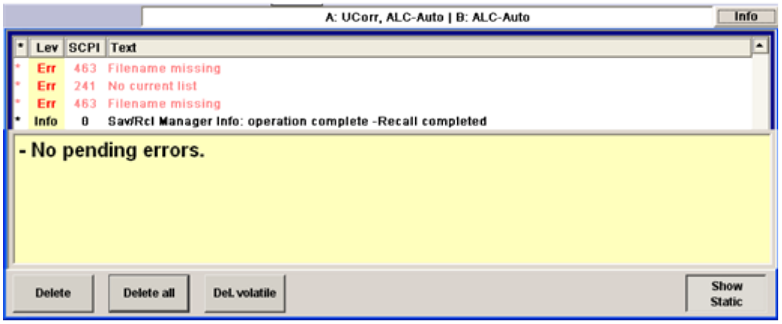
The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

These messages can be read from remote using SYST:SERR?.

### 4.2.3 Info Window

A few operating states and the current message are displayed in the info line.

The INFO window with a list of current permanent messages and a detailed description of each message can be opened with the INFO (CTRL+I) key.




The upper section of the info window contains a list of all current permanent messages in the order of their occurrence, i.e. the most recent message is displayed first. In the lower section of the window, additional information on the highlighted message is displayed. A history of all messages that have occurred since instrument switch-on can be called with the "History" key. The most recent message is displayed first.

The messages are color-coded according to their level. Device-specific messages are red, info and remote control error are black. The level is also indicated in the "Lev" column (Err, Sys or Info). Column "SCPI" indicates the SCPI error code.

With the aid of the softkey buttons, error messages can be cleared and a history of all messages called.

**Delete**
Clears the highlighted message.

This button is available only if the history of the messages is displayed.

**Delete All**
Clears all messages.

This button is available only if the history of the messages is displayed.

**History**
Calls the list of all messages that have occurred since instrument switch-on. The most recent messages are displayed at the top of the list. When the button is pressed again, the list of current messages is displayed.

SCPI command:
`SYSTem:ERRor[:NEXT]` on page 373 or `STATus:QUEue[:NEXT]` on page 365
Each time a `SYST:ERR?` or `STAT:QUE?` query is sent, the oldest entry in the error queue is returned and at the same time cleared in the list.

## 4.2.4 Block Diagram

The block diagram shows provided options, signal configuration and the currently selected signal flow of the generator with inputs and outputs used. Signal generation can be completely operated from the block diagram. The highlighted function block can be directly switched on and off with the TOGGLE ON/OFF (CTRL+T) key. Pressing the Enter opens the associated setting menu.

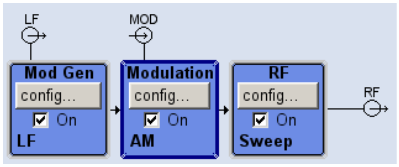


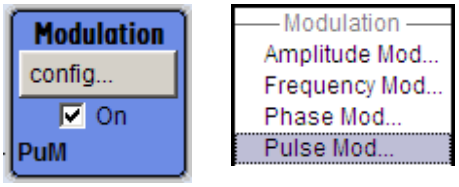

*Fig. 4-2: Block diagram of the R&S SMB*

### 4.2.4.1 Function Blocks in the Block Diagram

Each block represents a function of signal generation. The function is indicated in the headline of the block. In the check box, the respective function can be quickly activated/ deactivated with the TOGGLE ON/OFF (CTRL+T) key. After activation, the block is displayed in blue. Status information is displayed below the check box. It is different for the different blocks.

Pressing the rotary knob (front panel) or the "Config..." button (mouse) opens the associated setting menu.

**Example: Modulation block**



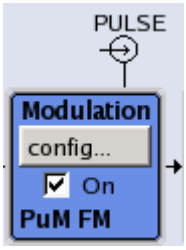

In this block, the modulation signals are set. The status information of the "Modulation" block indicates the selected modulation.

#### 4.2.4.2 Signal Flow and Input/Output Symbols in the Block Diagram

The input/output symbols in the block diagram show the currently used inputs and outputs of the signal generator. Unused inputs and outputs are not shown. The lines indicate the signal flow.

Symbols and labels refer to the corresponding inputs and outputs on the front and rear panel of the signal generator. The direction - input or output - is indicated by an arrow.

**Example:**




The symbols indicate the input for the external pulse signal on the instrument rear panel.

### 4.2.5 Structure of the Dialogs

The parameters are set in the menus. Menus are accessed either via the function blocks in the diagram or by means of the MENU (CTRL+M) key. The menus are displayed on top of the block diagram.

The WINBAR key toggles between the active menus. The REARR key toggles between the enlarged and normal sized menus.

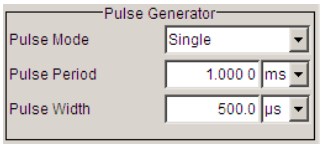
Working with menus and dialog boxes is described in chapter 4.3, "Accessing Dialogs", on page 61; the setting of parameters in chapter 4.4, "Setting Parameters", on page 62.

The menus are in Windows format. The menus differ in details depending on their function but they consist of the same main elements. Each menu consists of a menu header and one or more menu areas with various fields for setting parameters.

The header line contains the name of the menu and the buttons for minimizing and closing the menu. To operate the buttons, use the mouse or the front key CLOSE (ESC).

Several fields of associated but separately set parameters are organized in menu areas. A menu area is framed and labelled with the function common to all parameters.

**Example: Pulse Generator**




Each of the setting fields is assigned a parameter name. The kind of setting varies depending on the parameter to be set. Some settings can only be made in a specific configuration. If setting is not permitted with the specific configuration selected, the

respective item is disabled and displayed in gray and the entry or selection field cannot be accessed.

## 4.3 Accessing Dialogs

The MENU (CTRL+M) key opens the complete menu tree. Selecting a functional block and pressing the ENTER key opens the menu associated with this block.

An alternatively way to access a dialog is to use the CLOSE (ESC), DIAGRAM (CTRL +D) and REARR (CTRL+A) keys on the front panel.

For a quick access to the dialogs, use one of the following alternative methods.

**Displaying the block diagram or a dialog in the foreground**

► Press the DIAGRAM (CTRL+D) key to move the cursor to the block diagram.

All active menus are minimized.

**Enlarging the indication of the header section**

► Press the DIAGRAM key twice to enlarge the indication of the header section.

**Tip:** Use the REARR key to toggle between the enlarged and normal sized dialogs.

**Accessing the menu tree**

► Press the MENU (CTRL+M) key to open the complete menu tree.

**Calling the File or Setup dialog**

► Use the FILE (CTRL+S) or SETUP (CTRL+E) keys to open the respective dialog.

**Closing an active menu**

► Press the CLOSE key to close an active menu.

**Tip:** If the cursor is at the highest menu level, you can also use the ESC key to close the active menu.

**Accessing the header area**

► Press the FREQ (CTRL+F) and LEVEL (CTRL+L) keys to activate the "Frequency" or "Level" entry fields in the header area.



**Keyboard Shortcuts**

Keyboard shortcuts (e.g. "Ctrl + D" for the displaying the block diagram in the foreground) provide direct access to all utility dialogs of the instrument (see chapter 4.8, "Legend of Front-Panel Controls", on page 75).

## 4.4 Setting Parameters

The R&S SMB offers several and sometimes alternative possibilities for setting parameters. Operation is possible from the front panel, with the aid of a mouse and/or from a PC keyboard.



The examples whitin this description focus on the operation from the front panel.



For more information, refer to:

- chapter 4.8, "Legend of Front-Panel Controls", on page 75 for an overview of key functions and a cross-reference between the front panel keys and the keyboard shortcuts
- section "Instrument Functions" for a detailed description of key functions.

Most of the parameters are set in the different menus. The R&S SMB provides alternative ways for accessing the dialogs. Turn the rotary knob and navigate to the corresponding block in the block diagram and press the knob to open the dialog or perform a mouse click on the "Config..." button.

An exception are the "Setup" and "File" dialogs. In the "Setup" dialog, general settings are made which are not directly concerned with signal generation, e.g. setting of the GPIB-bus address. In the "File" dialog, files and lists are managed.

These menus can only be called with the SETUP (CTRL+E) and FILE (CTRL+S) keys.

Frequency and level are directly set in the header area of the display using the FREQ and LEVEL keys.

Specific settings can also be made directly in the block diagram, e.g. activating a function block by means of the TOGGLE ON/OFF (CTRL+T) key or switching the RF output on and off with the aid of the RF ON/OFF (CTRL+R) key. Changes affecting the signal flow are immediately visible in the graphics display.

This section provides an information about the parameter handling that comprises of the following main steps:

- chapter 4.4.1, "Working with the Cursor", on page 63
- chapter 4.4.2, "Selecting a Control Element", on page 63
- chapter 4.4.3, "Switching Parameters On/Off", on page 63
- chapter 4.4.4, "Entering a Value", on page 64
- chapter 4.4.5, "Working with Units ", on page 65
- chapter 4.4.6, "Selecting a Value from a List", on page 66
- chapter 4.4.7, "Terminating Entries with Confirmation", on page 67
- chapter 4.4.8, "Restoring the Previous Value", on page 67

### 4.4.1 Working with the Cursor

After the instrument is switched on, the cursor is always on the first function block of the diagram (default setting).

**Moving the cursor on the display**

► To move the cursor, use one of the following alternative methods:

a) Use the rotary knob or the arrow keys.
b) Use the WINBAR key to toggle between the active dialogs.
c) Use the ESC key.

**Tip:** Be aware that the function of the ESC key depends on the current cursor position. The function of this key depends on the current cursor position.

- Calls the next higher selection level.
- Closes the open window without accepting new entries; the old value or parameter is retained.
- In dialog boxes that contain a "Cancel" button it activates that button.
- Closes all kinds of dialog boxes, if the edit mode is not active.
- Quits the edit mode, if the edit mode is active.
- Switches between different entry fields of a menu.
- Shifts the entry cursor from the header display to the previously active menu, or to the previously highlighted block in the block diagram if no menu is active.

**Moving the coursor to the heading area**

► Press the FREQ (CTRL+F) or LEVEL (CTRL+L) key to move the cursor to the header area.

### 4.4.2 Selecting a Control Element

Control elements are always selected in the same way no matter whether a function block in the diagram, a menu in the menu tree, a parameter in the menu or an entry in a list or table is concerned.

► To activate an element, put the cursor on it.




An active element is highlighted by a blue frame.

### 4.4.3 Switching Parameters On/Off

A parameter can be activated and deactivated using a button or a check box.

1. Select the parameter.

2. To change the state of a parameter, use the "Enter" function of the different control media:
   - Press the rotary knob
   - Press ENTER
   - Press the TOGGLE ON OFF (CTRL+T) key.

   Colour and label of a button change, the check box is ticked or the tick is removed.

### 4.4.4 Entering a Value

Numeric and alphanumeric values can be edited in the entry fields. In the editing mode, cursors of different colour are used. A blue cursor indicates the overwrite mode, a green cursor the insert mode.

Numeric and alphanumeric values can either be newly entered or the existing value can be changed. Incorrect entries are cleared with the BACKSPACE key.

**Entering a new numerical value**

1. Select the parameter.
2. Press a numeric key to activate the editing mode.

   The previous value is cleared and the new value can be entered.

**Editing a value in the insert mode (default setting)**

1. Press the rotary knob (= Enter) to activate the editing mode.

   If the cursor is placed at the right of the total value, the insert mode is always active.
2. Set the cursor to the left of the number to be changed using the LEFT/RIGHT arrow keys.

   The cursor is displayed in green.
3. Click on a numeric key to insert a new value.




**Editing a value in the overwrite mode**

1. Activate the editing mode.
2. Set the cursor on the numeric digit to be changed using the LEFT/RIGHT arrow keys.

   The cursor is displayed in blue and the number to be replaced is highlighted.
3. Click on a numeric key to overwrite the highlighted value.




**Varying a value**

1. Activate the editing mode.

2. Set the cursor to the left of the number to be changed using the LEFT/RIGHT arrow keys.

   The value at the cursor position is varied.

3. To vary the selected value, use the UP/DOWN arrow key or turn the rotary knob.

   The value is increased or decreased.

**Entering a new alphanumerical value**

1. Select the parameter.
2. Press an alphanumeric key to start the editing mode.

   The new value is entered.

**Editing an alphanumerical value**

An existing value, e.g. a file name, can be changed in the insert mode (see example) or in the overwrite mode.

1. Select the paramter and activate the editing mode.
2. Set the cursor to the left of the alphanumerical value using the LEFT/RIGHT arrow keys.

   **Tip:** If hexadecimal values are to be entered, the numeric front-panel keys are automatically changed to hexadecimal values.

3. Click on an alphanumeric key to insert a new alphanumerical value.

**Terminating the entry of a numeric value**

To terminate the entry of a numeric value:

1. Press the rotary knob (= Enter).
2. Press a UNIT key on the front panel.
3. Select a "Unit" in the selection field next to the parameter value.

### 4.4.5 Working with Units

The unit of a parameter is displayed next to the value. When the parameter is edited, the unit is selected either from the list or by means of the front-panel keys. When the entry is completed, the unit can be changed. In this case the value remains unchanged but is automatically adapted to the new unit.



While operating the instrument by means of a mouse, assign the unit to the selected parameter before entering its value.

**Assigning a unit**

To assign a unit to a value, use one of the following alternatives:

1. Press a UNIT key on the front panel.




2. Select a "Unit" in the selection field next to the parameter value.
   Press the ENTER key.

   The unit displayed in the entry field next to the value is assigned.

**Changing a unit**

To subsequently change a unit, i.e. after the entry has been terminated and when the editing mode is not active, use one of the following alternatives:

1. Press a UNIT key on the front panel.
2. Select"Unit" in the selection field next to the parameter value.

   The value remains unchanged but the display is automatically adapted to the new unit, i.e. the value is recalculated to suit the new unit.




   The new unit is indicated in the value field of the menu.

## 4.4.6 Selecting a Value from a List

Selection lists provide a list of predefined values for the selected parameter.




To select a item from a list, proceed as follow:

1. Press ENTER key to open the list.
2. Use one of the following alternatives to navigate through the list:
   a) Turn the rotary knob or use the UP/DOWN arrow keys.
      The selected item is highlighted.
   b) Press TOGGLE ON/OFF key several times until the preferred entry is displayed in the selection field.
3. To confirm the selection, press the ENTER key.

### 4.4.7 Terminating Entries with Confirmation

The instrument behaves different by the termination of entries deppending on the parameter type and the way this parameter is set.

#### Confirming settings

► To confirm the settings, press the rotary knob or one of the UNIT keys (see also chapter 4.4.5, "Working with Units ", on page 65) .

**Note:** Variations by means of the rotary knob are immediately set.

#### Confirming multiple values

In some cases, like for instance when editing data in a user correction table, it is useful first to enter few values and to confirm them together. Such settings require additional confirmation. Not yet confirmed settings are displayed on a yellow background as an indication that the currently displayed values do not represent the target signal.

► To confirm these settings, select the "Save" or "Accept" button, respectively.

#### Confirming parameters with On/Off state

Most of the instrument functions with enabled and disabled states are calculated and effective only after this functions have been enabled. However, there are functions like the frequency variation of the reference oscillator for instance, that are immediately set after confirmation.

► To confirm a parameter with On/Off state, enable the parameter.

### 4.4.8 Restoring the Previous Value

Parameter variations with the rotary knob are immediately set and therefore not reversible.

Normally, values cannot be restored in the case of mouse control because no explicit confirmation is required in this case and entries are automatically confirmed when the entry or selection field is exited.

#### Restoring values

In the case of front-panel control or operation from the keyboard, previous values can be restored as long as the new value is not confirmed, i.e. the entry is not completed.

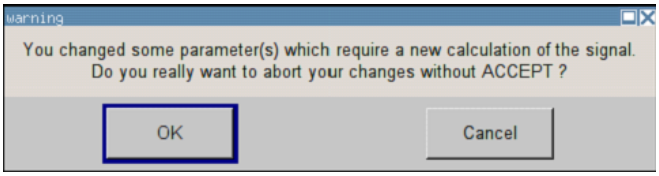
► To restore the values, press the ESC key.

#### Restoring values that require confirmation

All settings that are not confirmed with the "Accept" button but require this additional confirmation can be restored.

1. Press the ESC key.

   A confirmation query is displayed.




2. Confirm with "OK" to abort the changes.
   Select "Cancel" to return to the dialog. The previous selected settings are displayed.

**Restoring values after an extended calculation has been started**

Calculation and setting might require different period of time. Many settings are made without noticeable calculation times; such operations are indicated by a "BUSY" message displayed in the status field of the header section.

A window with a progress indicates that the instrument performs an extended calculation that requires longer calculation time. The termination of such a calculation restores the previous values.

► Press the ABORT button to terminate the calculation.

  All previous values are restored.

## 4.5 Editors

The R&S SMB provides user-friendly editors for defining lists. Lists containing frequency and level value pairs are used for the list mode and the user-defined level correction.

The lists are saved to files and may thus have any length. The file name of the lists and the directory to which the files are saved are user-selectable. The file prefix is different for each list type and is permanently assigned by the system.

For information about file handling and overview of the automatically assigned file prefixes, refer to chapter 4.7, "File Management", on page 71.

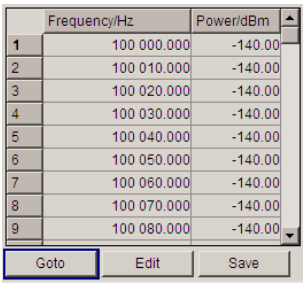
### 4.5.1 Working with List Editor

The "User Correction" and "List Mode" dialogs provide a list editor for defining the frequency/level value pairs.

**Editing list mode data lists**

1. To access a list editor and open an existing data list for editing, use the cursor keys to select the associated button "Edit User Correction Data..." or "Edit List Mode Data..." (if available) in the individual menu.

   The selected list is displayed and the cursor marks the first row of the "Frequency/ Hz" column.




If no list has been selected, a blank list of only one row is displayed.

2. Press the LEFT/RIGHT arrow keys to change between the colums.
   Use the UP/DOWN arrow keys to mark a row.
3. Use the numeric keys to enter the value for the value pairs in the "Frequency/Hz" and "Power/dBm" table columns. A blank row is inserted at the end of the list.
   Terminate the entry by pressing a UNIT key.
4. To select a row, select the "GoTo" button and press the ENTER key.
   Use the numeric keys to enter the row index in the entry field and press the ENTER key to confirm the entry.

   The cursor moves to the selected row.
5. To insert a new row in the table, select the row above which the new row is to be inserted and select "Insert Row(s)".

   A row is inserted above the currently marked row.
   If no row has been selected, a row is inserted at the beginning of the list.
6. Use the "Save" function to save the edited list under its current name.
   Enter the file name in the "File Select" dialog and select the directory (see chapter 4.7.1, "File Select Dialog", on page 72).

   Only complete value pairs are taken into consideration; rows containing an entry in only one column are ignored.

**Creating a new list mode data list**

A new list can be created under a new name either by generating a blank file in the "File Select" menu (see section chapter 4.7, "File Management", on page 71) or by changing an existing list which will then be saved under a new name.

1. To create an empty data list, select "RF > List Mode > List Mode Data... > New List" or respectively "RF > User Correction > User Cor. Data... > New User Correction Data" and enter the file name of the new data list.
2. To open the data list for editing, select the associated button "Edit User Correction Data..." or "Edit List Mode Data..." in the individual menu.
   Edit the list and save it under a new name.

## 4.6 How to Use the Help System

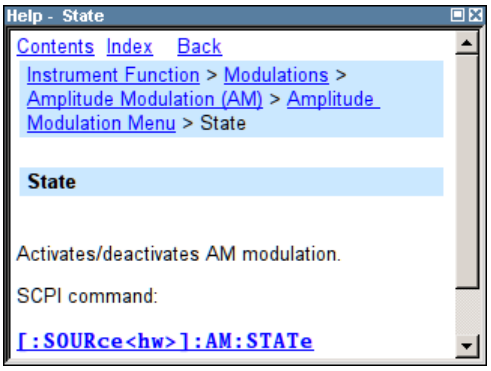
The R&S SMB is equipped with a context-sensitive help function. A help page is available for each parameter and can be called any time during instrument operation.

Compiled online help systems are also available for all functions of the R&S SMB on the CD-ROM supplied with the instrument. This help program can be called on any controller with Internet Explorer version V4.0 and higher.

**Calling context-sensitive and general help**

► To display the general help dialog box, press the HELP (F1) key.

The help dialog is displayed. A topic containing information about the current menu or the currently opened dialog box and its function is displayed.




On top, the help dialog box contains a navigation bar with:

- "Contents" - accesses a table of help contents
- "Index" - switches to an index table
- "Back "/"Previous"/"Next" for navigation to further help topics

**Navigating in the table of contents**

1. To move through the displayed contents entries, use the UP/DOWN keys. Entries that contain further entries are marked with a plus sign.
2. To display a help topic, press the "ENTER" key.

   The corresponding help topic is displayed.

**Navigating in the help topics**

1. To scroll through a page, use the UP/DOWN arrow keys.
2. To jump to the linked topic, press the link text.
3. Use the "Previous" or "Next" links to jump to the corresponding topic.
4. Use the "Scroll Right" or "Scroll Left" buttons to shift the indicated area of the navigation window to the left or right.

**Using the Index**

1. Select "Index".
2. Enter the first characters of the topic you are interested in. The entries starting with these characters are displayed.
3. Press the ENTER key to change the focus.
4. Use the UP/DOWN keys to navigate and select the suitable keyword.
5. Press the ENTER key to display the help topic.

   The corresponding help topic is displayed.

**Closing the help window**

► Press the HELP (F1) key.

## 4.7 File Management

The R&S SMB uses files to save all instrument data, i.e. system and user data.

The user data includes saved instrument settings and lists and the user correction.

The files are stored in the internal memory of the instrument or on a USB memory stick. The `/var` directory can be used to save user-defined data; any subdirectory structure can be created on `/var`. Some default subdirectories are predefined, but can be changed at any time.

The `/opt` directory is a protected system drive and therefore unaccessible system directory. The files on this directory contain data that must not be changed. Therefore, this drive should not be accessed, since reconstruction of the system partition will lead to data loss. To prevent inadvertent deletion or overwriting of system files, this drive is not specified in the file menus.

Files can be exchanged either via a memory stick or a connected network. A memory stick is connected to the USB interface and is assigned the `/usb` drive. In the case of a connected network, all network drives that can be accessed are available. The files are accessed in a "Save/Recall" dialog in the individual menus.

The files are differentiated according to their extensions; each type of file is assigned a specific file content. The extension is usually of no consequence to the user since access to the files occurs in the individual menus where only the relevant type of file is available. See chapter 4.7.2.1, "Extensions for User Files", on page 74 for an overview of the supported file extensions.

The user data can be roughly divided into the following data types:

- Settings
  Instrument settings can be saved and loaded. In case of saveing, the current setting is saved to the specified file.
- Lists

Lists, e.g. user correction lists, can be loaded. They can be generated either externally or internally. For internal generation, a new list must be created in the "File Select" dialog which will then be edited in the list editor of the individual menu.

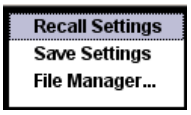


For more information, refer to:

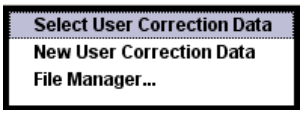
- chapter 4.8, "Legend of Front-Panel Controls", on page 75 for an overview of key functions and a cross-reference between the front panel keys and the keyboard shortcuts
- to section "Instrument Functions" for a detailed description of key functions.

**Accessing files with user data**

1. To access an editable user data file, select the "Save/Recall" or "File Manger" function in the individual dialog.




2. To access a loadable data file, select the "Select/New" or "File Manager" function in the individual dialog.




3. To access the "File Manager" function, press the SETUP (CTRL+E) key and select "Save/Recall > File Manager".

   A "File Select" window for loading, saving or creating a file or the "File Manager" dialog for managing all files is displayed.



**Saving and loading of all instrument settings**

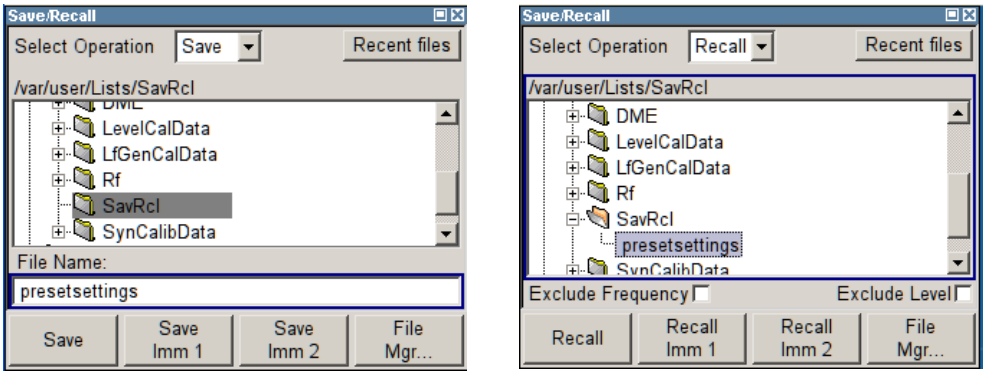
All instrument settings are saved and loaded in the "File" menu.

To access the "File" menu, press the FILE (CTRL+S) key.

For more information, see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 106.

## 4.7.1 File Select Dialog

The "Save/Recall" dialaog displays the available drives and directories. In the upper part, "Recent Data Sets", the files last used are listed.




The available drives and directories and the files of the selected directory are displayed. The currently selected path is displayed above the window. Only the relevant files without file extensions are displayed. If the area is opened several times, the path last selected is displayed. When a file is saved or created, its name is user-selectable; the extension is assigned automatically and cannot be entered. The file is saved to the selected path.

In addition to the files saved by the user, some menus also offer files containing predefined contents. These files are saved to a specific directory on system drive; for this reason, this directory cannot be chosen from the "File Select" menu.

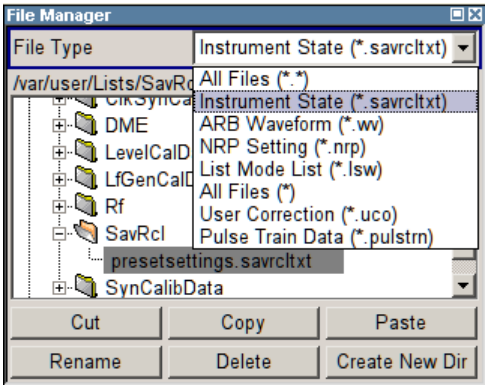
**Working with the File Select dialog**

1. Access the "File Select" dialog (see "Accessing files with user data" on page 72).
2. Navigate in the "File Select" dialog.
3. Load an existing file.
   In the "Recall Settings" dialog, mark a file and press the "Select" button.
4. Save a file.
   In the "Save Settings" dialog, enter file name in the "File Name:" field.
   Select the directory to which the file is to be saved and then select the "Save" button.
5. Create a new file.
   To create a new file, use the "Save Settings" functionality, i.e. specify file name and directory and save the file.

   The created file is empty; it must be filled with the necessary values in the individual editor.

## 4.7.2 File Manager

The "File Manager" allows general file management such as copying, shifting, renaming and deleting files as well as generating new directories.




Use the "File Type" to select a file type form the list. This can be used to process either all files (all files (*) selection) or a specific selection of files. See chapter 4.7.2.1, "Extensions for User Files", on page 74 for an overview of the supported file extensions. The available drives and directories and the files of the selected directory are displayed. The currently selected path is displayed above the windows. If the area is opened several times, the path last selected is displayed. Unlike the "File Select" window, the "File Manager" displays the full file names including extensions.

**Working with the File Manager dialog**

1. Accessing the "File Manager" dialog (see "Accessing files with user data" on page 72).
2. Navigating in the "File Manager" dialog.
   Operation is similar to the operation of menus with several areas.
3. Moving, duplicating, deleting or renaming files
   To move a file, select the file and press the "Cut" button. Mark the directory to which the file is to be moved and select the "Paste" button. If the target directory already contains a file with the same name, a confirmation query is displayed to confirm overwriting of this file.
   Perform the similar steps and cut/copy/rename/delete the file.

   **Tip:** The operation corresponds to the Windows concept.
4. Creating a new directory
   Mark drive or directory level where the new directory is to be created, select the "Create New Directory" button and enter the name of the new directory in the entry window that opens. Confirm with ENTER.

### 4.7.2.1 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.

*Table 4-1: List of the automatically assigned file extensions in the instrument*

| Function | List type | Contents | File suffix |
|---|---|---|---|
| Instrument State | Settings | Instrument settings | `*.savrcltxt` |
| "User Correction" | List | User-defined level correction values | `*.uco` |
| | | Export Data | `*.txt` or `*.csv` |
| "List Mode" | List | User-defined frequency/level value pairs | `*.lsw` |
| | | Export Data | `*.txt` or `*.csv` |
| "Pulse Train List" | | User-defined offtime/ontime/repetition values | `*.pulstrn` |
| NRP Settings | Settings | NRP Settings | `*.nrp` |

## 4.8 Legend of Front-Panel Controls

The following table lists all key functions available on the front panel. Key combinations used on the PC keyboard to trigger key functions on the instrument front panel are also described. Keyboard labels are described in alphabetical order.

In addition, a front panel key emulation and an on-screen keyboard can be used for manual operation by mouse only.

*Table 4-2: Cross-reference between the front panel keys and keyboard shortcuts*

| Front-panel key | Key of PC keyboard | Function |
|---|---|---|
| Turning the rotary knob | Tab key (towards the right)<br>Shift + Tab (towards the left) | Sets the cursor with the rotary knob. |
| Pressing the rotary knob | Enter | Pressing the rotary knob confirms an entry; it has the same function as the ENTER key. |
| Arrow keys | Arrow keys | Moves the cursor. |
| . / *...# | . / *...# | Enters a period/decimal point. Enters a special character. |
| - / A<->a | - / (shift+) a—z | Enters the sign.<br>Switches between upper-case and lower-case letters. |
| 0-9 / a...z | CTRL+ 0-9 / a...z CTRL | Enters the number/letter. |
| BACKSPACE | Backspace | Clears the last entry (number, sign or decimal point) |
| DIAGR | CTRL+ D | Sets the cursor on the block diagram and hides all menus. |
| ENTER / *1 / dB(m) | Enter<br>ALT + F12 | Terminates an entry.<br>Confirms entries in the base unit and values without a unit.<br>Selects dBm for the RF level and dB for level offset and level step width. |

| Front-panel key | Key of PC keyboard | Function |
|---|---|---|
| ESC / CLOSE | ESC / CTRL + G | Selects the next higher menu/selection level. When the editing mode is exited with ESC, the previous value is restored.<br>Closes an active menu. |
| FILE | CTRL + S | Activates the menu for storing instrument settings. |
| FREQ | CTRL+ F | Activates the frequency entry. |
| G/n / dBuV | ALT + F9 | Selects the unit Giga/Nano, dBuV for the RF level and dBu for the LF level. |
| HELP | F1 | Opens/closes context-sensitive help. |
| INFO | CTRL + I | Opens/closes the info window |
| k/m / mV | ALT + F11 | Selects the units kilo/milli and mV for RF levels. |
| LEVEL | CTRL + L | Activates the level entry. |
| LOCAL | CTRL + Q | Switches the instrument from remote control to manual control. |
| M/u / uV | ALT + F10 | Selects the units Mega/Micro and uV for RF levels. |
| MOD ON/OFF | CTRL + O | Switches modulation on/off. "MOD OFF" is indicated in the status line. |
| ON/OFF TOGGLE | CTRL + T | Switches a block or parameter on/off.<br>Toggles between the different possibilities of setting a selection parameter. |
| PRESET | CTRL + P | Restores a defined basic instrument setup. |
| RF ON/OFF | CTRL + R | Switches the RF output signal on/off. "RF OFF" is indicated in the status line. |
| SETUP | CTRL + E | Opens the setup menu for general instrument settings. |
| WINBAR | CTRL + W | Toggles between the active menus. |

### 4.8.1 Front Panel Key Emulation

The R&S SMB provides a front panel key emulation to enable execution of the front panel key functions by mouse e.g. for remote access. The emulation is called by a right mouse click. The front panel key functions are executed by a mouse click on the associated button.


Freq
Diagram
Level
Menu
File
Rearr.
RF On/Off
WinBar
Mod On/Off
Help
Preset
Local
Setup
Hardcopy
Info

# 5 Instrument Function

## 5.1 Overview of Instrument Functions

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

The description starts 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" block) and the analog modulations ("Mod" block). The configuration of the modulation generators (LF generators and pulse generator) and of the LF sweep is offered in the "Mod Gen" block. The clock synthesis signal is set in the "Clock Synthesis" 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 81
- Switching from remote control to manual control using the LOCAL key
  see chapter 5.2.4, "Switching to Manual Control - Local Key", on page 102
- Configuring the generator and its interfaces in the "Setup" dialog - 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 81
- Calling up the online help using the HELP key
  see chapter 5.2.7, "Help System - Help Key", on page 105
- Querying messages using the INFO key
  see chapter 5.2.6, "Messages - Info Key", on page 105
- Loading and storing complete instrument settings in the "File" menu
  see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 106

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

- CW mode
  see chapter 5.3.1, "Overview of RF Signal", on page 112
- List mode
  see chapter 5.3.9.4, "List Mode", on page 152
- Frequency and Level Sweep mode
  see chapter 5.3.9.1, "Overview", on page 140
- Reference Oscillator
  see chapter 5.3.4, "Reference Oscillator", on page 117
- RF Level
  see chapter 5.3.6, "Overview RF Level Settings", on page 125
- RF Level Sweep

see chapter 5.3.9.3, "RF Level Sweep", on page 147

- ALC
  see chapter 5.3.8.1, "Automatic Level Control - ALC", on page 131
- Power Sensors
  see chapter 5.3.5, "NRP-Z Power Viewer", on page 119
- User Correction
  see chapter 5.3.8.2, "User Correction", on page 133

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

- Amplitude Modulation
  see chapter 5.4.2, "Amplitude Modulation (AM)", on page 162
- Frequency Modulation
  see chapter 5.4.3, "Frequency Modulation (FM)", on page 164
- Phase Modulation
  see chapter 5.4.4, "Phase Modulation (PhiM)", on page 167
- Pulse Modulation
  see chapter 5.4.5, "Pulse Modulation (PM)", on page 170
- Stereo Modulation
  see chapter 5.4.6, "Stereo Modulation", on page 172

The internal LF generators, the LF frequency sweep and the pulse generator are configured in the "Mod Gen" function block:

- LF Frequency Sweep
  see chapter 5.5.2, "LF Frequency Sweep", on page 179
- LF output
  see chapter 5.5.3, "LF Output", on page 184

## 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 SMB (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 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.

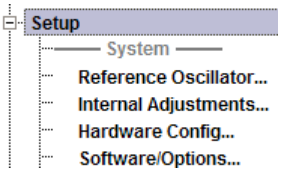
- "RF frequency" = 1 GHz
- "RF level" RF output switched off
- "Level" = 30 dBm for instruments including an attenuator
  "Level" = -5 dBm for instruments with no attenuator
- "Offsets" = 0
- "Modulations State" = Off
- Uninterrupted level settings are switched off
  "Level Attenuator Mode" = AUTO
- Internal level control "Level ALC" = AUTO
- User correction "Level Ucor" = OFF
- "LF output State" = Off
- "Sweep State" = Off

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 236

### 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 and security settings.
- The "Settings" section is used to save or recall instrument settings or to preset the instrument to factory settings.

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 5.3.4, "Reference Oscillator", on page 117).
- 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 106.

#### 5.2.3.1 Internal Adjustments

The R&S 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..." dialog. 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.

**NOTICE**

**Risk of damage to the DUT**

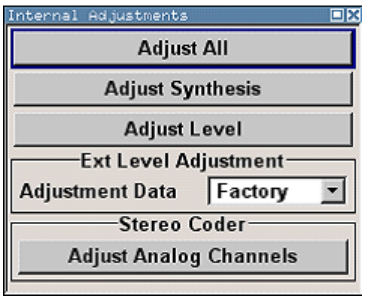
High power at the RF output may destroy a connected DUT (**D**evice **U**nder **T**est).

During level adjustments instruments without step attenuator, i.e. with frequency options R&S SMB-BxxxL, temporarily apply high power at the RF output. This may damage the DUT. Therefore, it is required that the RF connector is terminated during adjustment.

Disconnect the DUT and replace it by a 50 Ohm terminating resistor.

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).

Adjustment may take some time. Especially in instruments with frequencies above 6 GHz, it may last up to 15 minutes.

SCPI command:
`:CALibration:ALL[:MEASure]` on page 239

**Adjust Synthesis**
Performs all adjustments which affect the frequency.

SCPI command:
`:CALibration<hw>:FREQuency[:MEASure]` on page 240

**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 240

**Adjustment Data**
Selects the data used for external level correction.

By default the instrument uses correction data obtained in the factory before delivery. In addition, customer data can be used for external level correction. The customer data is obtained using a R&S NRP power sensor. External level correction is a protected function (see Service Manual, chapter 2, "Adjustment").

SCPI command:
`:CALibration<hw>:LEVel:EXTern:DATA` on page 240

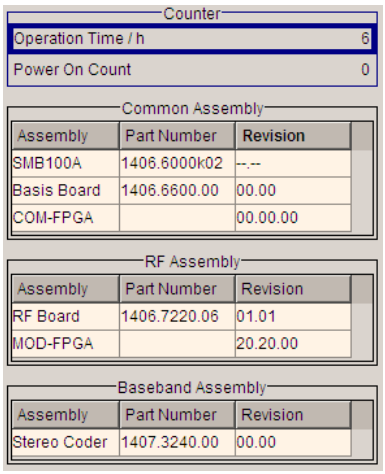
**Adjust Stereo Coder**
Performs all adjustments which affect the analog channels of the stereo coder. For the adjustment of the S/P DIF see Service Manual, chapter 2, "Adjustment".

SCPI command:
`[:SOURce]:CALibration:STEReo:ANALog[:MEAS]` on page 241

### 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 242

**Power On Count**
Displays the number of power-on.

SCPI command:
`:DIAGnostic:INFO:POCount` on page 242

**Assembly**
The tables list the installed assemblies.

"Assembly" Assembly name

"Part Number" Part Number of assembly

"Revision" Revision state of assembly

SCPI command:
`:DIAGnostic<hw>:BGINfo` on page 241

### 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.

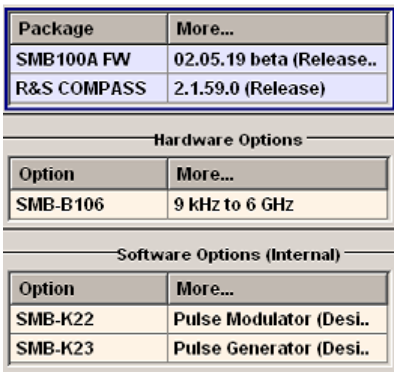
Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in Chapter 4 of the Service Manual (supplied with the instrument).

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

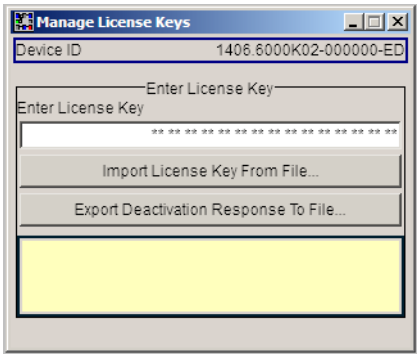
SCPI command:
*OPT on page 235
*IDN on page 234

**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 Manage License Keys

This dialog is the central dialog for managing licenses, like enabling newly purchased and/or newly registered options or performing the required instrument related steps during the process of unregistration of licenses.




An option is ready to operate after it is enabled by means of a license key code supplied with the option. The license key is delivered as a file or on paper. Unregistered licenses must be registered for a particular instrument prior to the corresponding option can be enabled for operation.

**License Registration**

If your purchased license is delivered unregistered, you must register it before you can activate the option.

For detailed information about the license registration, refer to the installation instructions provided with the option (Supplement A) and the documentation of the online tool "Manage Licenses" (https://extranet.rohde-schwarz.com/service).

Only if the R&S 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, chapter 4 (on CD ROM, supplied with the instrument).

**Device ID**
Displays the instrument specific identification number. The device ID is an unique string with the following structure:

`<stock number>-<serial number>-<checksum>`

**Enter License Key**
Type here the license key provided with the option.

For license keys delivered as a file, use Import License Key from File....

**Import License Key from File...**
Opens a dialog for selecting the file with the license key.

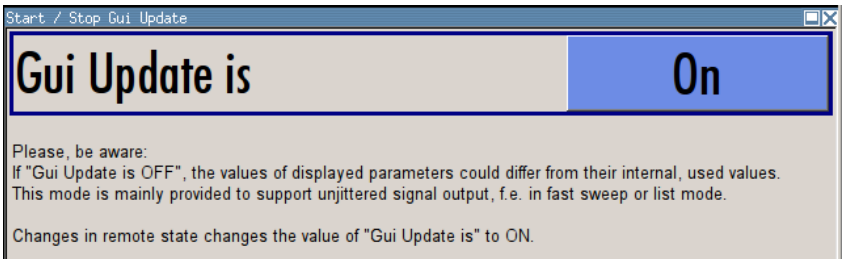
**Export Deactivation Response to File...**
Exports the generated deactivation response key to a file and opens a file management dialog to save the file. This key is required during the unregistration process.

**Status Information**
Displays status information.

### 5.2.3.5 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.

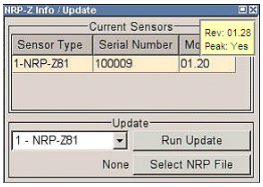
**Note:** It is especially recommended to switch off the GUI update for optimum sweep performance with short dwell times and for fast settling times.

SCPI command:
`:SYSTem:DISPlay:UPDate` on page 371

### 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. 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.

**Tip:** Click on a sensor to get quick information about the firmware version and whether this sensor measures the peak of the signal.

SCPI command:
`SENSe<ch>[:POWer]:TYPE` on page 270
`SENSe<ch>[:POWer]:SVERsion` on page 270
`SENSe<ch>[:POWer]:SNUMber` on page 269

**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.

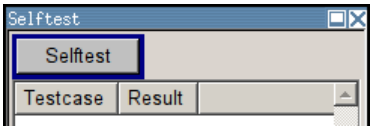
The procedure is as follows:
- Do not reconnect the sensor but keep it ready to be connected
- Select "Rescue" in the left sensor selection field
- Activate "Run Update"
- Confirm query in message box
- Connect sensor within 4 seconds

The update starts, a bar informs about the progress.

SCPI command:
n.a.

### 5.2.3.7 Selftest

A selftest is provided for service purposes. The selftest is a protected test procedure, which can be accessed if protection level 1 is disabled. The protection dialog is called in the "Setup" menu (see chapter 5.2.3.13, "Protection", on page 96).




The following tests are only available via remote control:

- `:TEST<hw>:DIRect` on page 378

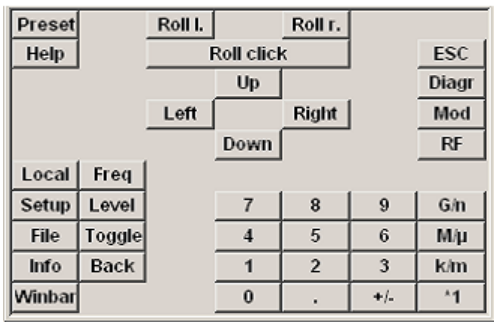
**Selftest**
Performs a selftest on all installed hardware options.

A list of the performed tests cases and the result of each of them (passed or failed) is displayed.

SCPI command:
`:TEST<hw>:ALL:STARt` on page 378
`:TEST<hw>:ALL:RESult` on page 378

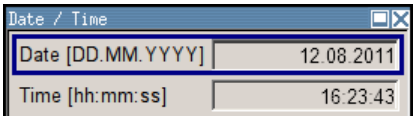
### 5.2.3.8 Check Front Panel

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.




To prevent accidental changes, "Date" and "Time" are protected functions. They can be accessed with protection level 1, see chapter 5.2.3.13, "Protection", on page 96.

**Date**
Indicates the date in the format day.month.year.

In order to prevent accidental changes, this parameter is protected. It can be accessed with protection level 1, chapter 5.2.3.13, "Protection", on page 96.

SCPI command:
`:SYSTem:DATE` on page 371

**Time**
Indicates the time in the format hour.minute.second

In order to prevent accidental changes, this parameter is protected. It can be accessed with protection level 1, see chapter 5.2.3.13, "Protection", on page 96.

SCPI command:
`:SYSTem:TIME` on page 377

### 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 SMB is equipped with a network interface and can be connected to an Ethernet LAN (local area network).

How to connect the signal generator to the network is described in chapter 2.6.1, "Connecting the Instrument to the Network", on page 33.

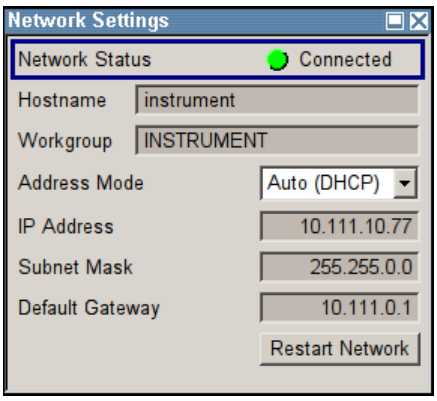
**NOTICE**

**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 Signal Generator.

**Note:** The computer name can only be changed after protection level 1 is deactivated (see chapter 5.2.3.13, "Protection", on page 96).

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

SCPI command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 367

**Workgroup**
Enters the individual windows workgroup name of the R&S 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 5.2.3.13, "Protection", on page 96).

SCPI command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup` on page 368

**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 368

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

SCPI command:
`:SYSTem:COMMunicate:NETWork:IPADdress` on page 368

**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 369

**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 369

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

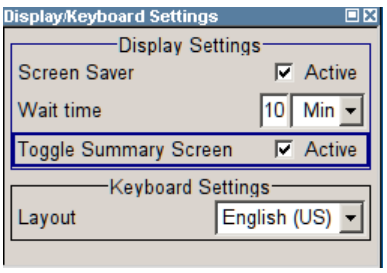
This function can be used to resolve network problems.

**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 243

**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 243

**Toggle Summary Screen**
Activates/deactivates the magnified frequency and level indication. If activated, the frequency and level indication covers the complete display.

SCPI command:
n.a.

**Layout (Keyboard)**
Selects the keyboard layout for the selected keyboard language.

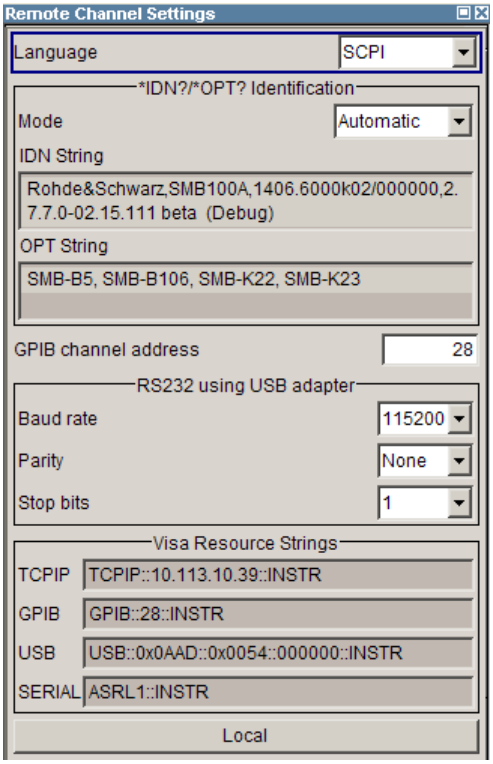
The assignment of some keys depends on the selected layout and language.

SCPI command:
`:KBOard:LAYout` on page 252
`:KBOard:LANGuage` on page 252

### 5.2.3.12 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 SMB.

The R&S SMB 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 SMB 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 SMB 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 SMB, 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 375

**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 374

**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 SMB' for instance.

SCPI command:
`:SYSTem:IRESponse` on page 374

**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 375 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 367

**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 chapter 5.2.3.14, "Security", on page 97).

SCPI command:

`:SYSTem:COMMunicate:SERial:BAUD` on page 370

`:SYSTem:COMMunicate:SERial:PARity` on page 370

`:SYSTem:COMMunicate:SERial:SBITs` on page 371

**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 369

`:SYSTem:COMMunicate:GPIB:RESource` on page 370

`:SYSTem:COMMunicate:USB:RESource` on page 369

`:SYSTem:COMMunicate:SERial:RESource` on page 370

**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.

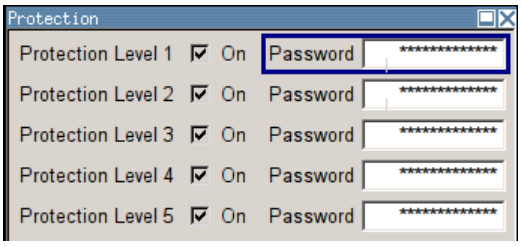
SCPI command:

`&GTL`

### 5.2.3.13 Protection

This "Protection" dialog provides access to the unlocking of different protection levels. To open this dialog, use the SETUP or MENU key under "Protection".

After the instrument has been switched on, the protection levels 1 to 5 are automatically activated. To deactivate the protection, the correct password has to be entered. With the corresponding check boxes, you can activate the protection again.




The following functions are protected in the rerspective levels:

- Protection Level 1
  protects against accidental changes to certain settings, such as clock and date, network settings or instrument names,etc. This level is accessible to the user.

- Protection Level 2
  provides access to the unlocking of protected service functions. It is accessible to authorized personnel of R&S Service Departments only.
- Protection Level 3-5
  are reserved for factory internal use.

**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.

For access to service functions of protection level 2, see the service manual of your R&S SMB.

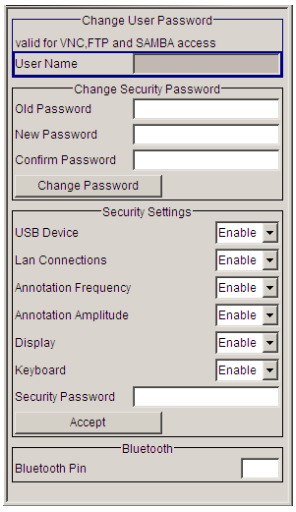
SCPI command:
`:SYSTem:PROTect<ch>[:STATe]` on page 376

### 5.2.3.14 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 371

**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 375

**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.

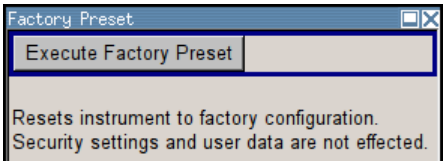
SCPI command:
n.a.

### 5.2.3.15 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 106).

### 5.2.3.16 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 238

### 5.2.3.17 Help

The "Help" dialog offers comprehensive online help for the R&S 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 105).

### 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.

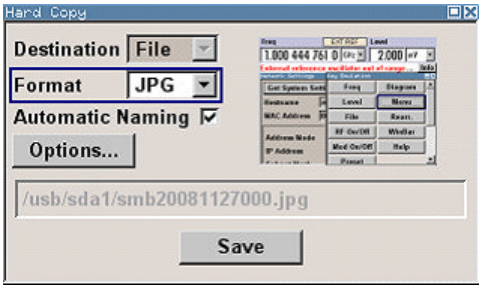
If the "REMOTE" status message is shown, the LOCAL key switches the instrument from remote control to manual control. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

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 generation of a hardcopy of the display requires that an external keyboard is connected to the instrument. The hardcopy dialog is called with the key combination CTRL +Z or CTRL+Y depending on the used keyboard settings.




#### 5.2.5.1 Hardcopy Dialog

**Destination**
Indicates that the hardcopy is stored in a file (see also "File Options" on page 103).

SCPI command:
`:HCOPy:DEVice` on page 246

**Options**
Opens the Hardcopy Options dialog for configuring the hardcopy parameters (see "File Options" on page 103.

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 103.

**Automatic Naming**
Activates, deactivates automatic generation of the file name. Automatic naming is configured in the "Options…" submenu, see "File Options" on page 103.

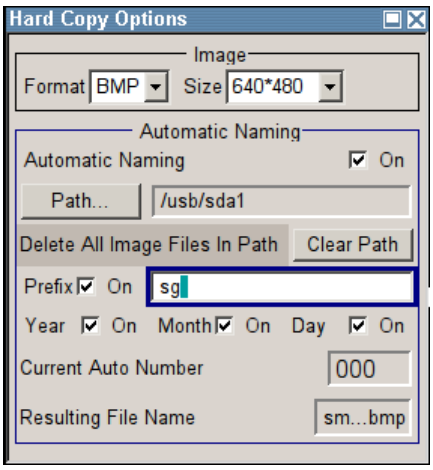
SCPI command:
`:HCOPy:FILE[:NAME]:AUTO:STATe` on page 251

**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 247
`:HCOPy:FILE[:NAME]:AUTO:FILE` on page 248

### 5.2.5.2 Hardcopy Options

This section describes the "Hardcopy Options" dialog.




**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 251

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

SCPI command:
`:HCOPy:DEVice:LANGuage` on page 246

"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..." 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 247
`:HCOPy:FILE[:NAME]:AUTO` on page 247

"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 248

"Prefix" 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 250

"Enter prefix" 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 250

"Date - Year / Month / Day" 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 251
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe` on page 249
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe` on page 249

"Current Auto Number" 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 249

"Resulting File Name" Indicates the automatically generated file name.

SCPI command:
`:HCOPy:FILE[:NAME]:AUTO:FILE` on page 248

**Save**
Triggers the generation of a hardcopy.

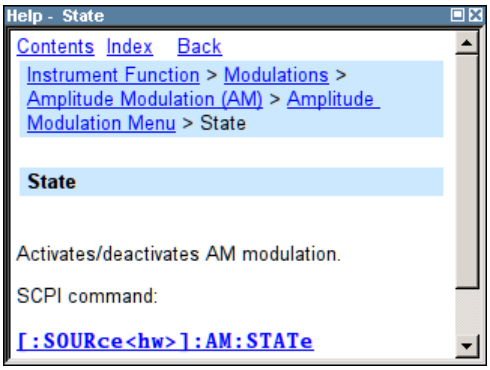
SCPI command:
`:HCOPy[:EXECute]` on page 246

## 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 4.2.3, "Info Window", on page 58 and chapter 9, "Error Messages", on page 411.

## 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.

### 5.2.8 Storing and Loading Instrument Data - File Key

The R&S SMB allows complete instrument settings to be stored in files either on the internal flash memory or on external USB memory devices.

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. 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 chapter 4.7.1, "File Select Dialog", on page 72.

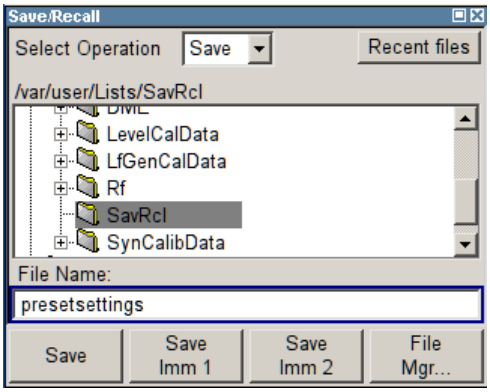
**Select Operation**
Selects the file function.

"Save…" Calls the menu for storing the current instrument setting (see chapter 5.2.8.2, "Storing Instrument Settings", on page 107).

"Recall..." Calls the menu for calling up a stored instrument setting (see chapter 5.2.8.3, "Loading Instrument Settings", on page 109).

### 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 files**
Displays the files last used.

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 256

**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 255

**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 236
`:MMEMory:STORe:STATe` on page 260

**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 236

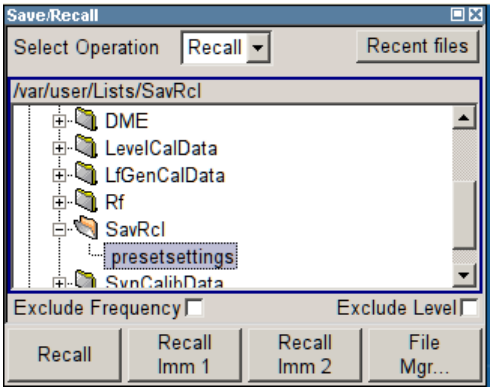
**File Manager**
Calls the "File Management" menu.

Directories can be created and files managed in this menu (see chapter 5.2.8.4, "File Manager", on page 110).

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 256

**File List**
Selects the file with the desired instrument configuration.

SCPI command:
:MMEMory:CATalog on page 255

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

SCPI command:
[:SOURce<hw>]:FREQuency[:CW|:FIXed]:RCL on page 286

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

SCPI command:
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL on page 322

**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 259
*RCL on page 236

**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.

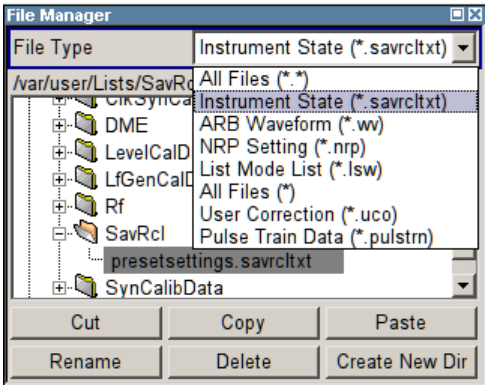
If the list has been deleted in the meantime, an error message appears when the instrument setting is loaded. If the list has been overwritten in the meantime, the new entries will be used.

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

SCPI command:
*RCL on page 236

### 5.2.8.4 File Manager

The "File Management" 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 (internal flash memory and memory stick).




For more information, see chapter 4.7.2, "File Manager", on page 73.

**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 256

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

SCPI command:
`:MMEMory:DELete` on page 258

**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 257

**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 259

**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 258

**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`).

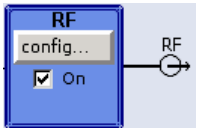
The directory is created as a subdirectory in the selected level.

SCPI command:
`:MMEMory:MDIRectory` on page 259

# 5.3 RF Signal - RF Block

## 5.3.1 Overview of RF Signal

Settings for the RF output signal and analog modulation are made under "RF Signal". These settings can be accessed in the block diagram by way of the "RF" 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 SMB + frequency option R&S SMB-B10x) without additional equipment options.

### 5.3.1.1 RF Output

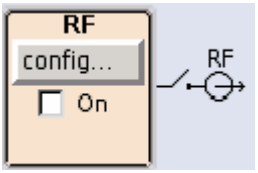
To activate and deactivate the RF output signal, use one of the following alternatives:

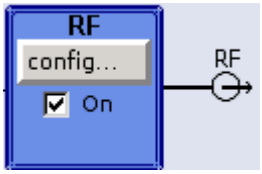
- by means of the RF ON/OFF key (the current entry focus is irrelevant)
- by changing the state of the "RF" functional block (see "State RF" on page 113)

- by enabling/disabling the RF in the "Configure" menu of the "RF" block (see "RF Output State" on page 113).

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.

An active sweep is also indicated in the block.



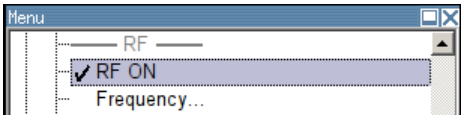

To query the impedance of the RF outputs, use the command `:OUTPut<hw>:IMPedance` on page 262.

**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 263

**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 263

### 5.3.1.2 Overview of the RF Signal Settings

- **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 Signal Generator generates the RF signal in unmodulated or analog form. The signal generator is equipped therefore with the following sources for analog modulations:

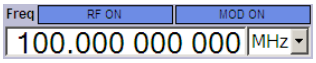
- an internal LF generator
- an internal pulse generator
- the external modulation inputs MOD EXT and PULSE EXT.

An external trigger signal for the analog modulations, the sweeps and the LIST mode can be provided at the INST TRIG input.

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. Alternatively, you can enter the RF frequency in the "Frequency/Phase" dialog.




Be aware that the displayed RF frequency in the header, and the RF output frequency, entered in the "Frequency/Phase" dialog can be different, as explained in the following section.

### 5.3.2.1 RF Frequency vs. RF Output Frequency

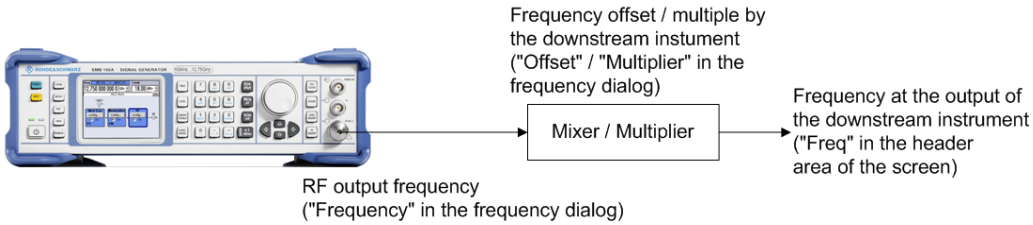
The signal generator offers the possibility, to take additional frequency modifications of a downstream instrument into consideration, such as an offset set by a mixer, or a multiple of the frequency by a frequency multiplier. The R&S SMB indicates the resulting frequency, including offset and multiplication factor in the header of the screen. I.e. the indicated frequency corresponds to the frequency at the output of the downstream instrument. However, the frequency at the RF output of your signal generator always corresponds to the frequency set in the "Frequency/Phase" dialog.

In this dialog, you can also enter the values of the downstream instrument.

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

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 dialog) * "Multiplier" factor (Multiplier in dialog) + "Freq offset" (Offset in dialog)




If you have an R&S SMB microwave instrument, i.e. equipped with one of the options R&S SMB-B112, -B120, or -B140, you can, in addition, operate an R&S SMZxx frequency multiplier. xx represents the multiplier type that you can use according to the target frequency range.

### 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.

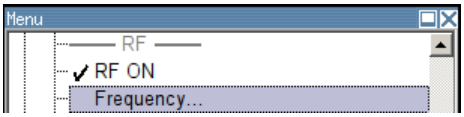
**Note:** The SCPI command sets the level of the "Freq" display, i.e. an entered frequency offset and multiplier factor are taken into consideration in the frequency value.

SCPI command:
`[:SOURce<hw>]:FREQuency[:CW|:FIXed]` on page 286

### 5.3.2.3 Frequency Menu

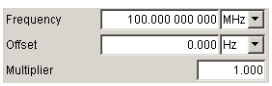
In the combined "Frequency/Phase" dialog, you can enter the frequency, the frequency offset and multiplication factor of a downstream instrument, set the step width for the frequency entry using the rotary knob, and set the phase for the RF output signal.

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

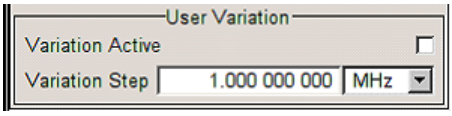



The "Frequency/Phase" dialog is divided into the several sections.

Frequency and offset of the RF output signal are set in the "Frequency Settings" section in the upper part of the dialog. In addition, the multiplier factor of an externally connected multiplier is specified.




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 117.

**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.

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 288

**Multiplier - RF Signal**
Sets the multiplication factor for the RF frequency.

In the frequency field of the status bar, the instrument adjusts its frequency display according to the set multiplication factor. This frequency value shows the frequency at the output of the downstream multiplier. The entry does not change the RF frequency at the RF output of the R&S SMB.

SCPI command:
`[:SOURce<hw>]:FREQuency:MULTiplier` on page 288

**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 291

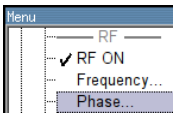
**Variation Step - RF Signal**
Sets the user-defined step width. This step width is used when entering the RF frequency using the rotary knob. Frequency variation with this step width must also be activated with "Variation Active".

SCPI command:
`[:SOURce<hw>]:FREQuency:STEP[:INCRement]` on page 291

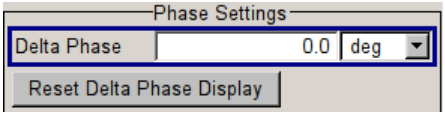
## 5.3.3 Phase Settings

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




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




**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 314

**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.

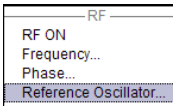
SCPI command:
`[:SOURce<hw>]:PHASe:REFerence` on page 315

## 5.3.4 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.

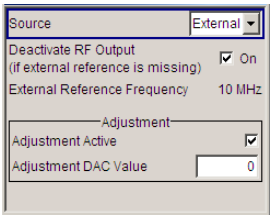
The settings of the reference oscillator are not influenced by an instrument preset ("PRESET" key).

### 5.3.4.1 Reference Oscillator Dialog




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

The menu is used to select the source and to adjust the reference frequency. In case an external source is selected, the reference frequency is displayed.




**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 343

**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 341

**External Reference Frequency**
Indicates the frequency of the external reference signal.

SCPI command:
`[:SOURce]:ROSCillator:EXTernal:FREQuency` on page 341

**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 342

**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 342

**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 342

### 5.3.5 NRP-Z Power Viewer

The R&S signal generator supports R&S NRP-Z power sensors to measure the power of the output signal in the RF path or any freely selectable source. The generator performs up to four power measurements, with the sensors either directly connected, or via the R&S NRP-Z5 USB Sensor Hub.



The R&S NRP-Z5 USB Sensor Hub (high-speed USB 2.0) can host up to 4 R&S NRP-Z sensors and provides simultaneous internal and external triggering of all connected sensors.

You can directly connect the R&S NRP-Z Sensors to the standard NRP sensor connectors of the hub. The hub is connected to the R&S instrument via USB with the adapter cable R&S NRP-Z4.

See also the R&S website http://www.rohde-schwarz.com in section "Power Meters & Voltmeters > R&S NRP-Z Sensors" for information on the sensor hub and the available accessories.

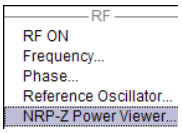
To connect a sensor directly at a USB interface, the USB adapters R&S NRP-Z3 or R&S NRP-Z4 are available.

The instrument automatically detects a connected R&S NRP-Z power sensor and indicates it in the "NRP-Z Power Viewer" dialog. In addition, you find device specific information on the connected sensor in the chapter 5.2.3.6, "NRP-Z Info/ Update", on page 88. For information on the scope of your power sensor refer to the manual of your R&S NRP-Zxx power sensor.

A sensor continuously measures the average signal power of the selected source. The signal generator shows the result in either the "NRP-Z Power Viewer" dialog, or directly in the block diagram. You can activate the permanent display in the block diagram in the "NRP-Z Power Viewer" dialog. This dialog provides access to all parameters concerning sensor settings, like average or peak display, reference source, filter and level offset, see NRP-Z Power Viewer Settings.

The signal generator also supports the use of R&S NRP-Z 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 5.3.8.2, "User Correction", on page 133).

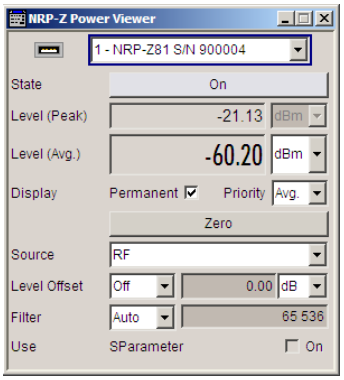
### 5.3.5.1 NRP-Z Power Viewer Settings




To open the "NRP-Z Power Viewer" menu, select "RF > Configure > NRP-Z Power Viewer" or use the MENU key under "RF".

The dialog shows the settings and measurement values of the sensor selected in the field next to the connector symbol. For indicating the parameters of another sensor, switch to the respective sensor in the selection list.

When you connect your power sensor(s) via the R&S NRP-Z5 USB sensor hub, each channel of the hub is firmly assigned to the associated sensor channel in the generator.




**Sensor - Power Viewer**
Selects the R&S NRP-Z power sensor for indication.

Indicates the connector used for the detected sensors. The values listed below belong to the respective sensor.

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 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 at the first USB interface, and suffix 2, 3 and 4 are assigned to further sensors connected via USB. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

**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 >" chapter 5.2.3.6, "NRP-Z Info/Update", on page 88 dialog to update the sensor software.

SCPI command:
SENSe<ch>[:POWer]:STATus[:DEVice] on page 270

**Type - Power Sensors**
Indicates the type and the serial number of the connected R&S NRP-Z power sensor. The sensor type is automatically detected.

SCPI command:
SENSe<ch>[:POWer]:TYPE on page 270
SENSe<ch>[:POWer]:SNUMber on page 269

**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 at the first USB interface, and suffix 2, 3 and 4 are assigned to further sensors connected via USB. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

To query the availability of a sensor at a given connector, use the command SENSe<ch>[:POWer]:STATus[:DEVice] on page 270.

SCPI command:
INITiate<ch>[:POWer]:CONTinuous on page 264

**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 265

**Level (Avg.) - Power Sensors**
Indicates the measured level value with the selected unit.

SCPI command:
READ<ch>[:POWer] on page 265

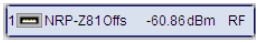
**Unit - Power Sensors**
Selects the unit used for result display.

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 271

**Permanent Display State - Power Sensors**
Activates the permanent indication of the power measurement result in the upper right corner of the block diagram. The instrument shows the type of sensor, the corresponding connector, the measurement source and - if set - the offset.




It is possible to switch the permanent display active for several sensors. In this case, the instrument indicates the values of the sensor with the lowest port number in the display.

SCPI command:
SENSe<ch>[:POWer]:DISPlay:PERManent:STATe on page 265

**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 266

**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 271

**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 269

**Frequency - Power Sensors**
Source User only

Enters the frequency for measurement source "User".

SCPI command:
`SENSe<ch>[:POWer]:FREQuency` on page 268

**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 269
`SENSe<ch>[:POWer]:OFFSet` on page 269

**Auto Once**
Searches for the optimum filter length for the current measurement conditions and indicates value in the "Filter Length" field above.

SCPI command:
`SENSe<ch>[:POWer]:FILTer:SONCe` on page 267

**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 268
`SENSe<ch>[:POWer]:FILTer:LENGth:AUTO` on page 266
`SENSe<ch>[:POWer]:FILTer:LENGth[:USER]` on page 266
`SENSe<ch>[:POWer]:FILTer:NSRatio` on page 267
`SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe` on page 267

**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.

Refer to the manual of the connected R&S NRP-Zxx power sensor for a description on how to use the s-parameters table.

SCPI command:
`SENSe<ch>[:POWer]:CORRection:SPDevice:STATe` on page 265

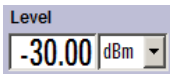
**Use Sensor for RF Lev. Control - Power Sensors**
Enables/disables controlling of the RF level via the power sensor.

SCPI command:
n.a.

## 5.3.6 Overview RF Level Settings

**Message "Level overrange/underrange"**
If this message appears in the status line, the set level ("Level") is in the overrange (see data sheet).

The correct level setting and signal quality cannot be guaranteed if the set level is in the overrange/underrange.




The value of the RF level is displayed in the level field in the header of the instrument's display and the easiest 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.

### 5.3.6.1 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.

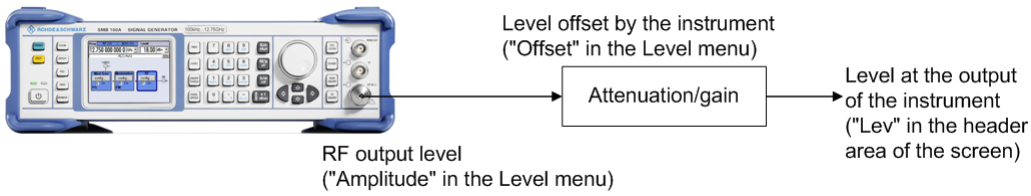
This allows the desired level at the output of downstream instruments to be entered. The R&S Signal Generator changes the RF output level according to the set offset.

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)




The RF output is protected against overloading by an external signal applied to the RF output (see "Reverse Power Protection" on page 129).

#### 5.3.6.2 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 (see chapter 5.3.6.1, "RF level vs. RF output level", on page 125).

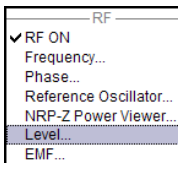
dBm, dBuV, mV and uV can be used as the level units. The 4 unit keys are labeled with these units.

**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 320

### 5.3.7 RF Level / EMF

#### 5.3.7.1 RF Level



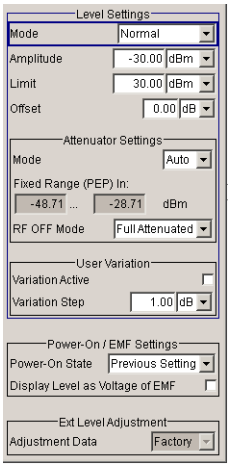

To open the "RF Level/EMF" dialog, select "RF > Configure > Level" or use the MENU key under "RF".

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

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

The offset-free level, level offset and level limit are set in the top section of the menu. The attenuator mode is set in the "Attenuator Settings" section.

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 5.3.7.2, "Power-On/EMF Settings", on page 130).

### Level Settings

The offset-free level, attenuation mode, level offset and level limit are set in the top section of the menu.

**RF mode – RF Level**
Selects performance preferences of the RF output signal regarding wideband noise and distortion.

| | |
|---|---|
| "Normal" | The generator provides an RF output signal with high signal to noise ratio as well as low distortion, according to the data sheet. |
| "LOW Noise" | This setting forces the generator to optimize the signal to noise ratio. |
| "LOW Distortion" | The generator reduces distortion (harmonics) of the RF signal. |

SCPI command:
`[:SOURce<hw>]:POWer:LMODe` on page 323

**Amplitude - RF Level**
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 `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display, i.e. the level containing offset.

SCPI command:
`[:SOURce<hw>]:POWer:POWer` on page 324

**Limit - RF Level**
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 322

**Offset (Level) - RF Level**
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 321

**Attenuator Settings**

The R&S SMB can be configured to provide level settings without interruption. This applies to instruments with, as well as without step attenuator. The attenuator mode is set in the "Attenuator Settings" section of the "RF level / EMF" dialog.

**Attenuator Mode - RF Level**
Sets the attenuator mode at the RF output.

"Auto" Standard mode.

"Fixed" When this operating mode is switched on, the attenuator, relays and amplifier stages are fixed in their current positions to provide level settings without interruption. The resulting variation range is defined and displayed under "Attenuator Fixed Range".

**Note:** The function is effective when automatic level control is activated ("ALC State = On").
If the normal variation range is overranged or underranged, level errors increase considerably and the warning "Level under/overrange" appears in the info line. The spectral purity of the output signal decreases with high attenuation.

SCPI command:
`:OUTPut<hw>:AMODe` on page 262

**Fixed Range (PEP) In**
Displays the level range in which the level is set without interruption for the "Attenuator Mode fixed" setting.

SCPI command:
`:OUTPut<hw>:AFIXed:RANGe:UPPer` on page 261
`:OUTPut<hw>:AFIXed:RANGe:LOWer` on page 261

**RF OFF Mode**
Selects the attenuator mode, 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.

"Unchanged" Freezes the setting of the attenuator when RF is switched off. The attenuator is only activated when RF is switched on.
This setting recommended if a constant VSWR (**V**oltage **S**tanding **W**ave **R**atio) is required.
Furthermore, on instruments equipped with a mechanical attenuator, it provides fast and wear-free operation.

"Full Attenuated" Sets attenuation 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 320

**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 326

**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 325

**Reverse Power Protection**

The reverse power protection prevents against overload by an external signal applied to the RF output of the R&S Signal Generator.

The R&S SMB equipped with frequency options up to 6 GHz includes a reverse power protection as standard. For instruments equipped with frequency option R&S SMB-B112 or R&S SMB-B112L a reverse power protection option R&S SMB-B30 is available. Refer to the data sheet for additional information and the respective option.

Refer to the data sheet for additional information and the respective options.

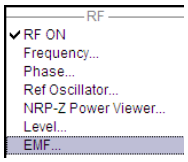
The reverse power protection is tripped when the power of the external signal becomes too high. A relay opens and interrupts the internal connection to the RF output. This condition is indicated in the display header by the "OVERLOAD" status message.

**Overload**
If an "Overload" status message is indicated in the display header, reset the overload protection by pressing the RF ON/OFF key.

The RF input is activated when the overload protection is reset.

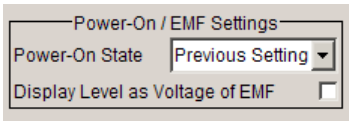
SCPI command:
`:OUTPut<hw>:PROTection:TRIPped` on page 263
`:OUTPut<hw>:PROTection:CLEar` on page 262
`:OUTPut<hw>[:STATe]` on page 263

### 5.3.7.2 Power-On/EMF Settings




The power-on behavior of the R&S SMB and the level display in the display header are set in the "Power-On / EMF Settings" section of the "RF Level/EMF" dialog.

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




**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 263

**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.

## 5.3.8 ALC / UCOR

### 5.3.8.1 Automatic Level Control - ALC

Your signal generator is equipped with an automatic level control unit to obtain best RF level accuracy.

**A**utomatic **L**evel **C**ontrol (ALC) is an adaptive control system to stabilize the RF output level. It continuously monitors the current level and adjusts it to keep a steady state over temperature and time.

ALC is active in almost all applications by default. However, the **Pulse Modulation** mode excludes ALC, as the control loop would detect incorrect values and result in level deviations.

Also note that ALC may detect incorrect values in **multi-transmitter** test setups. If multiple generators are coupled, reverse power may affect the ALC readings. Based on incorrect values, ALC would have an impact on the signal to intermodulation ratio.

**ALC States**

The following description basically explaines the ALC states and their principle of operation. In particular **ALC OFF (Sample & Hold)** gives an overview on the function in terms of the equipment of the generator.

The R&S SMB offers the ALC states:

- AUTO
  automatically adjusts the output level to the operating conditions.
- On
- enables ALC permanently, regardless of the currently selected mode.
- Off
  deactivates ALC.
  The instrument switches to **Sample & Hold (S&H)** state, which still allows to maintain a constant output level.

The following section explains the functionality of "Sample & Hold", to provide an overview and to indicate what is to be considered. "On" and "Auto" require no additionial explanation. Furthermore, find the ALC state settings described in detail in State - ALC.

**ALC OFF (Sample & Hold)**

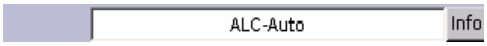
In "S&H" mode, the signal generator switches for a short period of time into CW mode and activates ALC. ALC adjusts the level to the set value and the generator holds the value (freeze). Then, the generator switches ALC off again and back to the operating mode.

RF output behaviour during Sample & Hold depends on the configuration of your instrument. Instruments equipped with...:

- an **electronic step attenuator**
  The level is decreased by 30 dB.

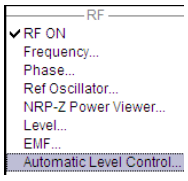
- a **mechanical step attenuator**
  By default, the mechanical step attenuator is not switched during S&H cycles to optimize the settling time. The instrument provides the output power for 3 ... 5 ms. However, you can affect the attenuation at the output by the setting "RF during Power Search" to "Minimum", see RF During Power Search - ALC. Then the generator decreases the level by 30 dB with the mechanical attenuator. Note that this may take a certain period of time.
  High frequency instruments, such as the R&S SMB with one of the high frequency options R&S SMB-B120 or R&S SMB-B140, are equipped with a **mechanical step attenuator.**
- **no step attenuator**
  The signal generator outputs the set level for 3 to 5 ms after level or frequency setting during a Sample & hold measurement.
  Instruments equipped with one of the options R&S SMB-B112L, R&S SMB-B120L or R&S SMB-B140L come without step attenuator.

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

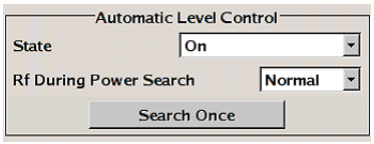



### Automatic Level Control Settings

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




The combined dialog "ALC / UCOR" is divided into the several sections and provides access to the "Automatic Level Control" settings and to function "User Correction", see chapter 5.3.8.2, "User Correction", on page 133).




**State - ALC**
Activates/deactivates internal level control.

| | |
|---|---|
| "Auto" | The instrument selects the most appropriate ALC mode automatically. ALC is on in most operating conditions. Default state. |
| "On" | Activates ALC, regardless of the operating conditions.<br>If "Attenuator Mode Fixed" is selected in addition, the instrument adjusts the level of every level and frequency setting. |
| "Off (Sample & Hold)" | Deactivates internal level control.<br>Sample & hold closes the level control loop at every frequency and level change for a short period of time. The level control voltage is sampled and then clamped. |

SCPI command:
`[:SOURce<hw>]:POWer:ALC[:STATe]` on page 319

**RF During Power Search - ALC**
Activates the mode for the mechanical step attenuator and for output during ALC power search.

"Normal" The RF output is active during power search.

"Minimum" The RF output is inactive during power search.

SCPI command:
`:OUTPut<hw>:ALC:SEARch:MODE` on page 261

**Search Once - ALC**
Forces the generator to execute level adjustment once, although the "Sample & Hold" mode is active.

SCPI command:
`[:SOURce<hw>]:POWer:ALC:SONCe` on page 319

### 5.3.8.2 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.

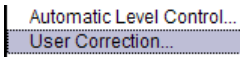
The amplitude can also be linearized automatically by means of an R&S NRP power sensor connected to one of the generator output signals. With the aid of the "Fill with Sensor" function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating 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 activated, user correction is effective in all operating modes.

### User Correction Menu



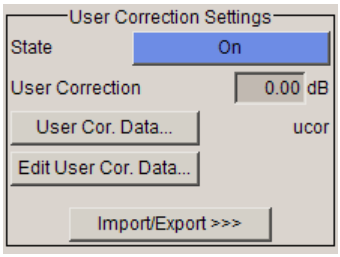

To open the "User Correction" menu, select "RF > Configure > User Correction" or use the MENU key under "RF".

The combined menu "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.

The upper section provides access to the automatic level control settings, see chapter 5.3.8.1, "Automatic Level Control - ALC", on page 131.




**State - User Correction**
Activates/deactivates user correction.

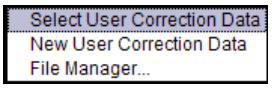
The "UCOR" status message appears in the frequency and level display.

SCPI command:
`[:SOURce<hw>]:CORRection[:STATe]` on page 282

**User Correction Value - User Correction**
Indicates the current value for level correction.

SCPI command:
`[:SOURce<hw>]:CORRection:VALue` on page 282

**User Cor. Data - User Correction**
Calls the "File Select" menu for selecting and creating a list or the "File Manager".



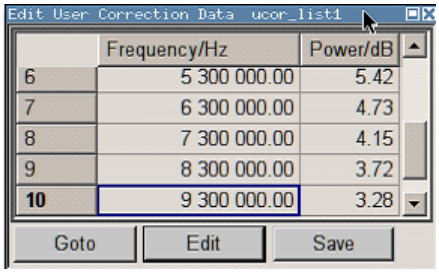

SCPI command:
`[:SOURce]:CORRection:CSET:DELete` on page 277
`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 281

**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.

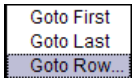



"Frequency / Hz" — Enters the frequency to which the level correction value applies.

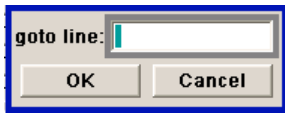
**Note:** The "Fill..." function allows to automatically enter any number of frequencies with freely selectable range and increment.
Using the "Fill With Sensor" function of the "Edit" sub menu requires only the entry of the frequency values. The level values are automatically acquired by the connected 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).

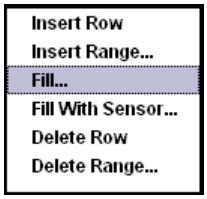
"Goto" — Selects row for editing.




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

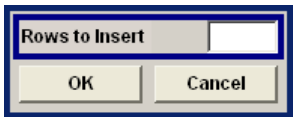



"Edit" — Calls a selection of possible actions described below.




"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.

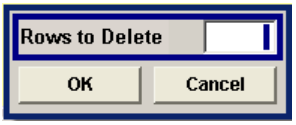


"Fill...." Opens a sub menu for defining a set of list values to be automatically entered in the ucor list (see "Filling the Correction List automatically" on page 138).

"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 "Filling the Correction List with Power Sensor Measurement Data" on page 139).

"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" The list is saved under its current name.

SCPI command:

`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 281

`[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency` on page 275

`[:SOURce<hw>]:CORRection:CSET:DATA:POWer` on page 276

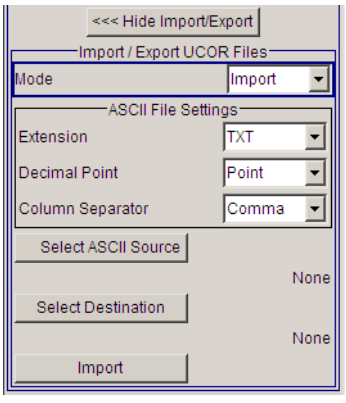
### Import/Export

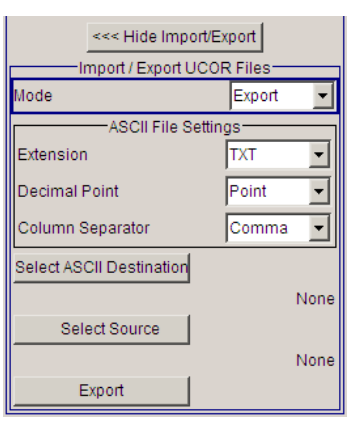
User correction list can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the "Import/Export" button.

**Import/Export >>>**
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.

Conversely, you can also export internally created user correction lists 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 280

**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 278

**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 279

**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 279

**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 278

**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 281

**Import / Export - User Correction**
Starts the export or import of the selected file.

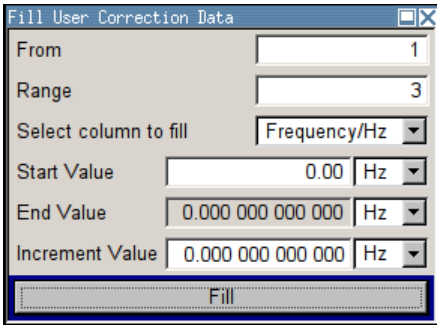
When import is selected, the ASCII file is imported as user correction list.

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

SCPI command:
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 280

### 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.

**Increment value**
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.

**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 5.3.5, "NRP-Z Power Viewer", on page 119). 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 134).

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).

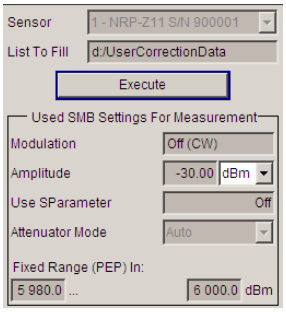


Do not save the list at this point, because the frequency entries are lost as long as there are no entries for the level column also. In the following these entries are automatically acquired by the connected power sensor.

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 277

## 5.3.9 Sweep Mode

### 5.3.9.1 Overview

The R&S Signal Generator offers three different sweep types (frequency sweep, level sweep and LF sweep) to be activated alternatively. Each type has 6 modes which differ with respect to the sweep cycle mode (continuous, individual and step-by-step) and triggering mode (automatic, internal and external).



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 sweep is activated and configured in the "Mod Gen" block.

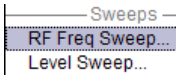
1. Set the sweep range ("Start Freq" and "Stop Freq" or "Center Freq" and "Span").
2. Select linear or logarithmic sweep spacing ("Spacing").
3. Set the step width ("Step Lin/Log") and dwell time ("Dwell Time").
4. Activate the sweep ("Mode" to Auto, Single, Step or Extern Single, Extern Step).
5. Trigger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



It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.5, "Gui Update", on page 87).

### 5.3.9.2 RF Frequency Sweep

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




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

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).

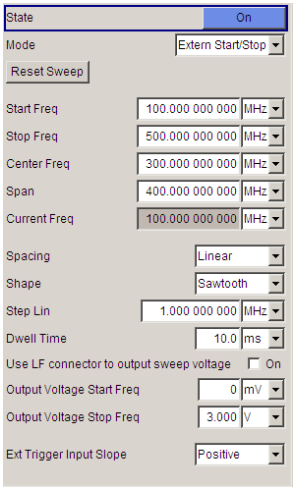
The sweep range, sweep spacing and dwell time are set in the bottom section.

For the frequency sweep, an output signal at the LF connector can be activated. It provides a linear voltage ramp from start to stop of the sweep. The output voltage can be used e.g. to control an oscilloscope.

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 288

#### 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 chapter 2.2, "Rear Panel Tour", on page 21).
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 INST TRIG).

**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 354
`:TRIGger<hw>:FSWeep:SOURce` on page 380
`[:SOURce<hw>]:FREQuency:MODE` on page 288

**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 353

**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 361

**Start Freq - Frequency Sweep**
Sets the start frequency.

SCPI command:
`[:SOURce<hw>]:FREQuency:STARt` on page 289

**Stop Freq - Frequency Sweep**
Sets the stop frequency.

SCPI command:
`[:SOURce<hw>]:FREQuency:STOP` on page 290

**Center Freq - Frequency Sweep**
Sets the center frequency.

SCPI command:
[:SOURce<hw>]:FREQuency:CENTer on page 285

**Span - Frequency Sweep**
Sets the span.

SCPI command:
[:SOURce<hw>]:FREQuency:SPAN on page 289

**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 287

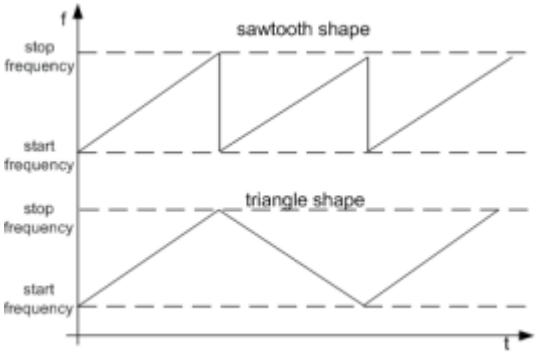
**Spacing - Frequency Sweep**
Selects linear or logarithmic sweep spacing.

"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 %.

SCPI command:
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 356

**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 356

**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 357

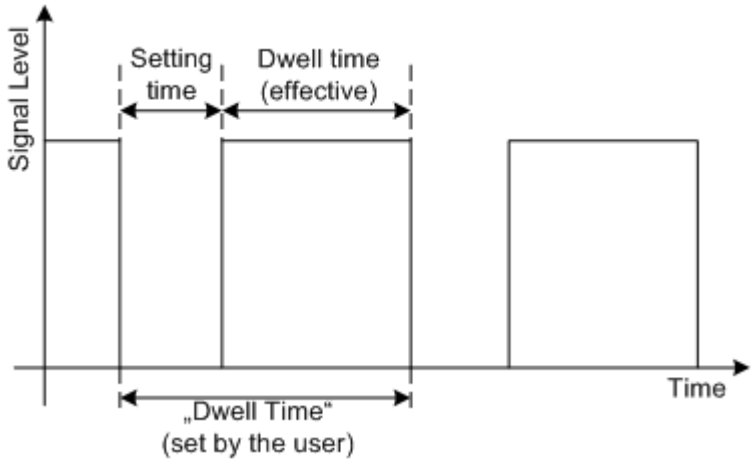
"Step Log" With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in %.

SCPI command:

`[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic` on page 358

**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 5.2.3.5, "Gui Update", on page 87).

SCPI command:

`[:SOURce<hw>]:SWEep[:FREQuency]:DWELl` on page 353

**Use LF connector to output sweep voltage - RF Frequency Sweep**
Activates the output of a linear voltage ramp from sweep start to sweep stop at the LF connector. This signal can be used for the X-deflection of an oscilloscope. The voltage range is determined below.

Remote-control command:SOUR:SWE:FREQ:LFC ON

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:LFConnector` on page 353

**Output Voltage Start Freq - RF Frequency Sweep**
Sets the voltage at the sweep start frequency.

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:OVOLtage:STARt` on page 354

**Output Voltage Stop - RF Frequency Sweep**
Sets the voltage at the sweep stop frequency..

SCPI command:
`[:SOURce<hw>]:SWEep[:FREQuency]:OVOLtage:STOP` on page 355

**Trigger Input Slope**
Sets the polarity of the active slope of an applied instrument trigger.

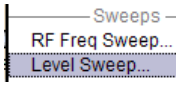
This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"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 292

### 5.3.9.3 RF Level Sweep

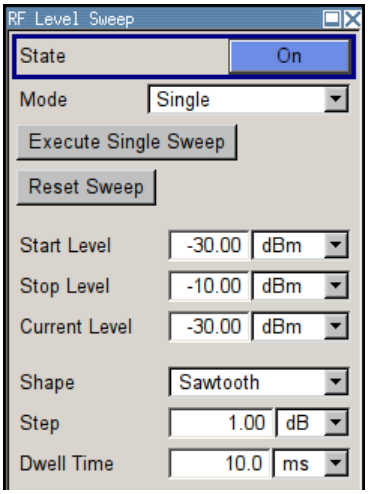



To open the "Level Sweep" menu, select "RF > Configure > Level Sweep" or use the MENU key under "RF".

**RF Level Sweep Settings**

In the top section, the Level Sweep 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 324

**Mode - Level Sweep**
Selects the level sweep instrument operating mode and the sweep mode.

"Auto" Sets an automatically 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 level.

**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 chapter 2.2, "Rear Panel Tour", on page 21).
The "Reset Sweep" button resets the sweep to the start level.

**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 level.

**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.
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").

**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 359
`:TRIGger<hw>:PSWeep:SOURce` on page 382.
`[:SOURce<hw>]:POWer:MODE` on page 324

**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 361

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

**Example:**

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

SCPI command:
[:SOURce<hw>]:SWEep:POWer:EXECute on page 359

**Start Level - Level Sweep**
Sets the start level.

SCPI command:
[:SOURce<hw>]:POWer:STARt on page 325

**Stop Level - Level Sweep**
Sets the stop level.

SCPI command:
[:SOURce<hw>]:POWer:STOP on page 326

**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 323

**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.

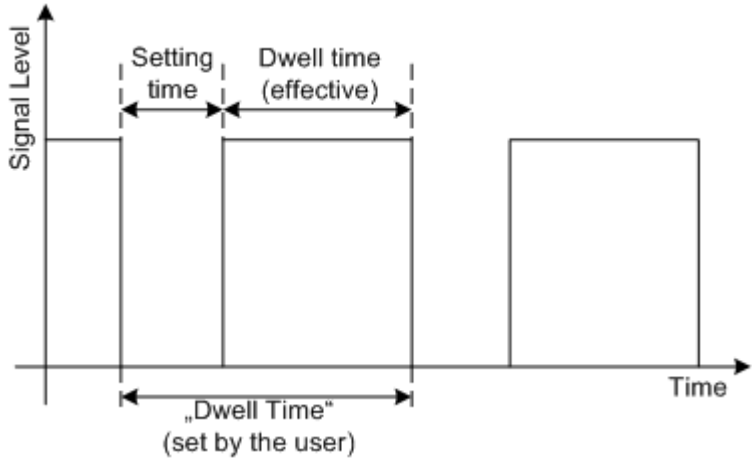
SCPI command:
[:SOURce<hw>]:SWEep:POWer:SHAPe on page 360

**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 360

**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 5.2.3.5, "Gui Update", on page 87).

SCPI command:
`[:SOURce<hw>]:SWEep:POWer:DWELl` on page 358

**Trigger Input Slope**
Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG 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 292

### 5.3.9.4 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.

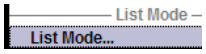
The lists can be created in the "List Editor". Each list is stored in its own file with the predefined file extension `*.lsw`. The name of the list file can be freely selected. The files are loaded from the "Lists..." file manager. Externally created tables with pairs of fre-

quency 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.

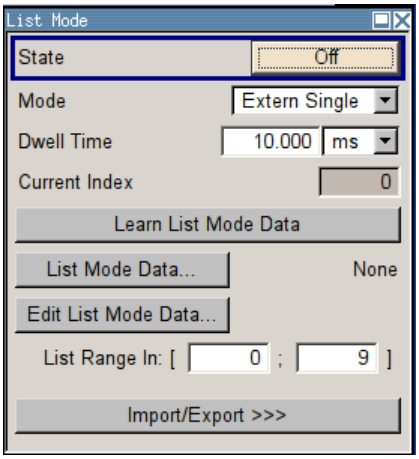
The list is processed from the beginning to the end of the list (modes "Auto", ("External") "Single", ("External") "Step").

### List Mode Dialog




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

The menu is used to activate/deactivate the 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 288

**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 BNC connector INST TRIG.
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 BNC connector INST TRIG.
Button "Reset" restarts the list at the starting point.

SCPI command:
[:SOURce<hw>]:LIST:MODE on page 310
[:SOURce<hw>]:LIST:TRIGger:SOURce on page 312

**Execute Single - List Mode**
Triggers the list manually. This button is available only if mode "Single" is selected.

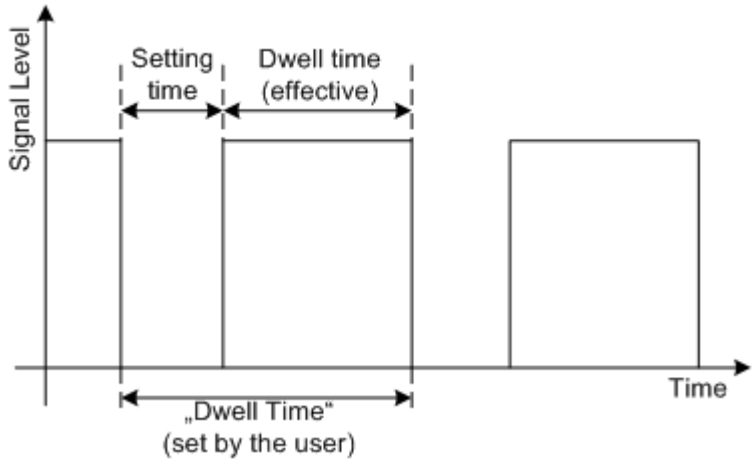
SCPI command:
[:SOURce<hw>]:LIST:TRIGger:EXECute on page 312

**Reset - List Mode**
Resets the list to the starting point.

SCPI command:
[:SOURce<hw>]:LIST:RESet on page 312

**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 307

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

SCPI command:
[:SOURce<hw>]:LIST:INDex on page 309

**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.

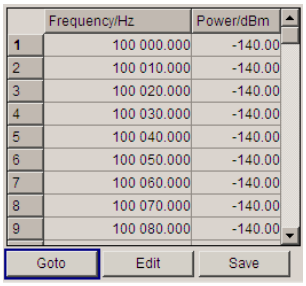
SCPI command:
[:SOURce<hw>]:LIST:LEARn on page 310

**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 312
`[:SOURce<hw>]:LIST:DELete` on page 302
`[:SOURce<hw>]:LIST:DELete:ALL` on page 303

**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 308

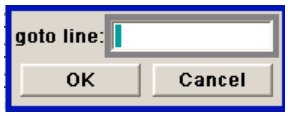
"Power /dBm" Enter the level of the frequency/power value pair.

SCPI command:
`[:SOURce<hw>]:LIST:POWer` on page 311

"Goto" Selects row for editing.




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

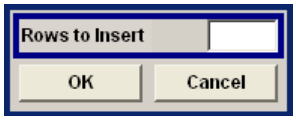



"Edit" Calls a selection of possible actions described below.




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

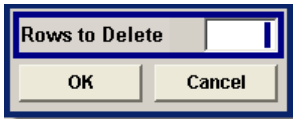
"Insert Range" Inserts new rows before the marked row. The number of rows to be inserted can be defined in an entry window.




"Fill...." Opens a sub menu for defining a set of list values to be automatically entered in the List Mode table (see "Filling the List Mode Data automatically" on page 159).

"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" 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 309
`[:SOURce<hw>]:LIST:INDex:STOP` on page 310

**Trigger Input Slope**
Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

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

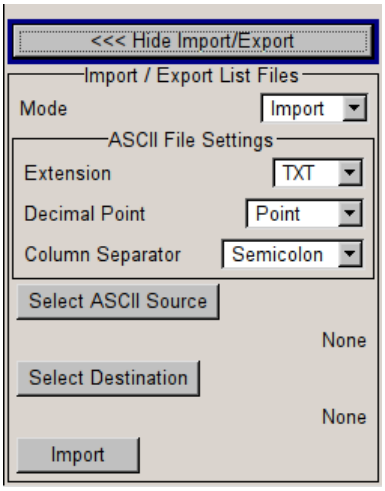
"Negative" The falling edge of the trigger signal is active.

SCPI command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 292

**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 306

**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 304

**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 305

**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 305

**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 304

**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 307

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

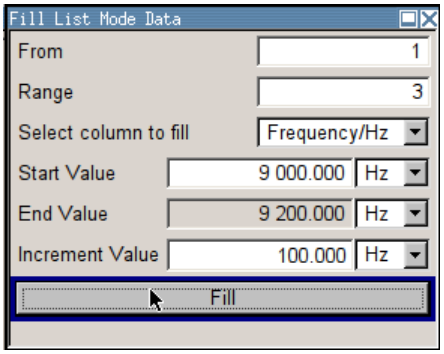
When import is selected, the ASCII file is imported as list mode list.

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

SCPI command:
`[:SOURce<hw>]:LIST:DEXChange:EXECute` on page 306

**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.

**Increment value**
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 Modulations

## 5.4.1 Overview

The R&S SMB provides amplitude modulation (AM), frequency modulation (FM), phase modulation (PM), pulse modulation and stereo modulation. In addition, the RF signal can be modulated with internal modulations waveforms, e.g. sine waves and rectangular signals.

Amplitude, frequency and phase modulation are available for the basic unit (R&S SMB + frequency option R&S SMB-B10x) without additional equipment options. A standard LF generator is provided for internal modulation. A Pulse Generator is provided by option R&S SMB-K23. Option R&S SMB-K22, Pulse Modulation, is designed for instruments equipped with frequency-options up to 6 GHz and R&S SMB-K21 for instruments with

high frequency options. Stereo modulation is available with option Stereo/RDS coder, R&S SMB-B5.

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.

#### 5.4.1.1 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 313

#### 5.4.1.2 Modulation Sources

The following modulations use internal and external modulation sources:

- Amplitude modulation
- Pulse modulation
- Frequency modulation
- Phase modulation

**Internal Modulation Sources**

An LF generator and a pulse generator are available as internal modulation sources for a fully equipped instrument. The LF generator supplies sinusoidal or rectangular signals.

The optional pulse generator (option R&S SMB-K27) provides single and double pulse modulation with selectable pulse widths and periods or a user-definable pulse train.

See also chapter 5.5.1, "LF Generator Overview", on page 178.

**External Modulation Sources**

The modulation inputs MOD EXT and PULSE EXT at the rear of the instrument are provided as the external modulation source for amplitude, pulse, frequency and phase modulation.

The external audio signal for stereo modulation is input via the analog L and R inputs or via the digital S/P DIF interface at the rear of the instrument.

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.

**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 | FM | PhiM | Pulse |
|---|---|---|---|---|
| Amplitude modulation (AM) | / | + | + | (+) |
| Frequency modulation (FM) | + | / | - | + |
| Phase modulation (PhiM) | + | - | / | + |
| Pulse modulation (Pulse) R&S SMB-K22 | (+) | + | + | / |

## 5.4.2 Amplitude Modulation (AM)

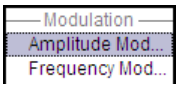
An internal and/or external source can be selected for amplitude modulation. The LF modulation generator is available as the internal source.

Two-tone AM is possible by simultaneously switching on the external and internal source.

The MOD EXT input connector for external feed of analog modulation signals is at the front of the instrument. The coupling mode of the input (AC or DC) can be selected.

The AM modulation depth is limited by the maximum peak envelope power (PEP).

### 5.4.2.1 Amplitude Modulation Menu

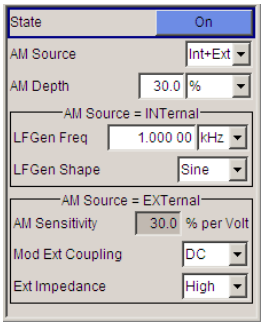



To open the "Amplitude Modulation" menu, select "Modulation > Configure > Amplitude Modulation" or use the MENU key under "Modulation".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The modulation source can be selected independently for the different modulation types and the LF output.

The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu or in the "LF Output" menu (internal source only).

These settings affect all modulations which use the same modulation source.



**State**
Activates/deactivates AM modulation.

SCPI command:
[:SOURce<hw>]:AM:STATe on page 274

**AM Source**
Selects the source for the AM signal.

| | |
|---|---|
| "Internal" | Selects the internal LF generator as the source for AM modulation. |
| "External" | Selects the external source.<br>The external signal is input via the MOD EXT connector. |
| "Intern + Extern" | Selects the internal and external source at the same time. This setting enables two-tone AM modulation. |

SCPI command:
[:SOURce<hw>]:AM:SOURce on page 273

**AM Depth**
Sets the modulation depth in percent.

**Note:** 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[:DEPTh] on page 272

**LF Gen Frequency**
Sets the frequency of the LF generator.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
[:SOURce]:LFOutput<ch>:FREQuency on page 293

**LF Gen Shape**
Selects the waveform shape of the LF signal.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe on page 300

**AM Sensitivity**
(Source External only)

Displays the input sensitivity of the MOD EXT input in %/V.

The modulation depth entered under "AM Depth" is reached with 1 volt modulation of the input.

SCPI command:
[:SOURce<hw>]:AM:SENSitivity on page 273

**AM External Coupling**
(Source External only)

Selects the coupling mode (AC or DC) for external feed.

**Note:** Coupling for external feed via input MOD EXT is set for all modulations with external source.

SCPI command:
`[:SOURce<hw>]:AM:EXTernal:COUPling` on page 272

**External Input Impendance**
(Source External only)

Selects the impedance for external feed via the EXT MOD input.

Selection 600 Ohm and high (>100 kOhm) is available.

**Note:** This setting affects all analog modulations which use the external modulation source.

SCPI command:
`[:SOURce<hw>]:INPut:MODext:IMPedance` on page 291

## 5.4.3 Frequency Modulation (FM)

An internal and/or external source can be selected for frequency modulation. The LF GEN modulation generator is available as the internal source. Two-tone FM is possible by simultaneously switching on the external and internal source.

The MOD EXT input connectors for external feed of analog modulation signals are at the front of the instrument. The coupling mode of the input (AC or DC) can be selected.

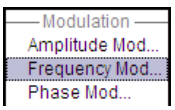
Selection between three modulation modes is possible:

- "Normal" mode with full setting range for modulation bandwidth and FM deviation.
- "Low Noise" mode with better signal/noise ratio, but reduced setting range for modulation bandwidth
- "High Deviation" mode with full setting range for FM deviation and a reduced setting range for modulation bandwidth (see data sheet).



It is not possible to use frequency modulation simultaneously with phase modulation.

### 5.4.3.1 Frequency Modulation Settings

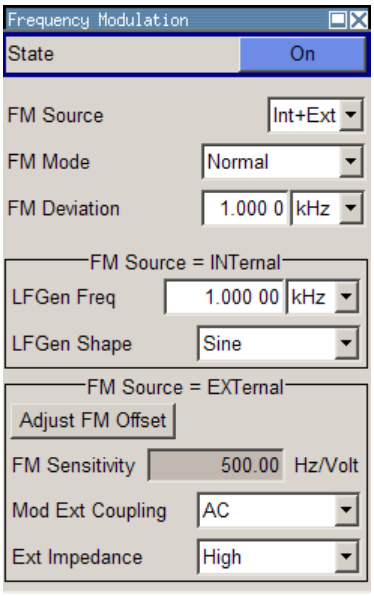



To open the "Frequency Modulation" menu, select "Modulation > Configure > Frequency Modulation" or use the MENU key under "Modulation".

In the upper section of the menu, the modulation source is selected and the modulation is switched on. The modulation source can be selected independently for the different modulation types and the LF output.

The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu (internal source only).

These settings affect all modulations which use the same modulation sources.




**State**
Activates/deactivates FM modulation.

Activation of FM deactivates phase modulation.

SCPI command:
`[:SOURce<hw>]:FM:STATe` on page 285

**FM Source**
Selects the source for the FM signal.

"Internal" Selects the internal LF generator as the source for FM modulation.

"External" Selects the external source.
The external signal is input via the MOD EXT connector.

"Internal + External" Selects the internal and external source at the same time.
This setting enables two-tone FM modulation.

SCPI command:
`[:SOURce<hw>]:FM:SOURce` on page 284

**FM Mode**
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).

"High Deviation" Frequency modulation with full setting range for FM deviation. The range for modulation bandwidth is reduced (see data sheet).

SCPI command:
[:SOURce<hw>]:FM:MODE on page 283

**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 in case of modulation source "Int+Ext".

SCPI command:
[:SOURce<hw>]:FM[:DEViation] on page 282

**LF Gen Frequency**
Sets the frequency of the LF generator.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
[:SOURce]:LFOutput<ch>:FREQuency on page 293

**LF Gen Shape**
Selects the waveform shape of the LF signal.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe on page 300

**FM Sensitivity**
(Source External only)

Displays the input sensitivity of the MOD EXT input in Hz/V.

The modulation depth entered under "FM Depth" is reached with 1 Volt (= $U_{peak}$) of the input signal.

**Note:** The input voltage should not exceed 1.1 $V_p$ otherwise modulation distortions might occur.

SCPI command:
[:SOURce<hw>]:FM:SENSitivity on page 284

**Adjust FM Offset**
Starts the adjustment for the FM/PhiM modulator. The option is adjusted with respect to DC-offset.

SCPI command:
:CALibration<hw>:FMOFfset[:MEASure] on page 240

**FM External Coupling**
(Source External only)

Selects the coupling mode (AC or DC) for external feed.

**Note:** Coupling for external feed via input MOD EXT is set for all modulations with external source.

"AC" The d.c. voltage content is separated from the modulation signal.

"DC" The modulation signal is not altered.

SCPI command:
`[:SOURce<hw>]:FM:EXTernal:COUPling` on page 283

**External Input Impendance**
(Source External only)

Selects the impedance for external feed via the EXT MOD input.

Selection 600 Ohm and high (>100 kOhm) is available.

**Note:** This setting affects all analog modulations which use the external modulation source.

SCPI command:
`[:SOURce<hw>]:INPut:MODext:IMPedance` on page 291

### 5.4.4 Phase Modulation (PhiM)



It is not possible to use phase modulation simultaneously with frequency modulation.

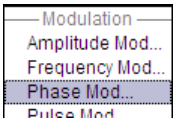
An internal and/or external source can be selected for phase modulation. The LF GEN modulation generator is available as the internal source.

The MOD EXT input connector for external feed of analog modulation signals is at the front of the instrument. The coupling mode of the input (AC or DC) and the impedance can be selected.

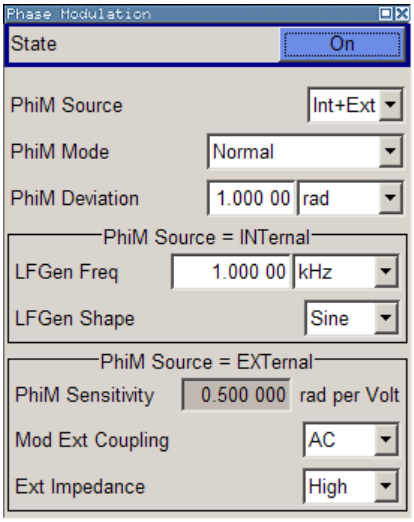
Selection between the following modulation modes is possible:

- "Normal" mode with full setting range for modulation bandwidth and PhiM deviation.
- "Low Phase" mode with better signal/noise ratio, but reduced setting range for modulation bandwidth and deviation (see data sheet)
- "High Deviation" mode with full setting range for PhiM deviation and a reduced setting range for modulation bandwidth. Phase noise is reduced in the lower modulation frequency range compared to the default mode.

### 5.4.4.1 Phase Modulation Menu




To open the "Phase Modulation" menu, select "Modulation > Configure > Phase 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 modulation source can be selected independently for the different modulation types and the LF output.

The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu (internal source only).

These settings affect all modulations which use the same modulation sources.

An LF generator and a pulse generator are available as internal sources.

**State**
Activates/deactivates PhiM modulation.

Activation of PhiM deactivates frequency modulation.

SCPI command:
`[:SOURce<hw>]:PM:STATe` on page 318

**PhiM Source**
Selects the source for the PhiM signal.

| | |
|---|---|
| "Internal" | Selects the internal LF generator as the source for PhiM modulation. |
| "External" | Selects the external source.<br>The external signal is input via the MOD EXT connector. |
| "Internal + External" | Selects the internal and external source at the same time.<br>The external signal is input via the MOD EXT connector. |

SCPI command:
`[:SOURce<hw>]:PM:SOURce` on page 317

**PhiM Mode**
Selects the mode for the phase modulation.

| | |
|---|---|
| "Normal" | The full range for modulation bandwidth and PM deviation is available. |
| "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).<br>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 316

**PhiM Deviation**
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<hw>]:PM[:DEViation]` on page 315

**LF Gen Frequency**
Sets the frequency of the LF generator.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 293

**LF Gen Shape**
Selects the waveform shape of the LF signal.

SCPI command:
`[:SOURce]:LFOutput<ch>:SHAPe` on page 300

**PhiM Sensitivity**
(Source External only)

Displays the input sensitivity of the MOD EXT input in RAD/V.

The modulation depth entered under "PhiM Depth" is reached with 1 volt (=$U_{peak}$) of the input signal.

**Note:** The input voltage should not exceed 1.1 $V_p$ otherwise modulation distortions might occur.

SCPI command:
`[:SOURce<hw>]:PM:SENSitivity` on page 317

**Mod External Coupling**
Selects the coupling mode (AC OR DC) for external feed.

**Note:** Coupling for external feed via input MOD EXT is set for all modulations with external source.

"AC" The DC voltage content is separated from the modulation signal.

"DC" The modulation signal is not altered.

SCPI command:
`[:SOURce<hw>]:PM:EXTernal:COUPling` on page 316

**External Input Impendance**
(Source External only)

Selects the impedance for external feed via the EXT MOD input.

Selection 600 Ohm and high (>100 kOhm) is available.

**Note:** This setting affects all analog modulations which use the external modulation source.

SCPI command:
`[:SOURce<hw>]:INPut:MODext:IMPedance` on page 291

## 5.4.5 Pulse Modulation (PM)

External and internal Pulse modulation requires options R&S SMB-K22, Pulse Modulator and R&S SMB-K23, Pulse Generator. Option R&S SMB-K27, Pulse Train, enables generation of pulse trains.

An internal or external source can be selected for pulse modulation. In case of external source, the external signal is input via the PULSE EXT connector at the rear of the instrument. In case of internal source, this connector can be used as external trigger or gate signal input for internal pulse modulation. The polarity and input impedance of the connector can be selected.

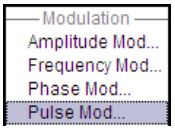
The pulse signal is output at the PULSE VIDEO connector at the rear of the instrument.

**Automatic Level Control is deactivated with pulse modulation!**

When pulse modulation is activated, the ALC state of the R&S SMB is automatically changed to "ALC OFF" ("Sample & Hold"). In this state, the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level, a sample & hold measurement is executed after each frequency or level setting.

The level is decreased by 30 dB during "Sample&Hold" measurement.

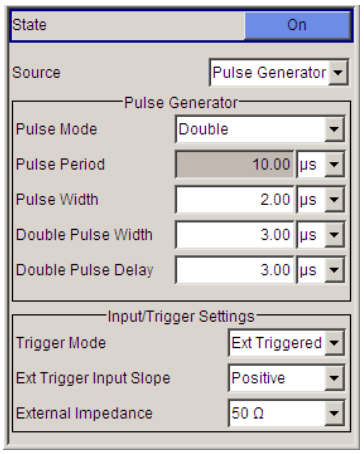
### 5.4.5.1 Pulse Modulation Settings

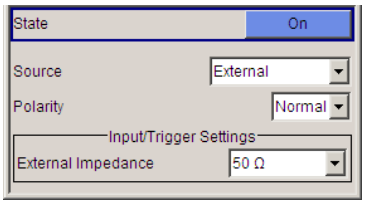



To open the "Pulse Modulation" menu, select "Modulation > Configure > Pulse Modulation" or use the MENU key under "Mod".

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 varies according to the selected 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 SMB-K23 offers extended features, e.g. generation of double pulse or selection of trigger mode. For description of the pulse generator dialog, see chapter 5.5.4, "Pulse Generator", on page 185.

Option R&S SMB-K27 enables the generation of pulse trains. For description of the pulse train dialog, see chapter 5.5.4.2, "Pulse Train Generation", on page 187.

**State**
Activates/deactivates pulse modulation.

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 5.5.4, "Pulse Generator", on page 185).

SCPI command:
`[:SOURce<hw>]:PULM:STATe` on page 331

**Source**
Selects the source for the pulse modulation signal.

| | |
|---|---|
| "Pulse Generator" | Selects the Pulse Generator as modulation source.<br>The internally generated reactangular signal is used for the pulse modulation. |
| "External" | Selects the external source.<br>The external modulation signal is input via the PULSE EXT connector. |

SCPI command:
`[:SOURce<hw>]:PULM:SOURce` on page 330

**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.

"Inverse" The RF level is **Off** if the level is high at the modulation input.

SCPI command:

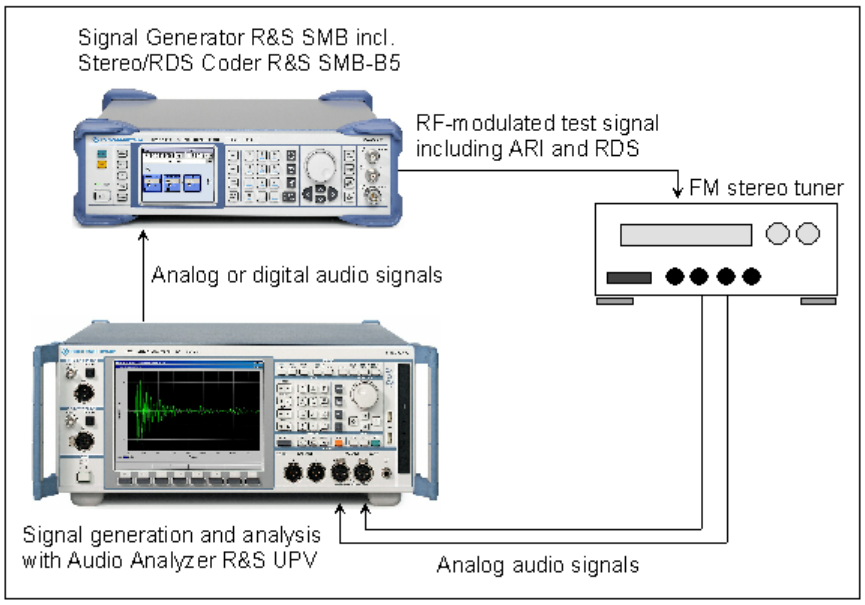
`[:SOURce<hw>]:PULM:POLarity` on page 330

## 5.4.6 Stereo Modulation

Options R&S SMB-B5, Stereo/RDS Coder enables generation of stereo-modulated RF signals according to standard. Beside the MPX (FM stereo multiplex) signal, also the radio traffic service ARI (Automotive Radio Information) and Radio Data System (RDS) are supported by the option.

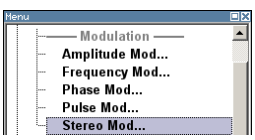
An internal or external source can be selected for the audio signal of the stereo modulation. In case of external source, the external signal is input via the analog L and R inputs or via the digital S/P DIF interface at the rear of the instrument. In case of internal source, the LF generator is used. Measurements can be performed in the operating modes L and R, and L = R, L = –R and R!=L (ext. signals only).

A typical setup with the R&S SMB with the option Stereo/RDS Coder in connection with the Audio Analyzer UPV is shown in the following graph.

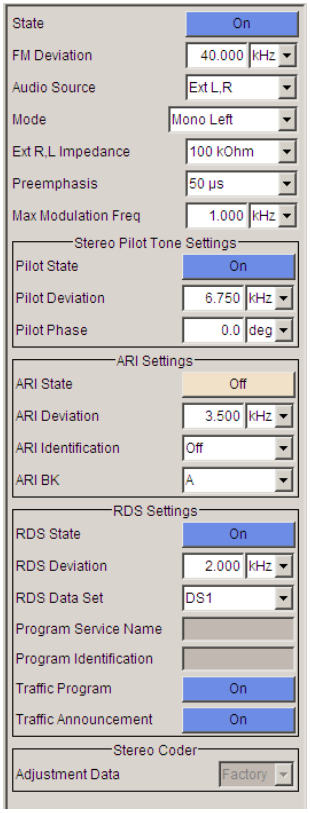



### 5.4.6.1 Stereo Modulation Dialog

To open the "Stereo Modulation" dialog, select "Modulation > Configure > Stereo Modulation" or use the MENU key under "Modulation".



In the upper section of the menu, the stereo modulation is configured and switched on. The configuration and activation of the additional pilot tone, ARI and RDS settings is performed in the lower section of the dialog.




### General Settings

#### State - Stereo Modulation

Activates/deactivates stereo modulation.

SCPI command:

`[:SOURce]:STEReo:STATe` on page 351

#### FM Deviation - Stereo Modulation

Sets the MPX (Multiplex stereo signal) deviation.

SCPI command:

`[:SOURce]:STEReo[:DEViation]` on page 351

#### Audio Source - Stereo Modulation

Selects the source for the audio signal.

| | |
|---|---|
| "Off" | No audio signal is provided, ARI and RDS signal can be generated separately. |
| "Ext L,R" | The external audio stereo signal is feed in via the analog L and R inputs. |
| "Ext S/P Diff" | The external audio signal is feed in via the digital S/P DIF input. |

"LF Gen" The audio stereo signal is internally generated by the LF generator.

SCPI command:
[:SOURce]:STEReo:SOURce on page 350

**Mode - Stereo Modulation**
Selects the mode for the audio signal. If the internal LF generator is selected as audio source, the signal is generated according to the selection here. For external signals, the signal type has to be entered.

"Mono Left" A mono signal containing the left channel is generated/fed in.

"Mono Right" A mono signal containing the right channel is generated/fed in.

"Stereo R=L" A stereo signal with right and left channel is generated/fed in. The channels have the same frequency and phase.

"Stereo R=-L" The signal on the left external audio input is used for both channels, left and right. The right channel is inverted.

"Stereo R!=L" (External source only)
A stereo signal containing different, independent right and left channels is fed in. It is possible, for example, to feed a fixed audio frequency to the first channel while a frequency sweep is being performed in the second channel.

SCPI command:
[:SOURce]:STEReo:AUDio:MODE on page 346

**LF Gen Freq - Stereo Modulation**
(Audio source "LF Gen" only)

Sets the frequency of the LF generator signal.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
(two alias commands are available)
[:SOURce]:STEReo:AUDio[:FREQuency] on page 347
[:SOURce]:LFOutput<ch>:FREQuency on page 293

**LF Gen Shape - Stereo Modulation**
(Audio source "LF Gen" only)

Selects the shape of the LF generator signal.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe on page 300

**External R/L Impedance - Stereo Modulation**
(External analog audio signal input only)

Selects the input impedance for the external analog audio signal inputs L and R.

SCPI command:
[:SOURce]:STEReo:EXTernal:IMPedance on page 348

**Preemphasis - Stereo Modulation**
Activates and sets the pre-emphasis used for signal generation.

SCPI command:
`[:SOURce]:STEReo:AUDio:PREemphasis:STATe` on page 347
`[:SOURce]:STEReo:AUDio:PREemphasis` on page 346

**Max Modulation Freq- Stereo Modulation**
Sets the maximum modulation frequency that may be used.

This parameter is valid/required only when pre-emphasis has been activated and an external modulation source is used.

Pre-emphasis increases the high-frequency portions of the signal in the level before the FM modulator is reached. This can lead to internal overload of the modulator in the case of sinewave signals with full modulation. The MMF parameter is used to reduce the internal full modulation to such an extent that sinewave signals with nominal voltage can be transmitted with low distortion at the stereo input even when pre-emphasis up to the set frequency has been activated. However, this reduces the S/N ratio on the basis of the increase in level by the pre-emphasis (at the MMF that has been set).

In the case of normal modulation signals such as voice or music, this parameter can be left at its default value because the amplitude of the high-frequency portions of these signals normally decreases substantially.

SCPI command:
`[:SOURce]:STEReo:MMF` on page 348

**Stereo Pilot Tone Settings**

The 19 kHz pilot tone is configured in the "Stereo Pilot Tone Settings" section.

**Pilot State - Stereo Modulation**
Activates/deactivates the pilot tone generation.

SCPI command:
`[:SOURce]:STEReo:PILot:STATe` on page 348

**Pilot Deviation - Stereo Modulation**
Sets the deviation of the pilot tone.

SCPI command:
`[:SOURce]:STEReo:PILot[:DEViation]` on page 349

**Pilot Phase - Stereo Modulation**
Sets the phase of the pilot tone in relation to the 38 kHz carrier signal of the receiver. For a correct demodulation, the pilot tone must be in phase with the 38 kHz carrier.

SCPI command:
`[:SOURce]:STEReo:PILot:PHASe` on page 348

**ARI Settings**

The radio traffic service ARI (Automotive Radio Information) is configured in the "ARI Settings" section.

**ARI State - Stereo Modulation**
Activates/deactivates the ARI signal generation. ARI signals can be generated simultaneously with MPX and RDS signals.

SCPI command:
[:SOURce]:STEReo:ARI:STATe on page 344

**ARI Deviation - Stereo Modulation**
Sets the frequency deviation of the ARI subcarrier signal.

SCPI command:
[:SOURce]:STEReo:ARI[:DEViation] on page 345

**ARI Identification - Stereo Modulation**
Selects the generated identifiers of the ARI signal.

"Off" Only the 57 kHz subcarrier is generated (Senderkennung). It marks the stations which broadcast traffic programs and enables the receiver to recognize the frequency as being ARI-capable.

"DK" The message identification (Durchsagekennung) is generated in addition (low-frequency 30% AM). It signalizes that a traffic message is currently broadcasted.

"BK" The area identification (Bereichskennung) is generated in addition (60% AM). This code is used to identify the geographical region covered by the radio station. The specific code is selected below.

"DK+BK" The area and message identification are generated in addition.

SCPI command:
[:SOURce]:STEReo:ARI:TYPE on page 344

**ARI BK - Stereo Modulation**
Selects the specific area identification (BK) code of the ARI signal. The six letters (six different frequencies) identify a specific region in each country.

SCPI command:
[:SOURce]:STEReo:ARI:BK[:CODE] on page 344

**RDS Settings**

The RDS (Radio Data System) is configured in the RDS Settings section, RDS is a communications protocol standard from the European Broadcasting Union for sending digital information embedded in conventional FM radio broadcasts. The RDS system standardises several types of transmitted information, including time, track/artist info and station identification.

**RDS State - Stereo Modulation**
Activates/deactivates the RDS signal generation. RDS signals can be generated simultaneously with MPX and ARI signals.

SCPI command:
[:SOURce]:STEReo:RDS:STATe on page 349

**RDS Deviation - Stereo Modulation**
Sets the deviation of the RDS subcarrier.

SCPI command:
`[:SOURce]:STEReo:RDS[:DEViation]` on page 350

**RDS Data Set - Stereo Modulation**
Selects the data set used in the RDS signal. Five data sets are provided on the instrument. The values of the data sets can be defined via remote control (command `SOURce:STEReo:DIRect`)

Each of these data sets contains predefined values for:
- PI (program identification, identifies the broadcast station )
- PS or scrolling PS (program service name, represents the station identity name)
- TP (traffic program, mark stations with regular traffic programs )
- TA (traffic announcement, marks the start of a traffic program)
- PTY (program type, predefined genres of broadcasting programs, e.g. news)
- PTYN (program type name)
- DI (decoder information)
- MS (music /speech)
- CT (clock time, used for synchronization)

The following values are empty:
- RT (radio text, two text blocks with 64 symbols each)
- AF (alternative frequencies, maximum of five lists with 25 frequencies each, enables the receiver to re-tune to a different frequency providing the same station when the first signal becomes too weak)
- TMC (traffic message channel)
- EON (enhanced other networks, eight PS with five EON AF lists each, enables the receiver to automatically tune into these stations if a traffic programs are broadcasted)

The program identification and the program service name of the selected data set are indicated in the menu.

SCPI command:
`[:SOURce]:STEReo:RDS:DATaset` on page 349

**RDS Program Service Name - Stereo Modulation**
Indicates the RDS program service name.

SCPI command:
`[:SOURce]:STEReo:DIRect` on page 347

**RDS Program Identification - Stereo Modulation**
Indicates the RDS program identification.

SCPI command:
`[:SOURce]:STEReo:DIRect` on page 347

**RDS Traffic Program State - Stereo Modulation**
Activates the RDS traffic program (TP function). The receiver can recognize a frequency as being capable of traffic information only if the TP function is active.

SCPI command:
`[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe]` on page 350

**RDS Traffic Announcement State - Stereo Modulation**
Activates the RDS traffic announcement (TA function). If activated, the receiver switches from the current status, e.g. playing a CD, to the receive mode and enables the broadcast of a traffic announcement. The TP state has to be on.

SCPI command:
`[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe]` on page 350

**Adjustment Data**
Indicates the adjustment state of the analog channels of the stereo coder. For the adjustment of the S/P DIF see service manual, chapter 2, "Adjustment".

See also "Adjust Stereo Coder" on page 84.

# 5.5 LF Generator and LF Output - Mod Gen

## 5.5.1 LF Generator Overview

An LF generator providing sinusoidal and square signals in the frequency range 0.1 Hz to 1 MHz is available for the basic unit without additional equipment options.

The LF-Generator is the internal source for the analog modulations AM, FM and PhiM, and provides the signal also at the LF output (front) of the instrument.

The frequency setting for the LF generator can be made both in the modulation menus and in the "LF Output" menu. The settings are effective for all modulations using the internal modulation source.

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 (i.e. "Internal" is selected as "Source").

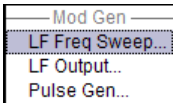
The LF Sweep mode is activated in the "LF Sweep" dialog (see chapter 5.5.2, "LF Frequency Sweep", on page 179). "RF frequency" and "RF Level" sweeps are activated in the respective menus of the RF block.

The option Pulse Generator (R&S SMB-K23) enables the generation of single and double pulse signals.

Option (R&S SMB-K27), Pulse Train, enables generation of pulse trains.

The generator is activated and configured in the "Pulse Generator" menu of the "Mod Gen" block or in the "Pulse Modulation" menu of the "Modulation" block ("Pulse Generator" is selected as "Source").

## 5.5.2 LF Frequency Sweep

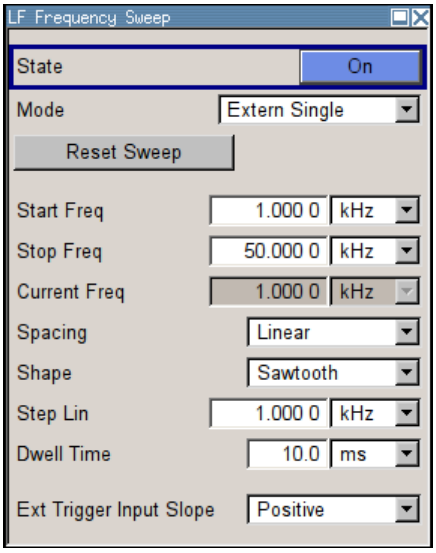



The "LF Frequency Sweep" dialog is used to activate and configure a sweep for the LF frequency.

To open the "LF Frequency Sweep" menu, select "Mod Gen > Configure > LF Frequency Sweep" or use the MENU key under "Mod Gen".

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.




**State - LF Sweep**
Activates LF Sweep mode.

**Note:** Activating the LF frequency sweep automatically deactivates the list mode, RF level sweep and RF frequency sweep.

SCPI command:
`[:SOURce]:LFOutput:FREQuency:MODE` on page 294

**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 BNC connector INST TRIG.
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 BNC connector INST TRIG.

**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 296
`:TRIGger<hw>[:SWEep]:SOURce` on page 383
`[:SOURce]:LFOutput:FREQuency:MODE` on page 294

**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 296

**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 361

**Start Freq - LF Sweep**
Sets the start frequency.

SCPI command:
[:SOURce]:LFOutput:FREQuency:STARt on page 294

**Stop Freq - LF Sweep**
Sets the stop frequency.

SCPI command:
[:SOURce]:LFOutput:FREQuency:STOP on page 295

**Current Freq - LF Sweep**
Displays the current frequency.

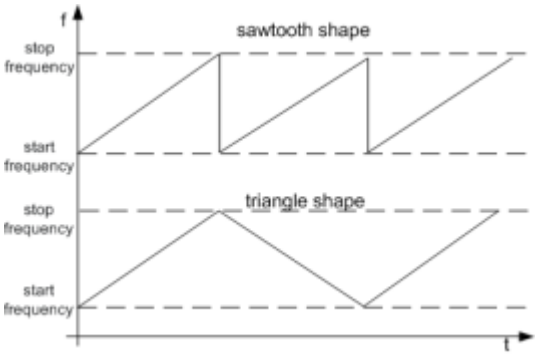
If "Step" is set, the frequency for the next frequency step of the sweep is entered here.

SCPI command:
[:SOURce]:LFOutput:FREQuency:MANual on page 293

**Spacing - LF Sweep**
Selects linear or logarithmic sweep spacing.

SCPI command:
[:SOURce]:LFOutput:SWEep[:FREQuency]:SPACing on page 298

**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 298

**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 298

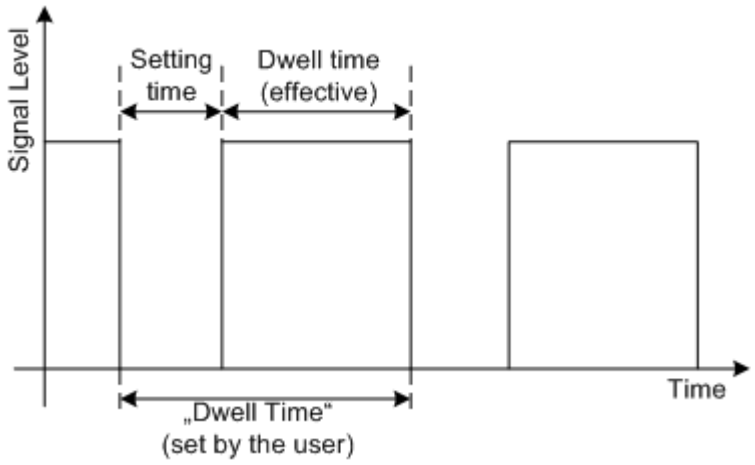
"Step Log" With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in %.

SCPI command:

`[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic` on page 299

**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 5.2.3.5, "Gui Update", on page 87).

SCPI command:

`[:SOURce]:LFOutput:SWEep[:FREQuency]:DWELl` on page 295

**Trigger Input Slope**

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

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

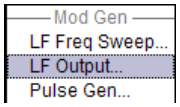
"Positive" The rising edge of the trigger signal is active.

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

SCPI command:

`[:SOURce]:INPut:TRIGger:SLOPe` on page 292

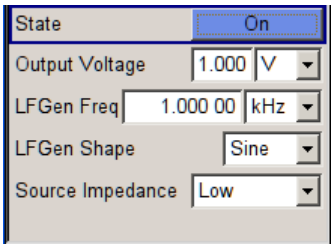
## 5.5.3 LF Output




To open the "LF Output" dialog, select "Mod Gen > Configure > LF Output" or use the MENU key under "Mod Gen".

The "LF Output" menu provides access to the configuration of the internal modulation generators. In addition, the LF output is configured in this menu. The available settings depend on the source selected and on the installed options.

In the upper section of the menu, the LF output is switched on. The configuration of the internal source is performed in the lower section of the "LF Output" menu or in the individual modulation menus (e.g. "Amplitude Modulation" menu). These settings affect all modulations which use the same modulation sources and the LF output.




### 5.5.3.1 LF Output Menu

**State - LF Output**
Activates/deactivates the LF output. This setting has no effect on the modulations.

The modulation signal is output at the LF OUTPUT connector of the instrument.

SCPI command:
`[:SOURce]:LFOutput[:STATe]` on page 295

**Output Voltage - LF Output**
Sets the output voltage of the LF output. The entered value determines the peak voltage.

SCPI command:
`[:SOURce]:LFOutput:VOLTage` on page 300

**LF Gen Frequency**
Sets the frequency of the LF generator.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

SCPI command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 293

**LF Gen Shape**
Selects the waveform shape of the LF signal.

SCPI command:
`[:SOURce]:LFOutput<ch>:SHAPe` on page 300

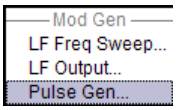
**LF Source Impedance**
Selects the output impedance of the LF generator. Selection LOW and 600 Ohm are available.

**Note:** This parameter requires the RF board version **1406.7207.02** or later. Up to this RF board version the LF output impedance is forced to LOW and cannot be selected.

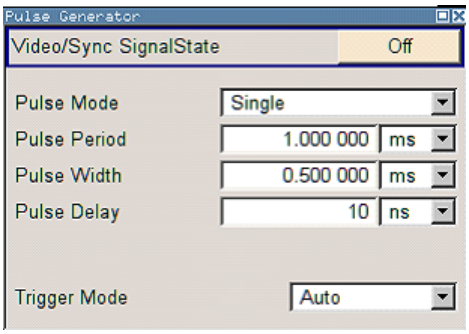
SCPI command:
`[:SOURce]:LFOutput:SIMPedance` on page 300

## 5.5.4 Pulse Generator

The "Pulse Generator" dialog is used to activate and configure a pulse modulation signal.




The "Pulse Generator" menu is opened in the "Mod Gen" function block or using the MENU key under "Mod gen". The same settings can be made in the "Pulse Modulation" menu of the "Modulation" block.




### 5.5.4.1 Pulse Generator Settings

The dialog provides the settings for the pulse characteristics and trigger mode.

**Video Sync Signal State - Pulse Generator**
Switches on/off the output of the video/sync signal at the PULSE VIDEO connector. The signal output and the pulse generator are automatically switched on with activation of pulse modulation if pulse generator is selected as modulation source. The signal output can be switched off subsequently.

Pulse modulation of the RF carrier is activated in the "Pulse modulation" menu of the "Modulation" block.

SCPI command:
`[:SOURce<hw>]:PGEN:STATe` on page 314

**Pulse Mode - Pulse Generator**
Sets the mode of the pulse generator.

"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 SMB-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 5.5.4.2, "Pulse Train Generation", on page 187).
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 329

**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 329

**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 340

**Pulse Delay - Pulse Generator**
(External trigger only)

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 328

**Double Pulse Width - Pulse Generator**
(Double Pulse only)

Sets the width of the second pulse.

SCPI command:
`[:SOURce<hw>]:PULM:DOUBle:WIDTh` on page 329

**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 328

**Trigger Mode - Pulse Generator**
Selects the trigger mode for pulse modulation.

"Auto" The pulse generator signal is generated continuously.

"Ext Triggered" The pulse generator signal is triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

"Ext Gated" The pulse generator signal is gated by an external gate signal. The signal is supplied via the PULSE EXT connector.

SCPI command:

`[:SOURce<hw>]:PULM:TRIGger:MODE` on page 336

**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 336

**Gate Input Polarity - Pulse Generator**
(Trigger Mode External Gated only)

Selects the polarity of the Gate signal.

The signal is supplied via the PULSE EXT connector.

"Normal" The pulse signal is generated while the gate signal is high.

"Inverse" The pulse signal is generated while the gate signal is low.

SCPI command:

`[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity` on page 335

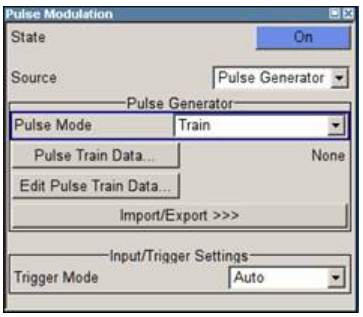
**Pulse External Input Impedance**
Selects the input impedance for the external trigger and gate signal input (PULSE EXT).

SCPI command:

`[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance` on page 336

### 5.5.4.2 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.

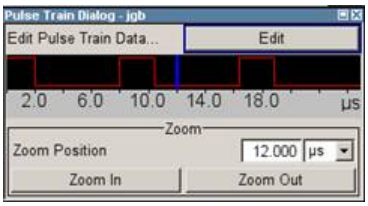
**Pulse Train Data – Pulse Generator**
Calls the "File Select" menu for selecting and creating a pulse train file or to open the "File Manager".

SCPI command:

`[:SOURce<hw>]:PULM:TRAin:CATalog` on page 331
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 335
`[:SOURce<hw>]:PULM:TRAin:DELete` on page 331

**Edit Pulse Train Data – Pulse Generator**
Calls the Pulse Train Dialog.

**Pulse Train Dialog**



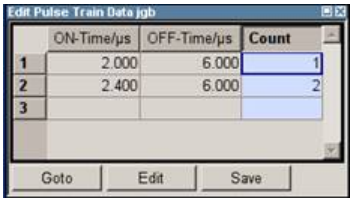

The pulse train defined by the selected file is displayed.

The display of the pulse train can be zoomed, the zoom center is defined by the blue marker.

| | |
|---|---|
| "Edit" | Calls the Edit Pulse Train Data dialog for editing the pulse train. |
| "Zoom Position" | Positions the blue marker in the pulse train. The marker defines the center of any zoom in or zoom out action. |
| "Zoom In/Out" | Zooms in or out the graphical display of the pulse train. The zoom factor of each zoom action is 2. |

**Edit Pulse Train Data**
(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.



"Ontime/us" Sets the ontime of the ontime/offtime value pair.

SCPI command:
[:SOURce<hw>]:PULM:TRAin:ONTime on page 333

"Offtime/us" Sets the offtime of the ontime/offtime value pair.

SCPI command:
[:SOURce<hw>]:PULM:TRAin:OFFTime on page 332

"Count" Sets the number of repetitions for each ontime/offtime value pair.

SCPI command:
[:SOURce<hw>]:PULM:TRAin:REPetition on page 334

"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 CpompactFlash™ 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 339

**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 337

**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 338

**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 338

**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 337
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect` on page 337

**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 340

**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 339

# 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:<br>• VXI-11<br>• socket communication (Raw Ethernet, simple telnet)<br>VISA*) address string:<br>TCPIP::host address[::LAN device name][::INSTR] | A LAN connector is located on the front or rear panel of the instrument, or both.<br>The interface is based on TCP/IP and supports various protocols.<br>For a description of the protocols refer to:<br>• chapter 6.1.3.1, "VXI-11 Protocol", on page 196<br>• chapter 6.1.3.2, "Socket Communication", on page 196 |
| USB | VISA*) address string:<br>USB::<vendor ID>::<product ID>::<serial number>[::INSTR] | USB connectors are located on the front or the rear panel of the instrument, or both.<br>For a description of the interface refer to chapter 6.1.4, "USB Interface", on page 197 |
| Serial Interface | VISA*) address string:<br>ASRL[0-9][::INSTR] | For a description of the interface refer to chapter 6.1.5, "Serial Interface", on page 197. |
| GPIB (IEC/IEEE Bus Interface) | VISA*) address string:<br>GPIB::primary address[::INSTR]<br>(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.<br>For a description of the interface refer to chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 198. |
| *) 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 194. | | |

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 196
- chapter 6.1.4, "USB Interface", on page 197
- chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 198
- chapter 6.1.5, "Serial Interface", on page 197

For more information about VISA refer to the user documentation.

### 6.1.2 Messages

The messages transferred on the data lines 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 212. 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 194 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 necessary require a VISA installation on the remote controller side.

The simplest way to establish socket communication is to use the built-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 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 LAN 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::0x0054::100001::INSTR
```

0x0AAD is the vendor ID for Rohde&Schwarz

0x54 is the product ID for the R&S SMA

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 con-

nected 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 SMB 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 chapter 5.2.3.14, "Security", on page 97).

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 5.2.3.12, "Remote Channel Settings", on page 93).

## 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 199).

**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.



Any connected IEC bus cable must be terminated by an instrument or controller.

### 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). |
| 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. |

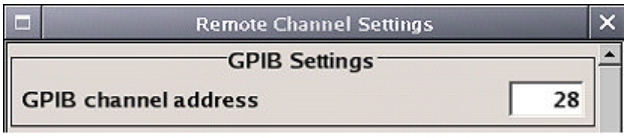
### 6.1.6.2 GPIB Instrument Address

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 195, chapter 6.1.4, "USB Interface", on page 197, chapter 6.1.5, "Serial Interface", on page 197or chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 198 for details.

The VISA resource strings are indicated in the "Setup > Remote Channel Settings" menu.

Refer to chapter 6.2.3, "Examples", on page 201 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 201).

**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, "LAN Interface Messages", on page 196).

   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 GPIB

The program example in this section is written in VISUAL BASIC. A condition for programming in VISUAL BASIC is that the modules NIGLOBAL (`Niglobal.bas`) and VBIB32 (`Vbib_32.bas`) are added to the projects.



Drivers for instrument, e.g. IVI-COM and LabVIEW drivers, are available in the download area of the product website (http://www2.rohde-schwarz.com/en/products/test_and_measurement/product_categories/signal_generation/).

**Starting a remote control session over GPIB**

As a prerequisite, the GPIB address of the instrument, which is factory-set to 28, must not have been changed.

1. Connect instrument and controller using GPIB cable and switch them on.
2. Execute following commands on the controller:
   a) Open port to the instrument
   ```
   CALL IBFIND("DEV1", generator%)
   ```
   b) Inform controller about instrument address
   ```
   CALL IBPAD(generator%, 28)
   ```
   c) Reset instrument
   ```
   CALL IBWRT(generator%, "*RST;*CLS")
   ```
   d) Set instrument to new address
   ```
   CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 18")
   ```
   e) Inform controller about new address
   ```
   CALL IBPAD(generator%, 18)
   ```
   The GPIB address of the instrument is changed.
3. To return to manual operation, press the LOCAL key at the front panel.

#### 6.2.3.2 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**



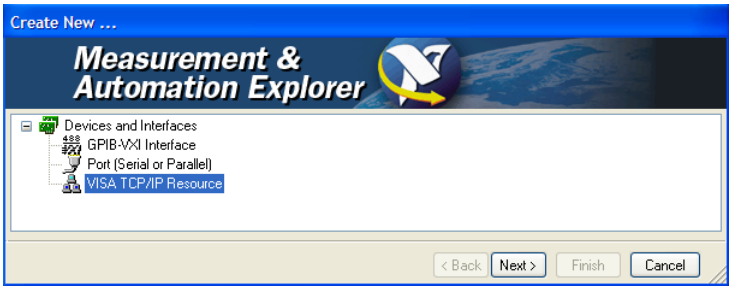
The instrument is preconfigured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, enter the computer name in the position of the IP address.

To enable the external controller to communicate with the software via TCP/IP protocol, set up a remote control link as follow:

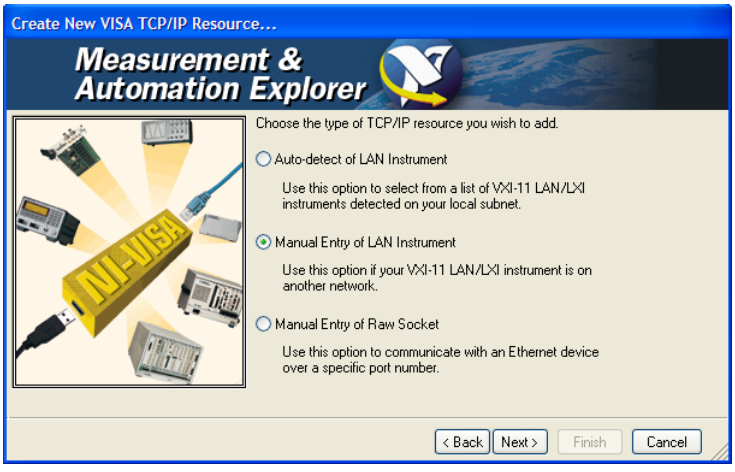
1. Connect the controller and the instrument to the network (network cable) and switch them on.
2. Start the 'Measurement & Automation Control' program on the controller.
3. Select "Devices and Interfaces > Create New".



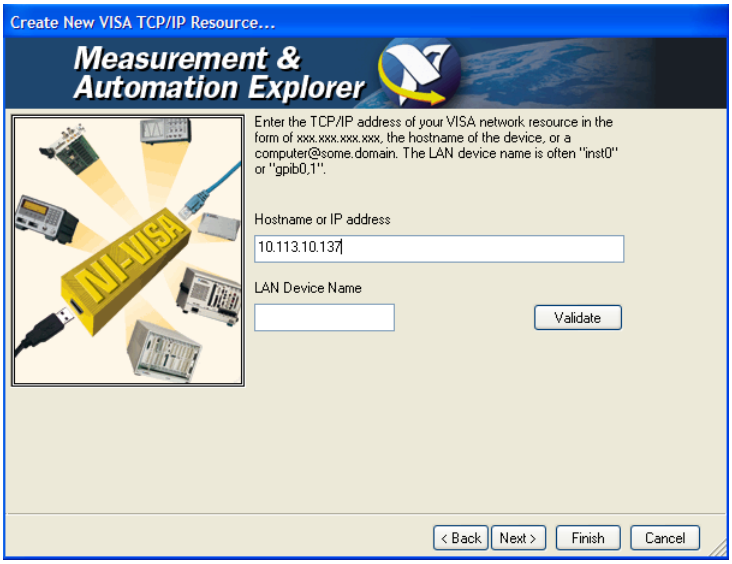

4. Select "VISA TCP/IP Resource" and confirm with "Next".




5. Choose the type of TCP/IP resource you wish to add and select Next.

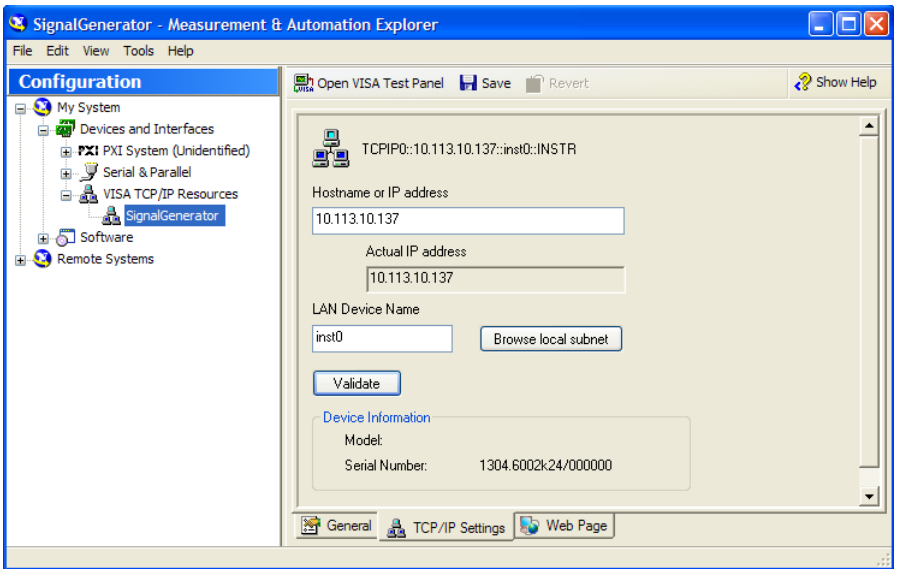



6. Enter the IP address or the host name of the R&S SMB and select "Next".

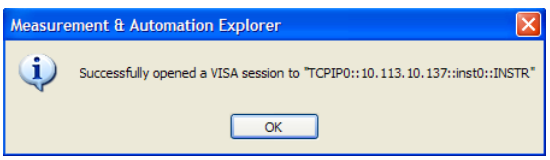



7. Enter the alias name if required.
   The alias name must not be mistaken for the computer name. It is only used for instrument identification within the program and displayed in the menu as an option in case of an Ethernet link.

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.

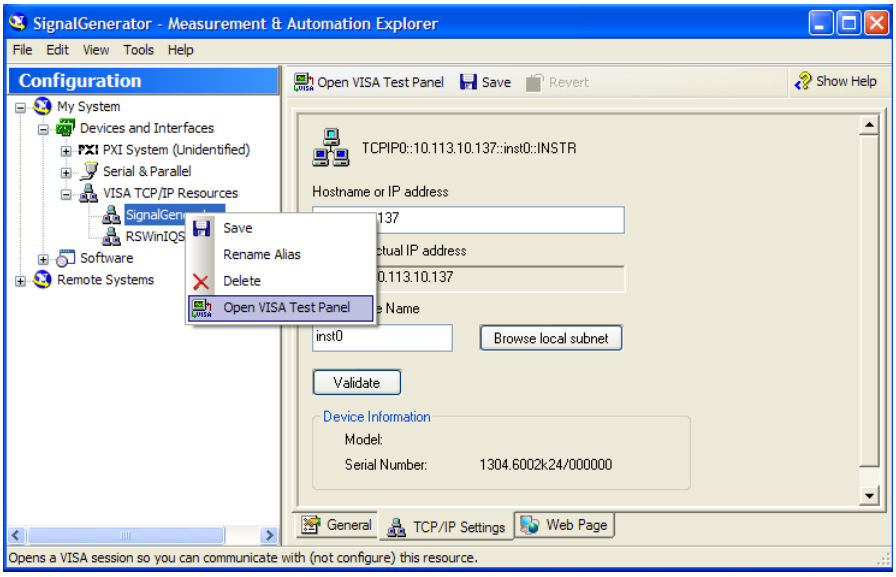


If a connection cannot be set up, check whether the controller and the instrument are connected to the network (network cable) and switched on. Correct spelling of the IP address or the computer name can also be checked. For further error location, inform the network administrator. In large networks, specification of additional addresses may be required for link setup, e.g. gateway and subnet mask, which are known to the network administrator.

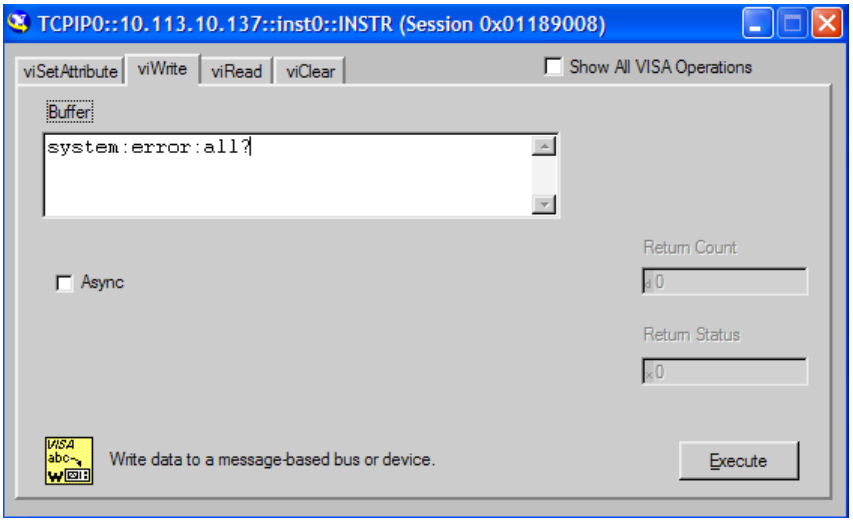
The instrument is now registered in the program and can be addressed via the resource string or alias name.

**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.

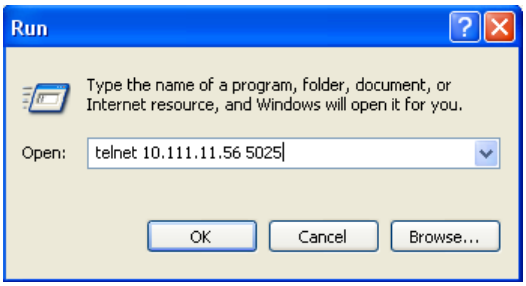
### 6.2.3.3 Remote Control over LAN using Socket Communication

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.

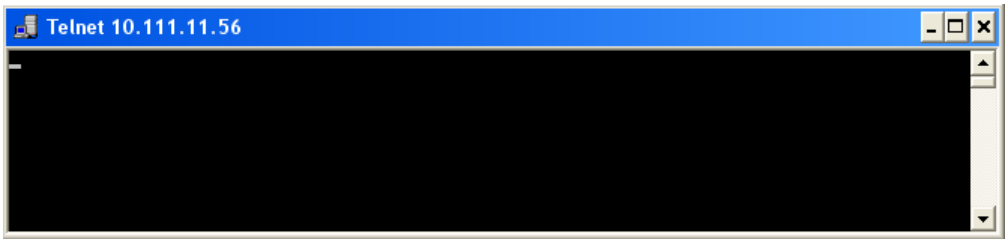
#### Setting up a Telnet Connection

To control the software, only a telnet program is required. The telnet program is part of every operating system.

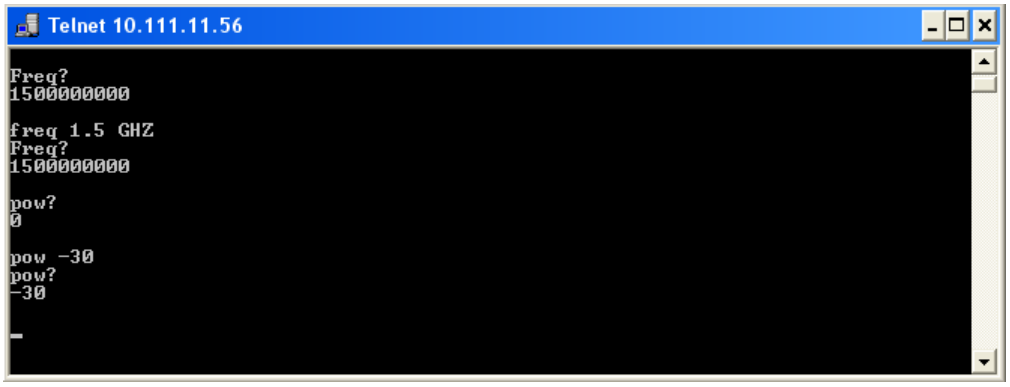
1. To establish a Telnet connection with the R&S SMB, start the telnet program and enter the socket address.
   The socket address is a combination of the IP address or the host name of the R&S SMB and the number of the port configured for remote-control via telnet.
   **Tip:** The R&S SMB uses the port 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 keyboard 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 SMB 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>]`
- `HCOPy:DEVice:COLor <Boolean>`
- `HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`
- `HCOPy[:IMMediate]`
- `HCOPy:ITEM:ALL`
- `HCOPy:ITEM:LABel <string>`
- `HCOPy:PAGE:DIMensions:QUADrant[<N>]`
- `HCOPy:PAGE:ORIentation LANDscape | PORTrait`
- `HCOPy: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:**

`HCOPy: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: `HCOPy: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. 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: `HCOPy[: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 215.

**Example:**

Definition:`HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`

Command:`HCOP:DEV:CMAP:COL:RGB 3,32,44`

### Special characters

| | |
|---|---|
| **\|** | **Parameters**<br>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.<br>**Example**:<br>Definition:`HCOPy:PAGE:ORIentation LANDscape \| PORTrait`<br>Command `HCOP:PAGE:ORI LAND` specifies landscape orientation<br>Command `HCOP:PAGE:ORI PORT` specifies portrait orientation<br>**Mnemonics**<br>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.<br>**Example**:<br>Definition`SENSE:BANDwidth\|BWIDth[:RESolution] <numeric_value>`<br>The two following commands with identical meaning can be created:<br>`SENS:BAND:RES 1`<br>`SENS:BWID:RES 1` |
| **[ ]** | Mnemonics in square brackets are optional and may be inserted into the header or omitted.<br>**Example**: `HCOPy[:IMMediate]`<br>`HCOP:IMM` is equivalent to `HCOP` |
| **{ }** | Parameters in curly brackets are optional and can be inserted once or several times, or omitted.<br>**Example**: `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`<br>The following are valid commands:<br>`SENS:LIST:FREQ 10`<br>`SENS:LIST:FREQ 10,20`<br>`SENS:LIST:FREQ 10,20,30,40` |

## 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:** `SENS:FREQ:STOP 1.5GHz` = `SENS: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: `HCOPy: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. |
| **' '**<br>**"** | Quotation marks introduce a string and terminate it (both single and double quotation marks are possible). |

| | |
|---|---|
| # | The hash symbol introduces binary, octal, hexadecimal and block data.<br>• Binary: #B10110<br>• Octal: #O7612<br>• Hexa: #HF3A7<br>• 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 contains two commands. 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
```

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: `HCOPy: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.

### 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<br>• Setting bit 5 in the SRE<br>• 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.

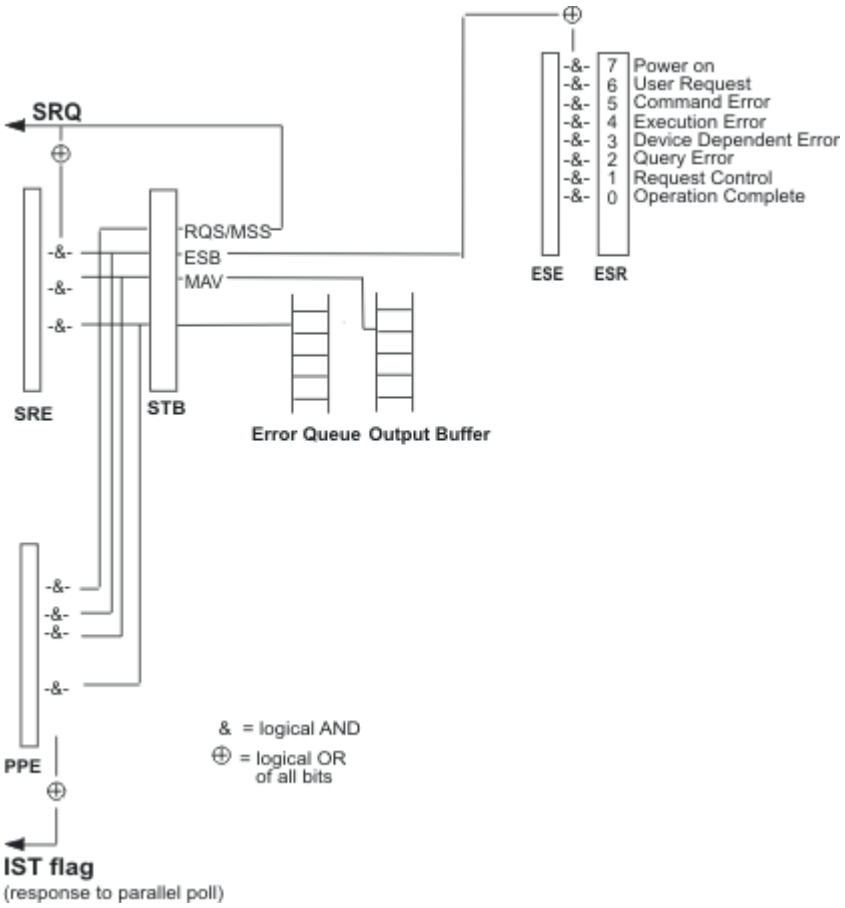



*Fig. 6-1: Graphical overview of the status registers hierarchy*

- **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.

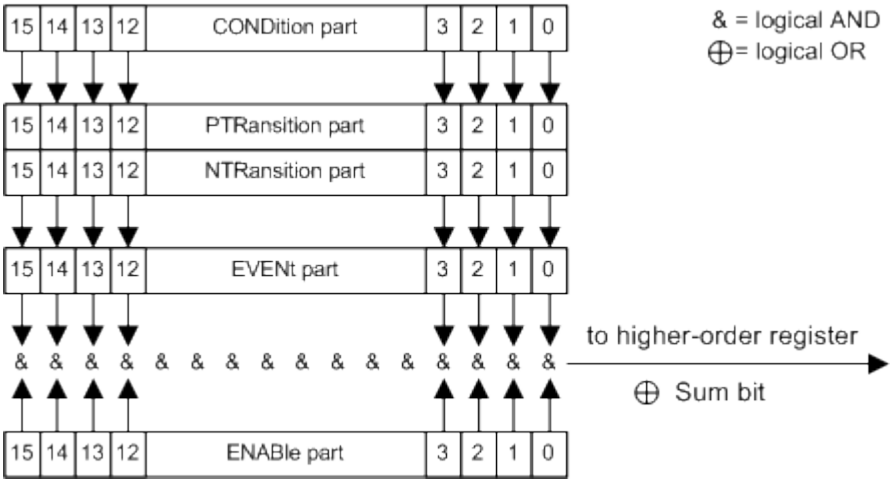



*Fig. 6-2: The status-register model*

**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<br>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)<br>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. |
| 5 | ESB bit<br>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)<br>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 229) 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 234. The ESE is the associated enable part. It can be set using the command *ESE on page 234 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<br>This bit is set on receipt of the command `*OPC` exactly when all previous commands have been executed. |
| 1 | not used |
| 2 | Query Error<br>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<br>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<br>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. |
| 5 | Command Error<br>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<br>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)<br>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` 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<br>Power-On-Status-Clear | | DCL, SDC<br>(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 193.

## 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....233
*CLS....233
*ESE....234
*ESR....234
*IDN....234
*IST....234
*OPC....235
*OPT....235
*PCB....235
*PRE....235
*PSC....235
*RCL....236
*RST....236
*SAV....236
*SRE....236
*STB....237
*TRG....237
*TST....237
*WAI....237

***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 settings from an intermediate memory identified by the specified number. The instrument settings can be stored to this memory using the command `*SAV` with the associated number.

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. The default settings are indicated in the description of commands.

The command is equivalent to `SYSTem:PRESet`.

**Usage:** Setting only

---

***SAV** <Number>

SAVe stores the current instrument settings under the specified number in an intermediate memory. The settings can be recalled 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 236). 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 238)

- Activating the preset state of all parameters that are not related to the signal path ( :DEVice:PRESet on page 238)
- Activating the original state of delivery (factory reset, :SYSTem:FPReset on page 238). 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

**SYSTem:PRESet**

The command triggers an instrument reset. It has the same effect as:

- the PRESET key on the front panel
- 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 81.

**Example:** SYST:PRES
All instrument settings (also those that are not currently active) are reset to their default values.

**Usage:** Setting only

**: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]....239
:CALibration<hw>:FMOFfset[:MEASure]....240
:CALibration<hw>:FREQuency[:MEASure]....240
:CALibration<hw>:LEVel[:MEASure]....240
:CALibration<hw>:LEVel:EXTern:DATA....240
[:SOURce]:CALibration:STEReo:ANALog[:MEAS]....241

---

**: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 confirmed

**:CALibration<hw>:FMOFfset[:MEASure]?**

The command starts all adjustment for the FM/PhiM modulator.

**Return values:**
<Measure> 0 | 1

**Example:** CAL:FMOF?
starts the adjustments for the FM/Phim modulator.
Response: "0"
the adjustments have been performed successfully

**Usage:** Query only

**: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[:MEASure]?**

The command starts all adjustments which affect the level.

The acquired correction values improve the settling time and the signal quality.

**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<hw>:LEVel:EXTern:DATA** <Data>

Selects the data used for of external level correction.

By default the instrument uses correction data obtained in the factory before delivery. In addition, customer data can be used for external level correction. The customer data is obtained using a R&S NRP power sensor. External level correction is a protected function (see service manual, chapter 2, "Adjustment").

**Parameters:**

<Data> FACT | CUST

*RST: FACTory

**Example:** `CAL:LEV:EXT:DATA FACT`
selects the use of the data aquired at the factory for external level correction.

---

**[:SOURce]:CALibration:STEReo:ANALog[:MEAS]?**

The command starts all adjustments which affect the analog channels of the stereo coder option.

**Return values:**

<Meas> 0 | 1

**Example:** `CAL:STER:ANAL?`
starts the adjustments for analog channels of the stereo coder.
`Response: 0`
the adjustments have been performed successfully.

**Usage:** Query only

**Options:** R&S SMB-B5

## 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....241
:DIAGnostic<hw>:BGINfo:CATalog....242
:DIAGnostic:INFO:OTIMe....242
:DIAGnostic:INFO:POCount....242

---

**: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 242.

**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`
Queries the instrument configuration.
returns the data of all available modules.
`DIAG:BGIN? 'MBRD'`
Queries the configuration of the motherboard.
`Response: MBRD 1141.3501.02 1.5.3 100023`
Module motherboard with stock number 1141.3501.01 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.

**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 SMB 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....244
:FORMat[:DATA]....244
:FORMat:SREGister....245

**: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.

**: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.

## 7.7 HCOPy Subsystem

The HCOPy subsystem contains the commands to generate a hardcopy of the display.

:HCOPy:DATA....246
:HCOPy:DEVice....246
:HCOPy:DEVice:LANGuage....246
:HCOPy[:EXECute]....246
:HCOPy:FILE[:NAME]....247
:HCOPy:FILE[:NAME]:AUTO....247
:HCOPy:FILE[:NAME]:AUTO:DIRectory....247
:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar....248
:HCOPy:FILE[:NAME]:AUTO:FILE....248
:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY....248
:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe....249
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh....249
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe....249
:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer....249
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix....250
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe....250
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR....250
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe....251
:HCOPy:FILE[:NAME]:AUTO:STATe....251
:HCOPy:IMAGe:FORMat....251
:HCOPy:IMAGe:SIZE....251

**: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>

The command defines the output device. The hardcopy can be output in a file. The HCOPy:FILE:… commands are used for configuration. The file is accessible using the MMEM:.. commands. In addition, the hardcopy data can be directly transferred to the remote client using command :HCOPy:DATA.

**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....252
:KBOard:LAYout....252

**: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 confirmed

**: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 confirmed

## 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 files are stored on the internal flash memory of the instrument or on external USB memory devices.

The `/var` directory can be used to save user-defined data; any subdirectory structure can be created on `/var`. Some default subdirectories are predefined, but can be changed at any time.

The default directory is determined using the command `MMEMory:CDIR`.



The `/opt` directory is a protected and therefore unaccessible system directory. 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 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 4.7.2.1, "Extensions for User Files", on page 74 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 `:MMEMory:STORe:STATe` command. Also, subsequently to loading a file with instrument settings with command `:MMEMory:LOAD:STATe`, these settings have to be activated with the common command `*RCL <number>`.

### 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.

*Table 7-1: List of the automatically assigned file extensions in the instrument*

| Function | List type | Contents | File suffix |
|---|---|---|---|
| Instrument State | Settings | Instrument settings | `*.savrcltxt` |
| "User Correction" | List | User-defined level correction values | `*.uco` |
| | | Export Data | `*.txt` or `*.csv` |
| "List Mode" | List | User-defined frequency/level value pairs | `*.lsw` |
| | | Export Data | `*.txt` or `*.csv` |
| "Pulse Train List" | | User-defined offtime/ontime/repetition values | `*.pulstrn` |
| NRP Settings | Settings | NRP Settings | `*.nrp` |

### 7.9.3 Examples

In these examples, the current instrument setting is stored in the file `test1.savrcltxt` in the directory `user`.

#### Storing and Loading Current Settings

1. Store the current 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`.
   ```
   *SAV 4
   ```
2. To store the settings in a file in a specific directory, specify the complete path.
   ```
   MMEM:STOR:STAT 4,"var/user/test.savrcltxt"
   ```
3. To store the settings in a file in the default drive, set the default drive and specify only the file name.
   ```
   MMEM:CDIR  'var/user'*SAV 4
   MMEM:STOR:STAT 4,"test.savrcltxt"
   ```
4. Load the file `test.savrcltxt` in the `user` directory.
   ```
   MMEM:LOAD:STAT 4,'/var//user/test.savrcltxt'
   ```
5. Activate the instrument setting of the file `test.savrcltxt`.
   ```
   *RCL 4
   ```

#### Working with Files and Directories

1. Read out all files in the specified directory.
   ```
   MMEM:CAT? '/usb/user'
   ```
   Response: `127145265,175325184,"test,DIR,0","temp,DIR,0","readme.txt,ASC,1324","state.savrcltxt,STAT,5327","waveform.wv,BIN,2342"`

the directory `/usb/user` contains the subdirectories `test` and `temp` as well as the files `readme.txt`, `state.savrcltxt` and `waveform.wv` which have different file types.

**Tip:** To query only the subdirectories of the current or specified directory, perform:
`MMEM:DCAT? '/usb/user'`

Response: `'test', 'temp'`

To query only the number of subdirectories in the current or specified directory, perform:

`MMEM:DCAT:LENG? '/usb/user'`

Response: `2`

2. To query the number of files in the current or specified directory, perform:
   `MMEM:CAT:LENG? '/usb/user'`
   Response: `3`
3. Create a new subdirectory for mass memory storage in the specified directory.
   `MMEM:MDIR '/usb/user/new'`
4. Copy the file `state` to a new file.
   `MMEM:COPY '/var//user/state.savrcltxt','/usb/user/new'`
5. Rename the file `state`.
   `MMEM:MOVE 'state.savrcltxt','state_new.savrcltxt'`
6. Remove the `test` directory.
   `MMEM:RDIR '/usb/user/test'`

### 7.9.4 Remote Control Commands

:MMEMory:CATalog....255
:MMEMory:CATalog:LENGth....256
:MMEMory:CDIRectory....256
:MMEMory:COPY....257
:MMEMory:DATA....257
:MMEMory:DCATalog....258
:MMEMory:DCATalog:LENGth....258
:MMEMory:DELete....258
:MMEMory:LOAD:STATe....259
:MMEMory:MDIRectory....259
:MMEMory:MOVE....259
:MMEMory:MSIS....260
:MMEMory:RDIRectory....260
:MMEMory:STORe:STATe....260

**:MMEMory:CATalog?** <path>

Returns the content of the current or a specified directory.

**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.

**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.

**Example:** See "Working with Files and Directories" on page 254.

**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:** See "Working with Files and Directories" on page 254.

**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:** See "Working with Files and Directories" on page 254.

**Usage:** Setting only
SCPI confirmed

**: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:** See "Working with Files and Directories" on page 254.

**Usage:** Event
SCPI confirmed

**: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.

**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.

**Return values:**

<Dcatalog> <file_entry>

Names of the subdirectories separated by colons. The first two strings are related to the parent directory.

**Example:** See "Working with Files and Directories" on page 254.

**Usage:** Query only

---

**:MMEMory:DCATalog:LENGth?** [<path_name>]

Returns the number of subdirectories in the current or specified directory.

**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.

**Return values:**

<file_entry_count> Number of parent and subdirectories.

**Example:** See "Working with Files and Directories" on page 254.

---

**: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:** See "Working with Files and Directories" on page 254.

**Usage:** Event
SCPI confirmed

---

**: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> Determines to the specific <number> to be used with the `*RCL` command, e.g. `*RCL 4`.

<file_name> String parameter to specify the file name with extension `*.savrcltxt`.

**Example:** See "Storing and Loading Current Settings" on page 254.

**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:** See "Working with Files and Directories" on page 254.

**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:** See "Working with Files and Directories" on page 254.

**Usage:** Setting only
SCPI confirmed

---

**:MMEMory:MSIS** <Msis>

The command is without effect for the Linux operating system.

**Usage:** SCPI confirmed

---

**: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:** See "Working with Files and Directories" on page 254.

**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> Corresponds to the specific <number> defined with the `*SAV` command, e.g. `*SAV 4`.

<file_name> String parameter to specify the file name with extension `*.savrcltxt`.

**Example:** See "Storing and Loading Current Settings" on page 254.

**Usage:** Event

## 7.10 OUTPut Subsystem

The `OUTPut` system contains the commands which set the properties of the RF output connector.

The properties of the LF output connector are set in the chapter 7.12.6, "SOURce:LFOutput Subsystem", on page 292 system.

:OUTPut<hw>:AFIXed:RANGe:LOWer....261
:OUTPut<hw>:AFIXed:RANGe:UPPer....261
:OUTPut<hw>:ALC:SEARch:MODE....261
:OUTPut<hw>:AMODe....262
:OUTPut<hw>:IMPedance....262
:OUTPut<hw>:PROTection:CLEar....262
:OUTPut<hw>:PROTection:TRIPped....263
:OUTPut<hw>[:STATe]....263
:OUTPut<hw>[:STATe]:PON....263

**: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 attenuator is switched automatically. The level settings are made in the full range.

**FIXed**
The level settings are made without switching the attenuator. When this operating mode is switched on, the attenuator is fixed in its current position 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<hw>:IMPedance?**

The command queries the impedance of the RF outputs. This permits converting the output level between units V and W. The impedances cannot be changed.

**Return values:**

<Impedance> G50 | G1K | G10K

Default unit: Ohm

**Example:** `OUTP:IMP`
queries the impedance of RF output.
`Response: 50`
the impedance is 50 ohms

**Usage:** Query only
SCPI confirmed

---

**:OUTPut<hw>:PROTection:CLEar**

The command resets the protective circuit after it has been tripped. The state of the output is again determined by `OUTPut:STATe`.

**Example:** `OUTP:PROT:CLE`
resets the protective circuit for RF output.

**Usage:** Event
SCPI confirmed

---

**:OUTPut<hw>:PROTection:TRIPped?**

The command queries the state of the protective circuit.

**Return values:**
<Tripped> 0 | 1 | OFF | ON

**Example:** `OUTP:PROT:TRIP`
Queries the state of the protective circuit for RF output A.
`Response: 0`
The protective circuit has not tripped.
`Response: 1`
The protective circuit has tripped.

**Usage:** Query only

---

**: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 confirmed

---

**: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 SENSe, READ and INITiate Subsystems

The SENSe subsystem contains the commands for configuring the power measurements with power R&S NRP-Zxx power sensor(s) connected to the generator. The measurement is started and the measurement result retrieved with the `READ` command. The description of this commands is included in the following.

Up to four sensors can be connected to the signal generator. They are distinguished by means of the suffix under SENSe, i.e. `SENSe [1]` ... `SENSe 4`.

INITiate<ch>[:POWer]:CONTinuous....264
READ<ch>[:POWer]....265
SENSe<ch>[:POWer]:CORRection:SPDevice:STATe....265
SENSe<ch>[:POWer]:DISPlay:PERManent:STATe....265
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SENSe<ch>[:POWer]:FILTer:LENGth:AUTO....266
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SENSe<ch>[:POWer]:FREQuency....268
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SENSe<ch>[:POWer]:SOURce....269
SENSe<ch>[:POWer]:STATus[:DEVice]....270
SENSe<ch>[:POWer]:SVERsion....270
SENSe<ch>[:POWer]:TYPE....270
SENSe<ch>[:POWer]:ZERO....271
SENSe<ch>:UNIT[:POWer]....271

---

**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.

**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

**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: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]: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]: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: 0.01

**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<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.

## 7.12 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.


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- SOURce:FM Subsystem....282
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## 7.12.1 SOURce:AM Subsystem

The AM subsystem contains the commands for checking the amplitude modulation.

The external signal is input at the MOD EXT connector.

The settings for the internal modulation source (LF generator) are made in the `SOURce:LFOutput` subsystem.


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[:SOURce<hw>]:AM:EXTernal:COUPling....272
[:SOURce<hw>]:AM:SENSitivity....273
[:SOURce<hw>]:AM:SOURce....273
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---

**[:SOURce<hw>]:AM[:DEPTh]** <Depth>

The command sets the modulation depth of the amplitude modulation in percent. The modulation depth is limited by the maximum peak envelope power (PEP).

**Parameters:**

<Depth> float

Range: 0 to 100
Increment: See data sheet
*RST: 30
Default unit: PCT

**Example:** `AM 15PCT`
sets the AM modulation depth to 15 percent

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:AM:EXTernal:COUPling** <Coupling>

The command selects the coupling mode for the external modulation input in the case of amplitude modulation.

**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:** `AM:EXT:COUP AC`
Selects the coupling mode AC for external amplitude modulation.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:AM:SENSitivity?**

The command queries the input sensitivity of the external modulation input in %/V. The command is only effective if the external modulation source is selected (`SOUR:AM:SOUR EXT`). The returned value depends on the modulation depth setting (`SOUR:AM:DEPTh`). This value is assigned to the voltage value for full modulation of the input.

**Return values:**

<Sensitivity> float

**Example:** `AM:DEPT 50`
sets a modulation depth of 50 %.
`AM:SENS?`
queries the input sensitivity at the external modulation input.
`Response: 50`
since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 50%/V.

**Usage:** Query only
SCPI confirmed

---

**[:SOURce<hw>]:AM:SOURce** <Source>

The command selects the modulation source for amplitude modulation.

Internal and external modulation source can be selected at the same time.

**Parameters:**

<Source> INT | EXT

**INT**
INT is the internal modulation source which is selected with command `AM:SOURce:INTernal` and configured in the `SOURce:LFOutput` subsystem.

**EXT**
The external signal is input at the MOD EXT connector.

*RST: INTernal

**Example:** AM:SOUR INT
selects the internal modulation source.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:AM:STATe** <State>

The command activates/deactivates amplitude modulation.

**Parameters:**
<State> 0 | 1 | OFF | ON

**Example:** AM:STAT ON
activates AM modulation.

**Usage:** SCPI confirmed

## 7.12.2 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 SMB, 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 256. 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....275
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency....275
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts....276
[:SOURce<hw>]:CORRection:CSET:DATA:POWer....276
[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts....276
[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe....277
[:SOURce]:CORRection:CSET:DELete....277

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog....277
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension....278
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect....278
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**[: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[: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

### 7.12.3 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 MOD EXT connector.

For information about the required options, see chapter 5.4.3, "Frequency Modulation (FM)", on page 164.

[:SOURce<hw>]:FM[:DEViation] ..... 282
[:SOURce<hw>]:FM:EXTernal:COUPling ..... 283
[:SOURce<hw>]:FM:EXTernal:DEViation ..... 283
[:SOURce<hw>]:FM:MODE ..... 283
[:SOURce<hw>]:FM:SENSitivity ..... 284
[:SOURce<hw>]:FM:SOURce ..... 284
[:SOURce<hw>]:FM:STATe ..... 285

**[:SOURce<hw>]:FM[:DEViation]** <Deviation>

The command sets the modulation deviation of the frequency modulation in Hz. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

**Parameters:**

<Deviation> float

Range: 0 Hz to 10 MHz
Increment: See data sheet
*RST: 10 kHz
Default unit: Hz

**Example:** `FM 5E3`
sets the FM modulation deviation to 5 kHz.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:FM:EXTernal:COUPling** <Coupling>

The command selects the coupling mode for the external modulation input in the case of frequency modulation.

**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:** `FM:EXT:COUP AC`
selects the coupling mode AC for external frequency modulation.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:FM:EXTernal:DEViation** <Deviation>

The command enters the deviation of the external FM signal The deviation of the internal source must not exceed the deviation of the external source in case of modulation source Int+Ext.

**Parameters:**

<Deviation> float

Range: 0 to 40 MHz
*RST: 1kHz
Default unit: Hz

**Example:** `FM:EXT:DEV 3kHz`
sets an external modulation depth of 3 kHz

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:FM:MODE** <Mode>

The command selects the mode for the frequency modulation.

**Parameters:**

<Mode> NORMal

**NORMal**
The maximum range for modulation bandwidth and FM deviation is available.

*RST: NORMal

**Example:** `FM:MODE NORM`
selects normal mode for external frequency modulation.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:FM:SENSitivity?**

The command is only effective if the external modulation source is selected `(SOUR:FM:SOUR EXT)`. The returned value depends on the modulation deviation setting `(SOUR:FM:DEViation)`. This value is assigned to the voltage value for full modulation of the input signal.

**Return values:**

<Sensitivity> float

**Example:** `FM:DEV 5E3`
sets a modulation deviation of 5 kHz.
`FM:SENS`
queries the input sensitivity at the external modulation input.
`Response: 5E3`
since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 5000Hz/V.

**Usage:** Query only
SCPI confirmed

---

**[:SOURce<hw>]:FM:SOURce** <Source>

The command selects the modulation source for frequency modulation. Internal and external modulation source can be selected at the same time.

**Parameters:**

<Source> INT | EXT | INT,EXT

**INT**
INT is the internal modulation source which is defined with command `FM:SOURce:INTernal` and configured in the `SOURce:LFOutput` subsystem.

**EXT**
The external signal is input at the MOD EXT connector.

*RST: INTernal

**Example:** `FM:SOUR INT`
selects the internal modulation source.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:FM:STATe** <State>

The command activates/deactivates frequency modulation.

Activation of FM (`FM:STAT ON`) deactivates phase modulation.

**Parameters:**

<State> 0 | 1 | OFF | ON
*RST: OFF

**Example:** `FM:STAT ON`
Activates FM modulation.

**Usage:** SCPI confirmed

## 7.12.4 SOURce:FREQuency Subsystem

This subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

[:SOURce<hw>]:FREQuency:CENTer....285
[:SOURce<hw>]:FREQuency[:CW|:FIXed]....286
[:SOURce<hw>]:FREQuency[:CW|:FIXed]:RCL....286
[:SOURce<hw>]:FREQuency:MANual....287
[:SOURce<hw>]:FREQuency:MODE....288
[:SOURce<hw>]:FREQuency:MULTiplier....288
[:SOURce<hw>]:FREQuency:OFFSet....288
[:SOURce<hw>]:FREQuency:SPAN....289
[:SOURce<hw>]:FREQuency:STARt....289
[:SOURce<hw>]:FREQuency:STOP....290
[:SOURce<hw>]:FREQuency:STEP[:INCRement]....291
[:SOURce<hw>]:FREQuency:STEP:MODE....291

---

**[: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:

300 kHz + `OFFSet` ... $RF_{max}$ +`OFFSet`

**Parameters:**

<Center> float

Range: 300kHz to RFmax (RFmax depending on model)
Increment: 0.01Hz
*RST: 300MHz
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 confirmed

---

**[: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:

300 kHz + `OFFSet` ... $RF_{max}$ +`OFFSet`

**Correlation**: `FREQ` for `FREQ:MODE SWE` is linked to sweep frequency.

**Parameters:**

<Fixed> float

Range: 300kHz to RFmax
Increment: 0.01Hz
*RST: 1GHz
Default unit: Hz

**Example:** `FREQ 500kHz`
sets the frequency of RF output signal A to 500 kHz.

**Usage:** SCPI confirmed

---

**[: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 confirmed

---

**[: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 ... STOP +OFFSet`

**Parameters:**

<Manual> float

Range: STARt to STOP
Increment: 0.01Hz
*RST: 100MHz
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 confirmed

**[: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 confirmed

**[: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.

**[: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 confirmed

---

**[: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: 0 to RFmax
Increment: 0.01Hz
*RST: 400MHz

**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 confirmed

---

**[: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:

300 kHz + OFFSet ... $RF_{max}$ +OFFSet

**Parameters:**

<Start> float

Range: 300kHz to RFmax
Increment: 0.01Hz
*RST: 100MHz

**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 confirmed

---

**[: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:

300 kHz + OFFSet ... $RF_{max}$ +OFFSet

**Parameters:**

<Stop> float

Range: 300kHz to RFmax
Increment: 0.01Hz
*RST: 500 MHz
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 confirmed

**[: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: 0Hz to RFmax - 100kHz
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).

## 7.12.5 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:IMPedance....291
[:SOURce]:INPut:TRIGger:SLOPe....292

**[:SOURce<hw>]:INPut:MODext:IMPedance** <Impedance>

This command sets the impedance for external feed via the MOD EXT input.

**Parameters:**

<Impedance> HIGH | G600

**HIGH**

> 100 k0hm to ground

*RST: HIGH

**Example:** `INP:MOD:IMP HIGH`

the EXT MOD input is set to > 100 kOhm to ground.

---

**[: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.

## 7.12.6 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.

**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>:FREQuency....293
[:SOURce]:LFOutput:FREQuency:MANual....293
[:SOURce]:LFOutput:FREQuency:MODE....294
[:SOURce]:LFOutput:FREQuency:STARt....294
[:SOURce]:LFOutput:FREQuency:STOP....295
[:SOURce]:LFOutput[:STATe]....295
[:SOURce]:LFOutput:SWEep[:FREQuency]:DWELl....295
[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute....296
[:SOURce]:LFOutput:SWEep[:FREQuency]:MODE....296
[:SOURce]:LFOutput:SWEep[:FREQuency]:POINts....297
[:SOURce]:LFOutput:SWEep[:FREQuency]:SHAPe....298
[:SOURce]:LFOutput:SWEep[:FREQuency]:SPACing....298
[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]....298
[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic....299
[:SOURce]:LFOutput<ch>:SHAPe....300
[:SOURce]:LFOutput:SIMPedance....300
[:SOURce]:LFOutput:VOLTage....300

---

**[: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.

---

**[: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

**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.

---

**[:SOURce]:LFOutput: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

**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.

---

**[: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

**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).

---

**[: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

**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.

---

**[:SOURce]:LFOutput[:STATe]** <State>

The command activates/deactivates the LF output.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** LFO ON
activates the LF output. The settings under LFO:FREQ and LFO:SWE become effective.

---

**[:SOURce]:LFOutput:SWEep[:FREQuency]:DWELl** <Dwell>

The command sets the dwell time for each frequency 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: 10.0E-3 to 100
Increment: 100.0E-6
*RST: 10.0E-3
Default unit: s

**Example:** `LFO:SWE:DWEL 20 ms`
sets a dwell time of 20 ms.

---

**[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute**

The command immediately starts an LF sweep.

The command is only valid for sweep mode Single (`SOURce:LFOutput:SWEep:FREQuency:MODE SINGle`).

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

---

**[: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 `[:SOURce]:LFOutput:FREQuency:MANual` 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:** `LFO:SWE:MODE AUTO`
selects Mode Auto.

---

**[: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.

**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.

---

**[: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.

---

**[: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

**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.

---

**[: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: 0.01PCT to 100PCT
Increment: 0.01PCT
*RST: 1

**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.

**[:SOURce]:LFOutput<ch>:SHAPe** <Shape>

The command selects the shape of the LF generator.

The instrument is equipped with one LF geneator only and the suffix has no impact.

**Parameters:**

<Shape> SINE | SQUare

*RST: SINE

**Example:** `LFO:SHAP SQU`
selects a rectangular shape for the signal of the LF generator.

**Usage:** SCPI confirmed

**[:SOURce]:LFOutput:SIMPedance** <Simpedance>

The command selects the output impedance of the LF generator. Selection LOW and 600 Ohm are available.

For instruments with older version of the RF board, the LF output impedance is forced to LOW and cannot be changed.

**Parameters:**

<Simpedance> LOW | G600

*RST: LOW|

**Example:** `SOUR:LFO:SIMP G600`
'sets the output impedance of the LF generator to 600 Ohms

**[:SOURce]:LFOutput:VOLTage** <Voltage>

The command sets the output voltage of the LF output.

**Parameters:**

<Voltage> float

Range: 0 to 4
Increment: 0.001
*RST: 1
Default unit: V

**Example:** `LFO:VOLT 3 V`
sets the voltage of the LF output to 3 V.

### 7.12.7 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....302
[:SOURce<hw>]:LIST:DELete....302
[:SOURce<hw>]:LIST:DELete:ALL....303
[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog....303
[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension....304
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect....304
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn....305
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal....305

[:SOURce<hw>]:LIST:DEXChange:EXECute....306
[:SOURce<hw>]:LIST:DEXChange:MODE....306
[:SOURce<hw>]:LIST:DEXChange:SELect....307
[:SOURce<hw>]:LIST:DWELl....307
[:SOURce<hw>]:LIST:FREE....308
[:SOURce<hw>]:LIST:FREQuency....308
[:SOURce<hw>]:LIST:FREQuency:POINts....308
[:SOURce<hw>]:LIST:INDex....309
[:SOURce<hw>]:LIST:INDex:STARt....309
[:SOURce<hw>]:LIST:INDex:STOP....310
[:SOURce<hw>]:LIST:LEARn....310
[:SOURce<hw>]:LIST:MODE....310
[:SOURce<hw>]:LIST:POWer....311
[:SOURce<hw>]:LIST:POWer:POINts....311
[:SOURce<hw>]:LIST:RESet....312
[:SOURce<hw>]:LIST:SELect....312
[:SOURce<hw>]:LIST:TRIGger:EXECute....312
[:SOURce<hw>]:LIST:TRIGger:SOURce....312

### [: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: 0.5 ms to 100 s
Increment: 1E-4
*RST: 10.0 ms
Default unit: s

**Example:** `LIST:DWEL 15`
each setting in the list is retained for 15 ms.

**[:SOURce<hw>]:LIST:FREE?**

This command queries on the free storage space for list mode lists.

**Return values:**

<Free> integer

Range: 0 to INT_MAX
Increment: 1
*RST: 0

**Example:** `LIST:FREE?`

**Usage:** Query only

Response: `2147483647;1`

**[: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 244).

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 confirmed

**[: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 confirmed

---

**[: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 244).

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 confirmed

---

**[: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 confirmed

---

**[: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.

## 7.12.8 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.

### 7.12.9 SOURce:PGEN Subsystem

This subsystem contains the commands for setting the pulse generator.

[:SOURce<hw>]:PGEN:STATe.....314

**[:SOURce<hw>]:PGEN:STATe** <State>

The command activates/deactivates the output of the video/sync signal at the PULSE VIDEO connector at the rear of the instrument.

The signal output and the pulse generator are automatically switched on with activation of pulse modulation if pulse generator is selected as modulation source. The signal output can be switched off subsequently.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `PULM:SOUR INT`
selects the internal pulse generator as source for pulse modulation
`PULM:STAT ON`
activates pulse modulation. The pulse generator and the output of the signals at the PULSE VIDEO connector are automatically activated in addition.
`PGEN:STAT OFF`
deactivates the output of the pulse signal by the pulse generator at the PULSE VIDEO connector. The pulse modulation of the RF carrier must be activated with command `SOURce:PULM:STATe`.

**Usage:** SCPI confirmed

### 7.12.10 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.....314
[:SOURce<hw>]:PHASe:REFerence.....315

**[: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 confirmed

---

**[: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 confirmed

## 7.12.11 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.

For information about the required options, see chapter 5.4.4, "Phase Modulation (PhiM)", on page 167.

[:SOURce<hw>]:PM[:DEViation] ..... 315
[:SOURce<hw>]:PM:EXTernal:COUPling ..... 316
[:SOURce<hw>]:PM:EXTernal:DEViation ..... 316
[:SOURce<hw>]:PM:MODE ..... 316
[:SOURce<hw>]:PM:SENSitivity ..... 317
[:SOURce<hw>]:PM:SOURce ..... 317
[:SOURce<hw>]:PM:STATe ..... 318

---

**[:SOURce<hw>]:PM[:DEViation]** <Deviation>

The command sets the modulation deviation of the phase modulation in RAD. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

The deviation of the internal source must not exceed the deviation of the external source in case of modulation source "Int+Ext" (`PM:SOURce INT,EXT`).

**Parameters:**

<Deviation> float

Range: 0 to 20
Increment: See data sheet
*RST: 1
Default unit: RAD

**Example:** `PM 5`
sets the PM modulation deviation to 5 RAD

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:PM:EXTernal:COUPling** <Coupling>

The command selects the coupling mode for the external modulation input in the case of phase modulation.

**Note:** Coupling for external feed via input MOD EXT can be set independently for modulations FM and PhiM.

**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:** `PM:EXT:COUP AC`
selects the coupling mode AC for external phase modulation.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:PM:EXTernal:DEViation** <Deviation>

The command sets the modulation deviation in case of external phase modulation in RAD. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

**Parameters:**

<Deviation> float

Range: 0 to 20
Increment: See data sheet
Default unit: RAD

**Example:** `PM 5`
sets the PM modulation deviation for external phase modulation of 5 RAD.

**Usage:** SCPI confirmed

---

**[: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 confirmed

---

**[:SOURce<hw>]:PM:SENSitivity?**

The command queries the input sensitivity of the EXT MOD input in RAD/V. The command is only effective if the external modulation source is selected (`SOUR:PM:SOUR EXT`). The returned value depends on the modulation deviation setting (`SOUR:PM:DEViation`). This value is assigned to the voltage value for full modulation of the input.

**Return values:**

<Sensitivity> float

**Example:** `PM:DEV 1`
sets a modulation deviation of 1RAD.
`PM:SENS?`
queries the input sensitivity at the EXT MOD input.
`Response: 1`
since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 1RAD/V.

**Usage:** Query only
SCPI confirmed

---

**[:SOURce<hw>]:PM:SOURce** <Source>

The command selects the modulation source for phase modulation.

**Parameters:**

<Source> INTernal | EXTernal | INT,EXT

**INTernal**
INT is the LF generator. The frequency of the internal modulation signal can be set in the `SOURce:LFOutput` subsystem.

**EXTernal**
The external signal is input at the MOD EXT connector.

**INT,EXT**
Internal and external modulation source can be selected at the same time.

*RST: INTernal

**Example:** `PM:SOUR INT`
selects the internal modulation source.

**Usage:** SCPI confirmed

---

**[:SOURce<hw>]:PM:STATe** <State>

The command activates/deactivates phase modulation. Activation of phase modulation deactivates frequency modulation.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `PM:STAT ON`
activates PM modulation.

**Usage:** SCPI confirmed

## 7.12.12 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:OMODe....319
[:SOURce<hw>]:POWer:ALC:SONCe....319
[:SOURce<hw>]:POWer:ALC[:STATe]....319
[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE....320
[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]....320
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet....321
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL....322
[:SOURce<hw>]:POWer:LIMit[:AMPLitude]....322
[:SOURce<hw>]:POWer:LMODe....323

[:SOURce<hw>]:POWer:MANual....323
[:SOURce<hw>]:POWer:MODE....324
[:SOURce<hw>]:POWer:POWer....324
[:SOURce<hw>]:POWer:STARt....325
[:SOURce<hw>]:POWer:STEP[:INCRement]....325
[:SOURce<hw>]:POWer:STEP:MODE....326
[:SOURce<hw>]:POWer:STOP....326

**[:SOURce<hw>]:POWer:ALC:OMODe** <OffMode>

The command sets the level control mode which becomes active when automatic level control is deactivated (ALC Off).

**Parameters:**

<OffMode> SHOLd

**SHOLd**
Level control is activated briefly if the level or frequency changes ("ALC Off Sample & Hold").

*RST: SHOLd

**Example:** `POW:ALC OFF`
deactivates automatic level control for RF output A.
`POW:ALC:OMOD SHOL`
level control is briefly activated if the frequency or level changes.

**[: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[:STATe]** <State>

The command activates/deactivates automatic level control.

**Parameters:**

<State> ON | OFF | AUTO

**ON**
Internal level control is permanently activated.

**OFF**
Internal level control is deactivated; Sample & Hold mode is activated.

**AUTO**
Internal level control is activated/deactivated automatically depending on the operating state.

*RST: AUTO

**Example:** `POW:ALC ON`
activates automatic level control for RF output A.

---

**[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE** <Mode>

The command selects the attenuator mode, 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> UNCHanged | FATTenuated

**UNCHanged**
Freezes the setting of the attenuator when RF is switched off. The attenuator is only activated when RF is switched on.
This setting recommended if a constant VSWR (**V**oltage **S**tanding **W**ave **R**atio) is required.
Furthermore, on instruments equipped with a mechanical attenuator, it provides fast and wear-free operation.

**FATTenuated**
Sets attenuation to maximum when the RF signal is switched off. This setting is recommended for applications that require a high level of noise suppression.

*RST: FATTenuated

**Example:** `SOUR:POW:ATT:RFOF:MODE FATT`
sets the RF OFF attenuator to maximum.

---

**[: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 confirmed

---

**[: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 5.3.6.1, "RF level vs. RF output level", on page 125.

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 confirmed

---

**[: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 confirmed

---

**[: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 confirmed

---

**[:SOURce<hw>]:POWer:LMODe** <LevMode>

The command sets the RF level mode.

**Parameters:**

<LevMode> NORMal | LOWNoise | LOWDistortion

**NORMal**
The RF signal is output in the standard values of the instrument.

**LOWNoise**
A very low noise sinewave signal is output.

**LOWDistortion**
A very pure sinewave signal is output.

**Example:** `POW:LMODE LOWD`
sets the LOWDistortion mode. The instrument reduces distortions of the RF signal to a minimum.

---

**[: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 confirmed

---

**[: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 confirmed

---

**[: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: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 confirmed

---

**[: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 confirmed

## 7.12.13 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 EXT 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 VIDEO connector.

[:SOURce<hw>]:PULM:DELay....328
[:SOURce<hw>]:PULM:DOUBle:DELay....328
[:SOURce<hw>]:PULM:DOUBle:STATe....328
[:SOURce<hw>]:PULM:DOUBle:WIDTh....329
[:SOURce<hw>]:PULM:MODE....329
[:SOURce<hw>]:PULM:PERiod....329
[:SOURce<hw>]:PULM:POLarity....330
[:SOURce<hw>]:PULM:SOURce....330
[:SOURce<hw>]:PULM:STATe....331
[:SOURce<hw>]:PULM:TRAin:CATalog....331
[:SOURce<hw>]:PULM:TRAin:DELete....331
[:SOURce<hw>]:PULM:TRAin:OFFTime....332
[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts....332
[:SOURce<hw>]:PULM:TRAin:ONTime....333
[:SOURce<hw>]:PULM:TRAin:ONTime:POINts....333
[:SOURce<hw>]:PULM:TRAin:REPetition....334
[:SOURce<hw>]:PULM:TRAin:REPetition:POINts....334
[:SOURce<hw>]:PULM:TRAin:SELect....335
[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity....335
[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance....336
[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe....336
[:SOURce<hw>]:PULM:TRIGger:MODE....336
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog....337
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension....337
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[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal....338
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute....339
[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE....339
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect....340
[:SOURce<hw>]:PULM:WIDTh....340

**[: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:** R&S SMB-K22 and R&S SMB-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:** R&S SMB-K22 and R&S SMB-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:** R&S SMB-K22 and R&S SMB-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:** R&S SMB-K22 and R&S SMB-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 SMB-K22, R&S SMB-K23 and R&S SMB-K27

**[: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

The min value depends on the installed option R&S R&S SMB-K22 or R&S R&S SMB-K23 respectively.

Range: 5us | 20ns to 100 s
Increment: 1us | 20ns
*RST: 1ms

**Example:** `PULM:PER 220 us`
the pulse period is 220 us.

**Options:** R&S SMB-K22 and R&S SMB-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 SMB-K22

---

**[:SOURce<hw>]:PULM:SOURce** <Source>

The command selects the source for pulse modulation.

**Parameters:**
<Source> INTernal | EXTernal

**INTernal**
The internally generated rectangular signal is used for the pulse modulation. The frequency of the internal signal can be set in the SOURce:LFOutput subsystem.

**EXTernal**
The signal applied externally via the EXT MOD connector is used for the pulse modulation.

*RST: INTernal

**Example:** `PULM:SOUR INT`
selects the internal modulation source.

**Example:** `PULM:STAT ON`
activates the pulse modulation.

**Usage:** SCPI confirmed

**[: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 confirmed

**Options:** R&S SMB-K22

**[: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 SMB-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 SMB-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 SMB-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 SMB-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 SMB-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 SMB-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 SMB-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 SMB-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 SMB-K27

---

**[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity** <Polarity>

Selects the polarity of the Gate signal.

The signal is supplied via the PULSE EXT 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.

**Options:** R&S SMB-K22 and R&S SMB-K23

**[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance** <Impedance>

The command selects the impedance for external pulse trigger. The trigger is fed via the PULSE EXT input.

**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 confirmed

**Options:** R&S SMB-K22

**[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe** <Slope>

The command sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

**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.

**Options:** R&S SMB-K22 and R&S SMB-K23

**[: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 EXT connector.

**EGATe**
The pulse modulation is gated by an external gate signal. The signal is supplied via the PULSE EXT connector.

*RST: AUTO

**Example:** `PULM:TRIG:MODE EXT`
selects triggering by an external trigger event.

**Usage:** SCPI confirmed

**Options:** R&S SMB-K22 and R&S SMB-K23

**[: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:** R&S SMB-K22 and R&S SMB-K23

## 7.12.14 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 236).

[:SOURce]:ROSCillator:EXTernal:FREQuency....341
[:SOURce]:ROSCillator:EXTernal:RFOFf:STATe....341
[:SOURce]:ROSCillator:EXTernal:SBANdwidth....342
[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue....342
[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]....342
[:SOURce]:ROSCillator:SOURce....343

**[:SOURce]:ROSCillator:EXTernal:FREQuency** <Frequency>

The command informs the instrument of the frequency of the external reference.

**Parameters:**

<Frequency> 5MHz | 10MHz
Default unit: Hz

**Example:** `ROSC:SOUR EXT`
selects the external source. The reference must be input at the REF IN input.
`ROSC:EXT:FREQ 5MHz`
informs the instrument that the external reference frequency is 5MHz.

**Usage:** SCPI confirmed

**[: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.

**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

*RST: 0

**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.

**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.

## 7.12.15 SOURce:STEReo Subsystem

This subsystem contains the SCPI commands for generating FM stereo multiplex signals, the radio traffic service ARI (Automotive Radio Information) and Radio Data System (RDS). Additional functions are available using the `SOURce:STEReo:DIRect` commands (see chapter 7.18, "Direct Commands for the Stereo/RDS Coder Option R&S SMB-B5", on page 384).

[:SOURce]:STEReo:ARI:BK[:CODE] ..... 344
[:SOURce]:STEReo:ARI:STATe ..... 344
[:SOURce]:STEReo:ARI:TYPE ..... 344
[:SOURce]:STEReo:ARI:TYPE:STATe ..... 345
[:SOURce]:STEReo:ARI[:DEViation] ..... 345
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[:SOURce]:STEReo:AUDio:PREemphasis ..... 346
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[:SOURce]:STEReo:DIRect ..... 347
[:SOURce]:STEReo:EXTernal:IMPedance ..... 348
[:SOURce]:STEReo:MMF ..... 348
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[:SOURce]:STEReo:RDS:DATaset ..... 349
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[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe] ..... 350
[:SOURce]:STEReo:RDS[:DEViation] ..... 350
[:SOURce]:STEReo:SOURce ..... 350

[:SOURce]:STEReo:STATe....351
[:SOURce]:STEReo[:DEViation]....351

**[:SOURce]:STEReo:ARI:BK[:CODE]** <Code>

Selects the area identification (BK) code of the ARI signal. The six letters (six different frequencies) identify a specific region in each country. The code is generated if the BK or DK+BK identifier of the ARI signal is activated.

**Parameters:**

<Code> A | B | C | D | E | F

*RST: A

**Example:** `STER:ARI:TYPE BK`
selects generation of area identification.
`STER:ARI:BK A`
selects the specific area identification code A to be generated.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:ARI:STATe** <State>

Activates/deactivates the ARI signal generation. ARI signals can be generated simultaneously with MPX and RDS signals.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `STER:ARI:STAT ON`
activates generation of an ARI signal.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:ARI:TYPE** <Type>

Selects the generated identifiers of the ARI signal.

**Parameters:**

<Type> OFF | DK | BK | BKDK

**OFF**
Only the 57 kHz subcarrier is generated (Senderkennung). It marks the stations which broadcast traffic programs and enables the receiver to recognize the frequency as being ARI-capable.

**DK**
The message identification (Durchsagekennung) is generated in addition (low-frequency 30% AM). It signalizes that a traffic message is currently broadcasted.

**BK**
The area identification (Bereichskennung) is generated in addition (60% AM). This code is used to identify the geographical region covered by the radio station. The specific code is selected below.

**BKDK**
The area and message identification are generated in addition.

*RST: DK

**Example:** `STER:ARI:TYPE BKDK`
A complete ARI signal with all identifiers is generated.

**Options:** R&S SMB-B5

---

**[:SOURce]:STEReo:ARI:TYPE:STATe** <State>

Activates/deactivates the Stereo ARI Identifier.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: 0

**Example:** `STER:ARI:TYPE:STAT ON`

**Options:** R&S SMB-B5

---

**[:SOURce]:STEReo:ARI[:DEViation]** <Deviation>

Sets the frequency deviation of the ARI subcarrier signal.

**Parameters:**

<Deviation> float

Range: 0 to 10kHz
*RST: 3.5kHz

**Example:** `STER:ARI:DEV 3.5kHz`
sets the frequency deviation of the 57 kHz subcarrier to 3.5kHz.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:AUDio:MODE** <Mode>

Selects the generated identifiers of the AUDio signal.

**Parameters:**

<Mode> LEFT | RIGHt | RELeft | REMLeft | RNELeft

**LEFT**
A mono signal containing the left channel is generated/fed in.

**RIGHt**
A mono signal containing the right channel is generated/fed in.

**RELeft**
A stereo signal with right and left channel is generated/fed in. The channels have the same frequency and phase.

**REMLeft**
The signal on the left external audio input is used for both channels, left and right. The right channel is inverted.

**RNELeft**
(External source only)
A stereo signal containing different, independent right and left channels is feed in. It is possible, for example, to feed a fixed audio frequency to the first channel while a frequency sweep is being performed in the second channel.

*RST: RIGHt

**Example:** `STER:SOUR LFG`
The internal LF generator is used as modulation source for the audio signal.
`STER:AUD:MODE RIGH`
A mono signal containing the left channel is generated.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:AUDio:PREemphasis** <Preemphasis>

Sets the preemphasis used for signal generation.

**Parameters:**

<Preemphasis> float

Range: 50µs to 75µs
*RST: 50µs

**Example:** `STER:SOUR LFG`
The internal LF generator is used as modulation source for the audio signal.
`STER:AUD:PRE 50µs`
sets preemphasis to 50µs.
`STER:AUD:PRE:STAT ON`
activates preemphasis.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:AUDio:PREemphasis:STATe** <State>

Activates the use of preemphasis for signal generation.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `STER:SOUR LFG`
The internal LF generator is used as modulation source for the audio signal.
`STER:AUD:PRE 50µs`
sets preemphasis to 50µs.
`STER:AUD:PRE:STAT ON`
activates preemphasis.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:AUDio[:FREQuency]** <Freqency>

Sets the frequency of the LF generator signal. The command is an alias to command `SOURce:LFOutput:FREQuency`.

**Parameters:**

<Freqency> float

Range: 0.1Hz to 1.0MHz
Increment: 0.01Hz
*RST: 1kHz

**Example:** `STER:SOUR LFG`
The internal LF generator is used as modulation source for the audio signal.
`STER:AUD:FREQ 1100`
sets the frequency of the audio signal to 1.1 kHz

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:DIRect** <Direct>

Sends a R&S SMB command string to the stereo coder. The direct commands offer extended settings possibilities for the stereo coder (see chapter 7.18, "Direct Commands for the Stereo/RDS Coder Option R&S SMB-B5", on page 384).

**Parameters:**

<Direct> string

**Example:** `STER:DIR 'ARI-ID=0'`
deactivates the ARI identification.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:EXTernal:IMPedance** <Impedance>

Selects the input impedance for the external analog audio signal inputs L and R.

**Parameters:**

<Impedance> 600 | 100000

Range: 100kOhm to 600Ohm
*RST: 100kOhm

**Example:** `SOUR:STER:EXT:IMP 600Ohm`
selects 600 OHM as the impedance for the external analog audio signals.

**Options:** Option R&S SMB-B5

**[:SOURce]:STEReo:MMF** <Mmf>

Sets the maximum possibly used modulation frequency. This setting is only effective for external modulation source and activated preemphasis. It prevents over modulation but result in a decreased s/n ratio.

**Parameters:**

<Mmf> float

Range: 0.00 to 18.0kHz
Increment: 0.01Hz
*RST: 1kHz

**Example:** `SOUR:STER:MMF 2000`
sets a maximum modulation frequency of 2 kHz.

**Options:** Option R&S SMB-B5

**[:SOURce]:STEReo:PILot:PHASe** <Phase>

Sets the phase of the pilot tone in relation to the 38 kHz carrier signal of the receiver. For a correct demodulation, the pilot tone must be in phase with the 38 kHz carrier.

**Parameters:**

<Phase> float

Range: -4.0DEG to +5.0DEG
Increment: 0.1DEG
*RST: 0DEG

**Example:** `SOUR:STER:PIL:PHAS .2DEG`
decreases pilot tone quality by adding a phase difference of 0.2 degrees between pilot signal and receiver carrier signal.

**Options:** Option R&S SMB-B5

**[:SOURce]:STEReo:PILot:STATe** <State>

Activates/deactivates the pilot tone generation.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `STER:PIL:STAT ON`
activates generation of the pilot tone.

**Options:** R&S SMB-B5

---

**[:SOURce]:STEReo:PILot[:DEViation]** <Deviation>

Sets the deviation of the pilot tone.

**Parameters:**

<Deviation> float

Range: 0.00 to 10kHz
Increment: 0.01Hz
*RST: 6.75kHz

**Example:** `SOUR:STER:PIL:DEV 6.75kHz`
sets the pilot tone deviation according to standard.

**Options:** Option R&S SMB-B5

---

**[:SOURce]:STEReo:RDS:DATaset** <Dataset>

Selects one of the five data sets provided on the instrument for use in the RDS signal.

**Parameters:**

<Dataset> DS1 | DS2 | DS3 | DS4 | DS5

*RST: DS1

**Example:** `STER:RDS:DAT DS5`
activates use of data set 5 for generation of the RDS signal.

**Options:** R&S SMB-B5

---

**[:SOURce]:STEReo:RDS:STATe** <State>

Activates/deactivates the RDS signal generation. RDS signals can be generated simultaneously with MPX and ARI signals.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `STER:RDS:STAT ON`
activates generation of RDS signal.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe]** <State>

Activates the RDS traffic announcement. If activated, the receiver switches from the current status, e.g. playing a CD, to the receive mode and enables the broadcast of a traffic announcement. The TP state has to be on.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `STER:RDS:TRAF:PROG:STAT ON`
activates RDS traffic program.
`STER:RDS:TRAF:ANN:STAT ON`
activates RDS traffic announcement.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:RDS:TRAFfic:PROGram[:STATe]** <State>

Activates the RDS traffic program. The receiver can recognize a frequency as being capable of traffic information only if the TP function is active.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `STER:RDS:TRAF:PROG:STAT ON`
activates the RDS traffic program.

**Options:** R&S SMB-B5

**[:SOURce]:STEReo:RDS[:DEViation]** <Deviation>

Sets the deviation of the RDS subcarrier.

**Parameters:**

<Deviation> float

Range: 0.00 to 10kHz

**Example:** `SOUR:STER:RDS:DEV 2kHz`
sets the RDS signal deviation according to standard.

**[:SOURce]:STEReo:SOURce** <Source>

Selects the source for the audio signal.

**Parameters:**

<Source> OFF | LREXt | SPEXt | LFGen

**OFF**
No audio signal is provided, ARI and RDS signal can be generated separately.

**LREX**
The external audio signal is feed in via the analog L and R inputs.

**SPEX**
The external audio signal is feed in via the digital S/P DIF interface

**LFG**
The audio stereo signal is internally generated by the LF generator.

*RST: LREXt

**Example:** `STER:SOUR LFG`
The internal LF generator is used as modulation source for the audio signal.

**Options:** R&S SMB-B5

---

**[:SOURce]:STEReo:STATe** <State>

Activates/deactivates stereo modulation.

**Parameters:**

<State> 0 | 1 | OFF | ON

*RST: OFF

**Example:** `STER:STAT ON`
activates generation of stereo signal.

**Options:** R&S SMB-B5

---

**[:SOURce]:STEReo[:DEViation]** <Deviation>

Sets the MPX (Multiplex stereo signal) deviation.

**Parameters:**

<Deviation> float

Range: 0.00 to 80.00kHz
Increment: 0.01Hz
*RST: 40kHz

**Example:** `STER 40kHz`
sets the stereo deviation according to standard.

**Options:** R&S SMB-B5

### 7.12.16 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....353
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute....353
[:SOURce<hw>]:SWEep[:FREQuency]:LFConnector....353
[:SOURce<hw>]:SWEep[:FREQuency]:MODE....354
[:SOURce<hw>]:SWEep[:FREQuency]:OVOLtage:STARt....354
[:SOURce<hw>]:SWEep[:FREQuency]:OVOLtage:STOP....355
[:SOURce<hw>]:SWEep[:FREQuency]:POINts....355
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe....356
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing....356
[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]....357
[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic....358
[:SOURce<hw>]:SWEep:POWer:DWELl....358
[:SOURce<hw>]:SWEep:POWer:EXECute....359
[:SOURce<hw>]:SWEep:POWer:MODE....359
[:SOURce<hw>]:SWEep:POWer:POINts....359
[:SOURce<hw>]:SWEep:POWer:SHAPe....360

[:SOURce<hw>]:SWEep:POWer:SPACing:MODE....360
[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic]....360
[:SOURce<hw>]:SWEep:RESet[:ALL]....361

**[: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: 10.0E-3 to 100
Increment: 100.0E-6
*RST: 10.0E-3
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]:LFConnector** <Lfconnector>

The command activates the output of a sweep voltage ramp at the LF connector.

The voltage range is set with commands
SOURce:SWEep:FREQuency:OVOLtage:STARt and …:STOP

**Parameters:**

<Lfconnector> OFF | ON

*RST: OFF

**Example:** SWE:LFC ON
activates the output of a linear voltage ramp from sweep start to sweep stop at the LF connector.
SWE:OVOL:STAR 0V
SWE:OVOL:STOP 3V
'the voltage at sweep start is 0 Volt and at sweep stop 3 V.

---

**[: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]:OVOLtage:STARt** <Start>

The command sets the voltage at the sweep stop frequency. The linear voltage ramp from sweep start to stop is output at the LF connector.

**Parameters:**

<Start> float

Range: -3.0 to 3.0

**Example:** `SWE:LFC ON`
activates the output of a linear voltage ramp from sweep start to sweep stop at the LF connector.
`SWE:OVOL:STAR 0V`
`SWE:OVOL:STOP 3V`
the voltage at the sweep start frequency is 0 V and at the stop frequency 3 V.

---

**[:SOURce<hw>]:SWEep[:FREQuency]:OVOLtage:STOP** <Stop>

The command sets the voltage at the sweep stop frequency. The linear voltage ramp from sweep start to stop is output at the LF connector.

**Parameters:**
<Stop> float
Range: -3.0 to 3.0

**Example:** `SWE:LFC ON`
activates the output of a linear voltage ramp from sweep start to sweep stop at the LF connector.
`SWE:OVOL:STAR 0V`
`SWE:OVOL:STOP 3V`
the voltage at the sweep start frequency is 0 V and at the stop frequency 3 V.

---

**[: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.

**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

**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 357).

**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 358).

*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: 0.001 Hz to (STOP - STARt)
Increment: 0.001 Hz
*RST: 1 MHz
Default unit: MHz

**Example:** `FREQ:STAR 1GHz`
sets the start frequency to 1 GHz.
`FREQ:STOP 5GHz`
sets the stop frequency to 5 GHz.
`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 2001.

**[: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: 0.01 PCT
*RST: 1 PCT

**Example:**

```
FREQ:STAR 1GHz
```
sets the start frequency to 1 GHz.
```
FREQ:STOP 5GHz
```
sets the stop frequency to 5 GHz.
```
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: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: 1.0E-3 to 100
Increment: 100.0E-6
*RST: 15.0E-3
Default unit: s

**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.

The command is only valid for sweep mode Single (`SOURce:SWEep:POWer:MODE SINGle`). The command corresponds to the manual-control command "Execute Single Sweep".

**Example:** `SOURce:SWEep:POWer:MODE SINGle`
sets the single cycle mode of the level sweep.
`SWE:POW:EXEC`
triggers a level sweep at the RF output.

**Usage:** Event

**[: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.

**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 139 dB
Increment: 0.01 dB
*RST: 1

**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 236 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 SMB causes the status registers to be changed. A decimal value between 0 and 32767 (= $2^{15}$-1) is set.

STATus:OPERation:CONDition....362
STATus:OPERation:ENABle....362
STATus:OPERation[:EVENt]....362
STATus:OPERation:NTRansition....363
STATus:OPERation:PTRansition....363
STATus:PRESet....363
STATus:QUEStionable:CONDition....364
STATus:QUEStionable:ENABle....364
STATus:QUEStionable[:EVENt]....364
STATus:QUEStionable:NTRansition....364

STATus:QUEStionable:PTRansition....365
STATus:QUEue[:NEXT]....365

**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 confirmed

**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 confirmed

**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 confirmed

**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 confirmed

**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 confirmed

**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 confirmed

**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 confirmed

**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 confirmed

**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 confirmed

**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 confirmed

---

**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 confirmed

---

**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 confirmed

## 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....366
:SYSTem:COMMunicate:GPIB:LTERminator....366
:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess....367

:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain....367
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:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup....368
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:SYSTem:COMMunicate:USB:RESource....369
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:SYSTem:ORESponse....375
:SYSTem:PROTect<ch>[:STATe]....376
SYSTem:SERRor....376
:SYSTem:STARtup:COMPlete....377
:SYSTem:TIME....377
SYSTem:VERSion....377

**: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 confirmed

**: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.

---

**: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 confirmed

---

**:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain** <Domain>

The command enters the domain of the network.

**Parameters:**

<Domain> string

**Example:** `SYST:COMM:NETW:COMM:DOM ABC.DE`
enters the domain of the network.

---

**:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname** <Hostname>

The command enters the individual computer name of the R&S 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 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 255.255.0.0`
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`

**: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.

**: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.

**: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.

**:SYSTem:COMMunicate:SOCKet:RESource?**

The command queries the visa resource string for remote control via the Socket interface.

**Return values:**

<Resource> string

**Example:** `SYST:COMM:SOCK:RES?`

**Usage:** Query only

**:SYSTem:DATE** <Date>

The command queries / sets the date for the instrument-internal calendar.

This parameter is protected, in order to prevent accidental changes. It can be accessed with protection level 1, see `:SYSTem:PROTect<ch>[:STATe]` on page 376.

**Parameters:**

<Date> <year>,<month>,<day>

**Example:** `SYST:DATE?`
Response: `2011,05,01` - it is the 1st of May in 2011.

**: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

*RST: 0

**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?**

The command queries all entries in the error queue and then deletes them.

**Parameters:**

<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

---

**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.

**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

**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.

**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

**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

**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.

**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

---

**: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 SMB 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 'HP8657'`
selects command set of the HP generator. The R&S SMB's command set is disabled.
To return to the SCPI command set of the R&S SMB, 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`.

**:SYSTem:LANGuage** <Language>

Sets the remote control command set.

The instrument can also be remote controlled via the command set of several other generators, e.g. HP generator.

Please check for 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).

**Note**: While working in a emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command `SYST:LANG` will be discarded.

The return to the SCPI command set of the R&S SMB can only be performed by using the appropriate command of the selected command set. For example, the HP command `EX` returns to the instrument-specific GPIB command set (selection `SYST:LANG HPxxxx`).

**Setting parameters:**

<Language> string

**Example:**
```
SYST:LANG?
Response: SCPI
```
The SCPI command set is used.

**Usage:** Setting only

**:SYSTem:ORESponse** <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 confirmed

---

**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
*RST: 0

**Example:** `SYST:STAR:COMP`
`Response: 1`
The startup of the instrument is completed.

**Usage:** Query only

**:SYSTem:TIME** <Time>

The command queries / sets the time for the instrument-internal clock.

The parameter is protected, in order to prevent accidental changes. It can be accessed with protection level 1, see `:SYSTem:PROTect<ch>[:STATe]` on page 376.

**Parameters:**

<Time> 0...23,0...59,0...59

**Example:** `SYST:TIME?`
Response: `12,0,0` it is precisely 12 pm.

**SYSTem: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

## 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 may 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>:ALL:STARt....378
:TEST<hw>:ALL:RESult....378
:TEST<hw>:DIRect....378

**:TEST<hw>:ALL:STARt**

This command performs a selftest on all installed hardware options. The selftest result is queried with the command `:TEST<hw>:ALL:RESult` on page 378.

**Example:** `TEST:ALL:STAR`
Starts the selftest

**Usage:** Event

**:TEST<hw>:ALL:RESult?**

Queries the result of the performed selftest (command `:TEST<hw>:ALL:STARt` on page 378).

**Return values:**
<All> 0 | 1

**Example:** `TEST:ALL`
Starts the selftest
`:TEST:ALL:RES?`
Response: "0" on success, "1" on fail

**Usage:** Query only

**: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 SMB 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 SMB can be found in the modulation and RF signal subsystems.

**TRIGger<hw>**

- Suffix TRIGger<1|2> is not permitted
- TRIGger0 activates the LF output.

***Table 7-2: 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.<br>Use command LFO:SWEep:MODE to select between the two sweep modes. |
| EAUTo | - | "Ext Start/Stop" mode. |

TRIGger0[:SWEep]:SOURce....379
:TRIGger<hw>:LFFSweep:SOURce....379
:TRIGger<hw>:FSWeep[:IMMediate]....380
:TRIGger<hw>:FSWeep:SOURce....380
:TRIGger<hw>:PSWeep[:IMMediate]....381
:TRIGger<hw>:PSWeep:SOURce....382
:TRIGger<hw>[:SWEep][:IMMediate]....382
:TRIGger<hw>[:SWEep]:SOURce....383

**TRIGger0[:SWEep]:SOURce** <Source>
**: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 7-2.

**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 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:** `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 7-2.

**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 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:** `TRIG:FSW:SOUR EXT`
selects triggering with an external trigger.

---

**: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 7-2.

**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 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:** `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 7-2.

**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> DEGree | DEGRee | RADian

*RST: RADian

**Example:** `UNIT:ANGL DEG`
sets default unit DEG for all commands which determine angle values.

**: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.

## 7.18 Direct Commands for the Stereo/RDS Coder Option R&S SMB-B5

The direct command allow to access all functions of the stereo coder option.

Some of the functions are also available via SCPI commands. In this case, it is recommended to use the SCPI commands in order to keep the settings of the R&S SMB and the stereo coder synchronized. Direct command for which a SCPI command is available are marked with “for documentation reasons only” and the SCPI command is given.

The direct commands are sent to the Stereo/RDS Coder with `[SOURce:]STEReo:DIRect "command string"`.

Information is queried with `STEReo:DIRect? "command string"`.

All parameters are string parameters, this is the reason why all of them have to be sent in qotation marks ( " – characters are part of the full direct command ! ).

Prior to using the stereo coder, the stereo modulation of the R&S SMB has to be switched on with command `SOURce:STEReo:STATe ON`. The SCPI command `SOURce:STEReo:AUDio:FREQuency` sets the LF-Generator frequency and command

`SOURce:STEReo:MMF` limits the modulation frequency. These commands have no counterpart in the direct commands.

### 7.18.1 Remote-Control Commands

**STEReo:DIRect** "<FFG>=<RetrNumb>,<DataSeq#1>,<DataSeq#2>,..."
**STEReo:DIRect?** "<FFG>"

Transmits data via free format groups (FFGs). A free format group can be filled with any desired data. (5 bits in block B and 16 bits each in blocks C and D of the group).

**Note:** The command described here only causes a queue to be filled with data for a specific group. The data will only be sent when the group in question is added to the group sequence with the command "GS", on page 393.

**Setting parameters:**

<RetrNumb> Number of retransmissions

<DataSeq> Max. 20 different data sequences can be defined.
10 characters must be specified each per <DataSeq>. Leading zeros, if any, must also be specified.
00: erases the data.

Range: 0000000000 to 1FFFFFFFFF (10 ASCII ccoded hexadecimal characters each)

**Parameters for setting and query:**

<FFG> 1A | 3A | 5A | 6A | 7A | 8A | 9A | 10A | 11A | 12A | 13A

Determines the free format group.
To transmit the FFGs of the B group, the same commands are used, only the A groups are replaced by the B groups in the group sequence. If B groups are transmitted, block C is overwritten with the PI code.

**Example:** `STEReo:DIRect "1A=01,0123456789,1FFFFFFFFF"`
Fills a queue with the data "0123456789,1FFFFFFFFF". The data is sent in consecutive order in group 1A after group 1A is added to the group sequence (see command "GS", on page 393).

**Example:** `STEReo:DIRect? "1A"`
Reads the data of group 1A.
Response: `"01,0123456789,1FFFFFFFFF"`

**STEReo:DIRect** "AF=<A>,<Freq#1>,<Freq#2>,..."
**STEReo:DIRect?** "AF<z>"

Defines an alternative frequency list.

**Note:** A maximum of five AF lists with max. 25 frequencies per list can be created.

**Parameters:**

<Freq> xxx.x

Sets the alternative frequencies as ASCII coded decimal numbers. If list <z> is not available, the response is ().

Range: 87.6 to 107.9

**Setting parameters:**

<A> **N**
new AF list

**+**
AF list to be added

**Query parameters:**

<z> AF list to be read

Range: 1 to 5

**Example:** `STEReo:DIRect "AF=N,97.4,98.3"`
Defines an alternative frequency list, the alternative frequencies 97.4 and 98.3 are inserted.

**Example:** `STEReo:DIRect? "AF1"`
Reads the first alternative frequency list.
Response: `"97.4,98.3"`

**Example:** `STEReo:DIRect "AF=N"`
Deletes all frequency lists.

---

**STEReo:DIRect** "ARI=<State>"
**STEReo:DIRect?** "ARI"

(for documentation reasons only)

Activates ARI signal transmission.

Use SCPI command `[:SOURce]:STEReo:ARI:STATe` instead.

**Setting parameters:**

<State> 0 | 1

**Example:** `STEReo:DIRect "ARI=0"`
Deactivates ARI signal transmission.

**Example:** `STEReo:DIRect? "ARI"`
Response: `"0"`

---

**STEReo:DIRect** "ARI-DEV=<Deviation>"
**STEReo:DIRect?** "ARI-DEV"

(for documentation reasons only)

Sets the frequency deviation of the ARI signal (max. deviation).

Use SCPI command `[:SOURce]:STEReo:ARI[:DEViation]` instead.

**Setting parameters:**

<Deviation> Sets the frequency deviation.
**Note:** A four-digit value must always be set. Leading zeros, if any, must also be specified.

Range: 0000 to 1000 (ASCII coded decimal numbers), corresponding to 0 Hz to 10 kHz

**Example:** `STEReo:DIRect "ARI-DEV=1000"`
Sets the ARI frequency deviation to 10 kHz.

**Example:** `STEReo:DIRect? "ARI-DEV`
Response: `"1000"`

---

**STEReo:DIRect** "ARI-ID=<Id>"
**STEReo:DIRect?** "ARI-ID"

(for documentation reasons only)

Selects the ARI identification.

Use SCPI command `[:SOURce]:STEReo:ARI:TYPE` instead.

**Parameters:**

<Id> 0 | 1 | 2 | 3

**0**
Off

**1**
DK (traffic announcement identification)

**2**
BK (area identification)

**3**
DK and BK (traffic announcement identification and area identification)

**Example:** `STEReo:DIRect "ARI-ID=0"`
Deactivates the ARI identification.

**Example:** `STEReo:DIRect? "ARI-ID"`
Response: `"0"`

---

**STEReo:DIRect** "BIN=<x>"

Defines and sends, or queries, binary test patterns.The BIN command causes the Stereo/RDS Coder to send periodic binary bit patterns instead of RDS data.

**Parameters:**

<x>

**0**
binary mode OFF

**1**
00000000...,

**2**
11111111...,

**3**
01010101...,

**4**
11001100...

**Example:** `STEReo:DIRect "BIN=2"`
The binary test pattern is set to "2" so that only "1s" are transmitted.

---

**STEReo:DIRect** "BK=<Code>"
**STEReo:DIRect?** "BK"

(for documentation reasons only)

Sets the ARI area identification.

Use SCPI command `[:SOURce]:STEReo:ARI:BK[:CODE]` instead.

**Parameters:**

<Code> A | B | C | D | E | F

**Example:** `STEReo:DIRect "BK=E"`
The ARI area identification is set to "E".

**Example:** `STEReo:DIRect? "BK"`
Response: `"E"`

---

**STEReo:DIRect** "CT= <Hour>:<Min>:<Sec>,<Day>.<Month>.<Year>"
**STEReo:DIRect?** "CT"

Sets and activates transmission of the real-time clock.

**Note:** The CT data is transmitted in group 4A. Setting the real-time clock (CT command) automatically adds group 4A to the group sequence. Group 4A must not be manually added to, or removed from, the group sequence. To remove group 4A from the group sequence, use the command "CT=off".

**Setting parameters:**

<Hour>:<Min>:<Sec> Range: 00:00:00 to 23:59:59

<Day>.<Month>.<Year> Range: 01.01.00 to 31.12.85

**Example:** `STEReo:DIRect "CT=20:30:59,01.08.03"`
The real-time clock is set to 20:30:59 and 1 August 2003.

**Example:** `STEReo:DIRect? "CT"`
Response: `"20:31:06,01.08.03"`

---

**STEReo:DIRect** "CT=off"

Deactivates transmission of the real-time clock signal in the RDS signal.

**Note:** This command is used to remove group 4A from the group sequence. Group 4A must not be manually removed from the group sequence.

**Example:** `STEReo:DIRect "CT=off"`
The real-time clock signal is no longer transmitted in the RDS signal.

**Usage:** Setting only

---

**STEReo:DIRect** "DI=<x>"
**STEReo:DIRect?** "DI"

Sets or reads the decoder information (DI).

With this command, the current decoder operating mode (mono, stereo, etc) can be detected and, if necessary, changed.

**Parameters:**
<x> Range: 0 to F (ASCII coded hexadecimal numbers)

**Example:** `STEReo:DIRect "DI=4"`
The decoder information is set to "4".

**Example:** `STEReo:DIRect? "DI"`
Response: `"4"`

---

**STEReo:DIRect** "DS=<x>"
**STEReo:DIRect?** "DS"

(for documentation reasons only)

Selects/activates a storage area in the Stereo/RDS Coder.

Upon activation, the settings stored in the selected area can be loaded.

Use SCPI command `[:SOURce]:STEReo:RDS:DATaset` instead.

**Parameters:**
<x> Range: 1 to 5

**Example:** `STEReo:DIRect "DS=2"`
Storage area 2 is activated.

**Example:** `STEReo:DIRect? "DS"`
Response: `"2"`

**STEReo:DIRect** "EON-AFA= <PI>,<A>,<Freq#1>,<Freq#2>,..."
**STEReo:DIRect?** "EON-AFA,<PI>,<z>"

Enhanced Other Networks: defines type A alternative frequencies for the EON with the selected PI.

**Parameters:**

<PI> Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

<Freq> xxx.x

Sets the alternative frequencies as ASCII coded decimal numbers. If list <z> is not available, the response is ().
**Note:** For each Enhanced Other Network (EON), a maximum of five type A alternative frequency lists can be created.

Range: 87.6 to 107.9

**Setting parameters:**

<A> **N**
new AF list

**+**
AF list to be added

**Query parameters:**

<z> AF list to be read

Range: 1 to 5

**Example:** `STEReo:DIRect "EON-AFA=1000,N,97.4,98.3"`
Creates a new type A alternative frequency list for the EON with PI=1000.
The new list contains the alternative frequencies 97.4 MHz and 98.3 MHz.

**Example:** `STEReo:DIRect? "EON-AFA,1000,1"`
Reads the first type A alternative frequency list of the EON with PI=1000.
Response: `"97.4,98.3"`

**STEReo:DIRect** "EON-AFB= <PI>,<A>,<Freq#1>,<Freq#2>,..."
**STEReo:DIRect?** "EON-AFB,<PI>,<z>"

Enhanced Other Networks: defines type B alternative frequencies for the EON with the selected PI.

**Parameters:**

<PI> Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

<Freq> xxx.x

Sets the alternative frequencies as ASCII coded decimal numbers. If list <z> is not available, the response is ().
**Note:** For each Enhanced Other Network (EON), a maximum of five type B alternative frequency lists can be created, each list containing max. five frequencies, where <Freq#1> is Tuned Frequency (TF) and <Freq#2..5> are the Mapped Frequencies (MF). A minimum of two frequencies per EON is required.

Range: 87.6 to 107.9

**Setting parameters:**

<A> **N**
new AF list

**+**
AF list to be added

**Query parameters:**

<z> AF list to be read

Range: 1 to 5

**Example:** `STEReo:DIRect "EON-AFB=1000,N,97.4,98.3"`
Creates a new type B alternative frequency list for the EON with PI=1000.
The list contains the alternative frequencies 97.4 MHz and 98.3 MHz.

**Example:** `STEReo:DIRect? "EON-AFB,1000,1"`
Reads the first type B alternative frequency list of the EON with PI=1000.
Response: `"97.4,98.3"`

---

**STEReo:DIRect** "EON-DEL=<PI>"

Enhanced Other Networks: deletes the complete EON with selected <PI>.

**Parameters:**

<PI> Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

**Example:** `STEReo:DIRect "EON-DEL=1000"`
Deletes the EON with PI=1000.

**Usage:** Setting only

---

**STEReo:DIRect** "EON-PI=<PI>"
**STEReo:DIRect?** "EON-PI"

Enhanced Other Networks: creates a new EON or reads the list of the program identification (PI) codes of all EONs created so far.

**Note:** A maximum of eight EONs can be created.

**Parameters:**

<PI> **Note:** A four-digit value must always be set. Leading zeros, if any, must also be specified.

Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

**Example:** `STEReo:DIRect "EON-PI=1000"`
Creates a new EON with PI=1000.

**Example:** `STEReo:DIRect? "EON-PI"`
Response: `"1000"`

---

**STEReo:DIRect** "EON-PS=<PI>,<PS>"
**STEReo:DIRect?** "EON-PS,<PI>"

Enhanced Other Networks: sets the program service (PS) name for the EON with the selected <PI>.

**Parameters:**

<PI> Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

**Setting parameters:**

<PS> 8 ASCII characters
**Note:** An eight-digit value must always be set. Blank spaces, if any, must also be entered, otherwise the value will not be accepted.

**Example:** `STEReo:DIRect "EON-PS=1000,Test 123"`
Sets the program service name for the EON with PI=1000 to "Test 123".

**Example:** `STEReo:DIRect? "EON-PS,1000"`
Reads the program service name of the EON with PI=1000.
Response: `"Test 123"`

---

**STEReo:DIRect** "EON-PTY=<PI>,<PTY>"
**STEReo:DIRect?** "EON-PTY,<PI>"

Enhanced Other Networks: sets the program type (PTY) for the EON with the selected <PI>.

**Parameters:**

<PI> Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

**Setting parameters:**

<PTY> Range: 00 to 31 (ASCII coded decimal numbers)

**Example:** `STEReo:DIRect "EON-PTY=1000,10"`
Sets the program type for the EON with PI=1000 to "10".

**Example:** `STEReo:DIRect? "EON-PTY,1000"`
Reads the program type of the EON with PI=1000.
Response: `"10"`

**STEReo:DIRect** "EON-TA=<PI>,<TA>"
**STEReo:DIRect?** "EON-TA,<PI>"

Enhanced Other Networks: sets the TA flag for the EON with the selected <PI>.

**Parameters:**
<PI> Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

**Setting parameters:**
<TA> 0 | 1

**Example:** `STEReo:DIRect "EON-TA=1000,1"`
Sets the TA flag for the EON with PI=1000 to "1".

**Example:** `STEReo:DIRect? "EON-TA,1000"`
Reads the TA flag of the EON with PI=1000.
Response: `"1"`

**STEReo:DIRect** "EON-TP=<PI>,<TP>"
**STEReo:DIRect?** "EON-TP,<PI>"

Enhanced Other Networks: sets the TP flag for the EON with the selected <PI>.

**Parameters:**
<PI> Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

**Setting parameters:**
<TP> 0 | 1

**Example:** `STEReo:DIRect "EON-TP=1000,1"`
Sets the TP flag for the EON with PI=1000 to "1".

**Example:** `STEReo:DIRect? "EON-TP,1000"`
Reads the TP flag of the EON with PI=1000.
Response: `"1"`

**STEReo:DIRect** "GS=<Group#1>,<Group#2>,...<Grpup#36>"
**STEReo:DIRect?** "GS"

Sets or reads the group sequence.

**Note:** Only group A or group B data may be sent at a time. Only groups that contain data are transmitted. The groups 4A, 14B and 15B are automatically added to the group sequence and must not be added or removed manually.

**Setting parameters:**
<Group> 0A,1A,2A, … to 15B

**Example:** `STEReo:DIRect "GS=0A,1B,10A,15A"`
The groups 0A,1B,10A,15A are transmitted.

**Example:** `STEReo:DIRect? "GS"`
Response: `"0A,1B,10A,15A"`

**STEReo:DIRect** "IMP=<x>"
**STEReo:DIRect?** "IMP"

(for documentation reasons only)

Sets external L, R impedances.

Use the SCPI command `[:SOURce]:STEReo:EXTernal:IMPedance` instead.

**Setting parameters:**

<x> 1 | 2

**1**
600 Ohm

**2**
100 kOhm

**Example:** `STEReo:DIRect "IMP=1"`
The external impedance is set to 600 Ohm

**Example:** `STEReo:DIRect? "IMP"`
Response: `"1"`

**STEReo:DIRect**
"MASK=<NumbGroups>,<ErrFreeGroups>,<BitMaskBlcA>,<BitMaskBlcB>,<BitMaskBlcC>,<BitMaskBlcD>"
**STEReo:DIRect?** "MASK"

Sets a bit mask to generate defined bit errors in the RDS data stream.

**Setting parameters:**

<NumbGroups> Number of groups to be masked.
If <NumbGroups> is set to zero, the RDS groups are continuously linked to the error mask.
If <NumbGroups> is set to a value other than zero, this value is decremented after each errored group transmitted. When zero count is reached, no further errored groups are transmitted, and MASK_STATE is set to "0".

Range: 00 to FF (hexadecimal values)

<ErrFreeGroups> Number of error-free groups to be inserted after each errored group.

Range: 00 to FF (hexadecimal values)

<BitMaskBlc> <BitMaskBlcA>,<BitMaskBlcB>,<BitMaskBlcC>,<BitMaskBlcD>

Hexadecimal bit mask for blocks A, B, C and D of the RDS groups. For each block, 26 bits (16 data bits and 10 CRC bits) have to be entered in hexadecimal code.

Range: 0000000 to 3FFFFFFF

**Example:** `STEReo:DIRect "MASK=09,01,0000001,0000000,0000000,0000000"`
In nine RDS groups, the least significant bit of the CRC code of block A is inverted, i.e. an errored bit is sent. After each errored group, one error-free group is inserted. After transmission of the complete sequence, `MASK_STATE` is set to "0".
With the command `MASK_STATE=1`, the above sequence (9 errored groups with one error-free group inserted after each errored group) is retransmitted once.
Then, `MASK_STATE` is again set to "0".

**Example:** `STEReo:DIRect? "MASK"`
Response: `"09,01,0000001,0000000,0000000,0000000"`

---

**STEReo:DIRect** "MASK_STATE=<State>"
**STEReo:DIRect?** "MASK_STATE"

Switches on or off the transmission of defined bit errors in the RDS data stream.

**Setting parameters:**
<State> 0 | 1

**Example:** `STEReo:DIRect "MASK_STATE=1"`
With the command `MASK_STATE=1`, a sequence of errored groups as defined by the MASK command is retransmitted once if the number of groups to be masked is other than zero. Then, `MASK_STATE` is automatically set to "0".
If the number of groups to be masked is equal to zero in the `MASK` command (which means continuous error transmission), the masking function can be switched off with `MASK_STATE=0`.

**Example:** `STEReo:DIRect? "MASK_STATE"`
Response: `"1"`
The `MASK_STATE` query provides information as to whether the RDS data stream is linked to an error mask.

---

**STEReo:DIRect** "MODE=<EMODE>"
**STEReo:DIRect?** "MODE"

(for documentation reasons only)

Sets one of various transmit modes.

Use the SCPI command `[:SOURce]:STEReo:AUDio:MODE` instead.

**Setting parameters:**

<EMODE> 1 | 2 | 3 | 4 | 5

**1**
L: signal in left channel only

**2**
R: signal in right channel only

**3**
signal of equal frequency and phase in left and right channel

**4**
signal of equal frequency and opposite phase in left and right channel

**5**
different, independent signals in left and right channel
(5 is not possible if the internal LF generator is selected as source (SRC = LFGen))

**Example:** `STEReo:DIRect "MODE=1"`
Only the signal of the left channel is transmitted.

**Example:** `STEReo:DIRect? "MODE"`
Response: `"1"`

---

**STEReo:DIRect** "MS=<Flag>"
**STEReo:DIRect?** "MS"

Sets or reads the music/speech flag.

The flag signals whether music or speech is being transmitted.

**Setting parameters:**

<Flag> M | S

**Example:** `STEReo:DIRect "MS=M"`
The music/speech flag is set to "M". This signals that music is currently transmitted.

**Example:** `STEReo:DIRect? "MS"`
Response: `"M"`

---

**STEReo:DIRect** "MPX-DEV=<Deviation>"
**STEReo:DIRect?** "MPX-DEV"

(for documentation reasons only)

Sets the MPX frequency deviation (max. deviation).

Use the SCPI command `[:SOURce]:STEReo[:DEViation]` instead.

**Setting parameters:**

<Deviation> A five-digit value must always be set. Leading zeros, if any, must also be specified.

Range: 00000 to 10000 (ASCII coded decimal numbers), corresponding to 0 Hz to 100 kHz

**Example:** `STEReo:DIRect "MPX-DEV=00201"`
Sets the MPX frequency deviation to 2.01 kHz.

**Example:** `STEReo:DIRect? "MPX-DEV"`
Response: `"00201"`

---

**STEReo:DIRect** "PI=<PI>"
**STEReo:DIRect?** "PI"

Sets or reads the RDS program identification (PI) code.

**Setting parameters:**

<PI> **Note:** A four-digit value must always be set. Leading zeros, if any, must also be specified, otherwise the value will not be accepted.

Range: 0000 to FFFF (ASCII coded hexadecimal numbers)

**Example:** `STEReo:DIRect "PI=1234"`
The program identification code to be transmitted is set to "1234".

**Example:** `STEReo:DIRect? "PI"`
Response: `"1234"`

---

**STEReo:DIRect** "PIL=<State>"
**STEReo:DIRect?** "PIL"

(for documentation reasons only)

Activates/deactivates the pilot tone.

Use the SCPI command `[:SOURce]:STEReo:PILot:STATe` instead.

**Setting parameters:**

<State> 0 | 1

**Example:** `STEReo:DIRect "PIL=1"`
The pilot tone is activated.

**Example:** `STEReo:DIRect? "PIL"`
Response: `"1"`

---

**STEReo:DIRect** "PIL-DEV=<Deviation>"
**STEReo:DIRect?** "PIL-DEV"

(for documentation reasons only)

Sets the pilot tone frequency deviation (max. deviation).

Use the SCPI command `[:SOURce]:STEReo:PILot[:DEViation]` instead.

**Setting parameters:**

<Deviation> **Note:** A four-digit value must always be set. Leading zeros, if any, must also be specified.

Range: 0000 to 1000 (ASCII coded decimal numbers), corresponding to 0 Hz to 10 kHz

**Example:** `STEReo:DIRect "PIL-DEV=1000"`
Sets the frequency deviation of the pilot tone to 10 kHz.

**Example:** `STEReo:DIRect? "PIL-DEV"`
Response: `"1000"`

---

**STEReo:DIRect** "PIL-PH=<Phase>"
**STEReo:DIRect?** "PIL-PH"

(for documentation reasons only)

Sets the pilot tone phase.

Use the SCPI command `[:SOURce]:STEReo:PILot:PHASe` instead.

**Setting parameters:**

<Phase> **Note:** A two-digit value must always be set with a sign ("+" or "-") in front of it. Leading zeros, if any, must also be specified.

Range: -5.0 to +5.0 (ASCII coded decimal numbers), corresponding to ±5.0

**Example:** `STEReo:DIRect "PIL-PH=-33"`
The pilot tone phase is set to 3.3

**Example:** `STEReo:DIRect? "PIL-PH"`
Response: `"-33"`

---

**STEReo:DIRect** "PRE=<Preemphasis>"
**STEReo:DIRect?** "PRE"

(for documentation reasons only)

Sets one of various preemphasis options.

Use the SCPI commands `[:SOURce]:STEReo:AUDio:PREemphasis:STATe` and `[:SOURce]:STEReo:AUDio:PREemphasis` instead.

**Setting parameters:**

<Preemphasis> 0 | 1 | 2

**0**
Off

**1**
50 us

**2**
75 us

**Example:** `STEReo:DIRect "PRE=1"`
The preemphasis is set to 50 us.

**Example:** `STEReo:DIRect? "PRE"`
Response: `"1"`

---

**STEReo:DIRect** "PRESET"

Sets the default settings in accordance with specifications.

**Example:** `STEReo:DIRect "PRESET"`

**Usage:** Event

---

**STEReo:DIRect** "PS=<PS>"
**STEReo:DIRect?** "PS"

Sets or reads the RDS program service (PS) name.

**Setting parameters:**

<PS> 8 ASCII characters

**Note:** An eight-digit value must always be set. Blank spaces, if any, must also be entered, otherwise the value will not be accepted.
Special characters in the program service name are entered with a leading back slash (\) followed by the decimal code of the spezial character according to tabe E1 of CENELEC.
Example: `STER:DIR "RT=02,0,test text with \217"` 217 denotes the German ü.

**Example:** `STEReo:DIRect "PS=RDS Test"`
Sets the program service name to be transmitted to "RDS Test".

**Example:** `STEReo:DIRect? "PS"`
Response: `"RDS Test"`

---

**STEReo:DIRect** "PS-TABLE=<Table>"
**STEReo:DIRect?** "PS-TABLE"

Selects the character set table tobe used for the display of the RDS program service (PS) name in the receiver.

The information concerning the character set is transmitted in segment 0 of the PS. Segment 0 is repeatedly transmtted if the value for `PS-TABLE` > 0. For `PS-TABLE`=0 no information concerning the character set is transmitted.

**Setting parameters:**

<Table> 0 | 1 | 2 | 3

**0**
no information concerning the character set table in the PS

**1**
table E.1 is used

**2**
table E.2 is used

**3**
table E.3 is used

**Example:** `STEReo:DIRect "PS-TABLE=2"`
The information concerning the character set is transmitted in segment 0 of the PS in group 0A. To this end, segment 0 is transmitted repeatedly. At the first transmission segment 0 contains the information about the character set, at the second transmission segment 0 contains the first two characters of the PS.

---

**STEReo:DIRect** "PTY=<PTY>"
**STEReo:DIRect?** "PTY"

Sets or reads the program type (PTY).

**Setting parameters:**

<PTY> **Note:** A two-digit value must always be set. A leading zero, if any, must also be specified.

Range: 00 to 31 (ASCII coded decimal numbers)

**Example:** `STEReo:DIRect "PTY=08"`
Sets the program type to be transmitted to "08".

**Example:** `STEReo:DIRect? "PTY"`
Response: `"08"`

---

**STEReo:DIRect** "PTYN=<PTYN>"
**STEReo:DIRect?** "PTYN"

Sets or reads the RDS program type (PTY) name.

**Setting parameters:**

<PTYN> 8 ASCII characters

**Note:** An eight-digit value must always be set. Blank spaces, if any, must also be entered, otherwise the value will not be accepted.

**Example:** `STEReo:DIRect "PTYN=Football"`
Sets the program type name to be transmitted to "Football".
`STEReo:DIRect "GS=0A,10A"`
Group 10A is activated in addition to group 0A. The program type name "Football" is now transmitted.

**Example:** `STEReo:DIRect? "PTYN"`
Response: `"Football"`

**Example:** `STEReo:DIRect "PTYN="`
Transmission of PTYN in group 10A is stopped, even if group 10A is contained in the group sequence.

---

**STEReo:DIRect** "RDS=<State>"
**STEReo:DIRect?** "RDS"

(for documentation reasons only)

Switches RDS on or off.

Use the SCPI command `[:SOURce]:STEReo:RDS:STATe` instead.

**Setting parameters:**
<State> 0 | 1

**Example:** `STEReo:DIRect "RDS=1"`
RDS is switched on.

**Example:** `STEReo:DIRect? "RDS"`
Response: `"1"`

---

**STEReo:DIRect** "RDS-PH=<Phase>"
**STEReo:DIRect?** "PDS-PH"

Sets the RDS phase.

**Setting parameters:**
<Phase> Range: 000 to 359 (ASCII coded decimal numbers)

**Example:** `STEReo:DIRect "RDS-PH=100"`
The RDS phase is set to 100.

**Example:** `STEReo:DIRect? "RDS-PH"`
Response: `"100"`

---

**STEReo:DIRect** "RDS-DEV=<Deviation>"
**STEReo:DIRect?** "RDS-DEV"

(for documentation reasons only)

Sets the RDS frequency deviation (max. deviation).

Use the SCPI command `[:SOURce]:STEReo:RDS[:DEViation]` instead.

**Setting parameters:**
<Deviation> **Note:** A four-digit value must always be set. Leading zeros, if any, must also be specified.

Range: 0000 to 1000 (ASCII coded decimal numbers), corresponding to 0 Hz to 10.00 kHz)

**Example:** `STEReo:DIRect "RDS-DEV=0201"`
The RDS frequency deviation is set to 2.01 kHz.

**Example:** `STEReo:DIRect? "RDS-DEV"`
Response: `"0201"`

---

**STEReo:DIRect** "RDS-PRESET"

All RDS specific parameters are deleted or set to a default values.

**Example:** `STEReo:DIRect "RDS-PRESET"`
Sets all RDS parameter to their preset values

**Usage:** Event

---

**STEReo:DIRect** "RT=<RetranNumber>,<A/BFlag>,<RadioTextMsg#1>,<RadioTextMsg#2>"
**STEReo:DIRect?** "RT"

Radio text

**Setting parameters:**

<RetranNumber> Range: 00 to 15 (ASCII coded decimal numbers), number of retransmissions of radio text message

<A/BFlag> 0 | 1
If the A/B flag is set, the A/B bit in group 2A is toggled to signal that a new radio text message will be transmitted.)

<RadioTextMsg> max. 64 characters
Two texts of 64 characters each can be transmitted in a radio text message
**Note:** For group B, the length of a radio text is li ited to 32 characters. Special characters in the radio text are entered with a leading back slash (\) followed by the decimal code of the spezial character according to tabe E1 of CENELEC.
Example: `STER:DIR "RT=02,0,test text with \217"` 217 denotes the German ü.

**Example:** `STEReo:DIRect "RT=02,1,Test message 123"`
The radio text message "Test message 123" is transmitted.

**Example:** `STEReo:DIRect? "RT"`
Response: `"02,1,Test message 123"`

---

**STEReo:DIRect** "SPS=<Time>,<PSN#1>,<PSN#2>,...<PSN#20>"
**STEReo:DIRect?** "SPS"

Switching program service names (PSN). The program name automatically changed after the set time interval

**Parameters:**

<PSN> 8 ASCII characters

Max. 20 program service names of eight characters each can be entered.
**Note:** The program service names have to be entered as 8-digit texts. Blank spaces, if any, must also be entered, otherwise the value will not be accepted.
`STEReo:DIRect "SPS=0"` stopps the transmission of the scrolling PS beendet and starts the transmission of the standard PS.

**Setting parameters:**

<Time> Time interval in seconds

Range: 00 to 59 s

**Example:** `STEReo:DIRect "SPS=05,TEST0123,TEST4567"`
The program service names "TEST0123" and "TEST4567" are alternately transmitted at an interval of 5 seconds.

**Example:** `STEReo:DIRect? "SPS"`
Queries the program service names
Response: `"05,TEST0123,TEST4567"`

---

**STEReo:DIRect** "SRC=<SigSource>"
**STEReo:DIRect?** "SRC"

(for documentation reasons only)

Selects the signal source.

Use the SCPI command `[:SOURce]:STEReo:SOURce` instead.

**Setting parameters:**

<SigSource> 0 | 1 | 2 | 3

**0**
Off

**1**
external analog (via L and R inputs)

**2**
external digital

**3**
internal with LF generator

**Example:** `STEReo:DIRect "SRC=1"`
The external analog L and R inputs are selected as source.

**Example:** `STEReo:DIRect? "SRC"`
Response: `"1"`

---

**STEReo:DIRect?** "STATUS"

Status request as to whether the encoder or the update loader program is being executed.

**Return values:**

<Status> **ENC**
encoder program is running

**UPL**
update loader program is running

**Example:** `STEReo:DIRect? "STATUS"`
Response: `"ENC"`

**Usage:** Query only

---

**STEReo:DIRect** "STORE=<DataSet#>"

Stores data in the flash memory. All RDS-specific settings are stored in data set <DataSet#> of the flash memory.

**Setting parameters:**

<DataSet#> Range: 1 to 5

**Example:** `STEReo:DIRect "STORE=1"`
The current settings are stored in data set "1"

**Usage:** Setting only

---

**STEReo:DIRect** "TA=<State>"
**STEReo:DIRect?** "TA"

(for documentation reasons only)

Sets or reads the traffic announcement flag.

This flag signals whether traffic information is currently being broadcast.

Use the SCPI command `[:SOURce]:STEReo:RDS:TRAffic:ANNouncement[:STATe]` instead.

**Setting parameters:**

<State> 0 | 1

**Example:** `STEReo:DIRect "TA=1"`
The traffic announcement flag is set to "1".

**Example:** `STEReo:DIRect? "TA"`
Response: `"1"`

---

**STEReo:DIRect** "TP=<State>"
**STEReo:DIRect?** "TP"

(for documentation reasons only)

Sets or reads the traffic program flag. This flag signals whether traffic information is generally transmitted.

Use the SCPI command `[:SOURce]:STEReo:RDS:TRAFfic:ANNouncement[:STATe]` instead.

**Setting parameters:**

<State> 0 | 1

**Example:** `STEReo:DIRect "TP=1"`
The traffic program flag is set to "1".

**Example:** `STEReo:DIRect? "TP"`
Response: `"1"`

---

**STEReo:DIRect** "TRANS<DataNumber>=<DataStream>"
**STEReo:DIRect?** "TRANS<DataNumber>"

Transparent mode.

An RDS data stream of binary data is generated. If transparent data is selected, all other RDS data is ignored.

**Parameters:**

<DataNumber> Max. 20 different data sequences can be defined.
Range: 0 to 20

<DataStream> 16 ASCII coded hexadecimal characters (blocks A to D of the RDS groups)
TRANS=0 deletes all transparent data and switches back to normal RDS data transmission.
**Note:** 16 characters must be specified for each data sequence. Leading zeros, if any, must also be specified. The data will be transmitted even if it constitutes no meaningful RDS data.

**Example:** `STEReo:DIRect "TRANS1=0123456789ABCDEF"`
The data "0123456789ABCDEF" is sent instead of the RDS data.

**Example:** `STEReo:DIRect? "TRANS1"`
Reads the transparent data.
Response: `"0123456789ABCDEF"`

## 7.18.2 Examples

### 7.18.2.1 Alternative Frequency Lists

Alternative frequency lists can be transmitted in two ways:

- **Method A:**
  The frequencies of an AF list are entered one after the other; the frequency currently transmitted has to be specified as the first frequency.
- **Method B:**
  The frequencies of an AF list are entered in pairs, each pair containing the frequency currently transmitted and an alternative frequency. The frequency pairs should nor-

mally be entered in ascending order. Descending order should be chosen only if the alternative frequencies belong to different regions or are used to broadcast different programs at different times.



Do not combine methods A and B!

**Method A:**

1. Generate a new alternative frequency list with
   `STEReo:DIRect "AF=N,87.6,87.7,87.8".`
2. Set the group sequence, e.g.
   `STEReo:DIRect "GS=0A,14A".`

   The group sequence must contain group 0A.
   The alternative frequencies are now transmitted in group 0A.
3. Add another alternative frequency list with
   `STEReo:DIRect "AF=+,88.6,88.7,88.8"`

**Method B:**

1. Generate a new alternative frequency list with
   `STEReo:DIRect "AF=N,87.6,90.2,87.6,90.2".`
2. Set the group sequence, e.g.
   `STEReo:DIRect "GS=0A,14A".`

   The group sequence must contain group 0A
   The alternative frequencies are now transmitted in group 0A.
3. Add another alternative frequency list with
   `STEReo:DIRect "AF=+,88.6,91.2,88.6,91.2"`

The frequency lists are not checked for correctness. For this reason, make sure that the syntax is correct.

A maximum of five AF lists can be generated. For type A lists, max. 25 frequencies per list can be specified, for type B lists, max. 12 frequencies per list.

### 7.18.2.2 Enhanced Other Networks

**Creating an EON data set**

1. Read the list of existing EON data sets with
   `STEReo:DIRect? "EON-PI"`

   The list shows the EON PI codes already used and those remaining for new data sets.
2. Create an EON data set with

```
STEReo:DIRect "EON-PI=1234"
```

3. Set the program service (PS) name for the EON data set with
   `STEReo:DIRect "EON-PS=1234,TEST EON"`
4. Set the group sequence, e.g.:
   `STEReo:DIRect "GS=0A,14A"`
   Group 14A with variants 0 to 3 is now transmitted.
5. Create a new AF list for the EON:
   a) Using method A
      `STEReo:DIRect "EON-AFA=1234,N,87.6,87.7,87.8"`
   b) Create further AF lists for the EON, using method A:
      `STEReo:DIRect "EON-AFA=1234,+,88.6,88.7,88.8"`
   c) Read the first AF list of the EON with
      `STEReo:DIRect? "EON-AFA,1234,1"`
6. Create a new AF list for the EON, using method B:
   `STEReo:DIRect "EON-AFB=1234,N,87.6,87.7,87.8"`
   where 87.6 = tuned frequency,
   87.7 = mapped frequency 1(variant 5),
   87.8 = mapped frequency 2 variant 6)
   **Note:** Do not combine methods A and B for generating EON alternative frequency lists.
   A maximum of five AF lists can be generated. For type A lists, max. 25 frequencies per list can be specified, for type B lists, max. five frequencies per list.

#### 7.18.2.3 Free Format Groups (FFGs)

In the user-definable groups 1A, 3A, 5A, 6A, 7A, 8A, 9A, 10A, 11A, 12A and 13A, any desired data can be transmitted. Five bits of this data are transmitted in block B and 16 bits each in blocks C and D of the specified group.

1. Define the data to be transmitted in group 1A:
   `STEReo:DIRect "1A=05,0000000000,1FFFFFFFFF"`
   Group 1A is now transmitted first with "0000000000" and then with "1FFFFFFFFF". Each of the two data sequences is retransmitted five times, which is indicated by the information "05".
2. Set the group sequence, e.g.:
   `STEReo:DIRect "GS=0A,1A"`
   The defined data is now transmitted in group 1A.
   Max. 20 different data sequences can be defined.

#### 7.18.2.4 Transparent-Mode

The transparent mode allows the user to transmit freely definable binary data instead of the standard RDS data. Blocks A to D of the RDS groups are used. This means that standard RDS data will no longer be transmitted when transparent data is set. The binary data will be sent even if it constitutes no valid or meaningful RDS data. The transmission of standard RDS data will not be resumed until the transparent data is deleted.

1. Transmit the alternating sequences '0123456789ABCDEF' and 'ABCDEF0123456789' instead of the RDS data:
   `STEReo:DIRect "TRANS=0123456789ABCDEF,ABCDEF0123456789"`
2. Delete the transparent data and switch back to standard RDS data transmission with:
   `STEReo:DIRect "TRANS=0"`

   Max. 20 different data sequences can be defined.

# 8 Maintenance

The instrument does not need 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 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 SMB. The error messages are output in the "Info" line on the screen and entered in the 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)

**OVERLOAD**
The power of the external signal applied to the RF output is too high. The overload protection is tripped and the connection between the RF output and attenuator is interrupted. The overload protection is reset by pressing the RF ON/OFF key. The RF input is activated when the overload protection is reset.

**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`).

**LOC-LLO**
For operating directly the instrument is placed from remote control to manual operation (Local State). The LOCAL key was disabled by remote control with the command `LLO` (**L**ocal**L**ock**O**ut).

With the next activating of the remote control mode, the instrument cannot be switched to manual operation by the operator. The status information changes to "REM-LLO".

The instrument can be switched to manual operation by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)`).

### 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 situation. 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.<br>• Change setting to 'internal' if no appropriate external source is available. |
| 140 | This modulation forces other modulations off | A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been switched off.<br>Example: Enabling FM modulation switches PM modulation off. | |
| 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 82. |
| 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. |

| Error Code | Error | Description | Remedy |
|---|---|---|---|
| 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.<br>For instance, 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. |
| 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 extension.<br>For instance, 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.<br>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.<br>Example: the extension of a waveform file (= `*.wv`) was changed to `*.txt` | Check the file extension. |



**Stereocoder error messages**

An error occurred concerning the stereo coder option R&S SMB-B5. Refer to the service manual, chapter 3, section "Trouble shooting" for error correction (the service manual is provided on the user documentation CD-ROM which is included in delivery).

# A Hardware Interfaces

This section covers hardware related topics, like pin assignment of the GPIB bus interface.

The remote control interfaces are described in detailes in chapter 6, "Remote Control Basics", on page 193.

All other interfaces are described in sections "Legend of Front Planel" and "Legend of Rear Panel" in the Quick Start Guide.

For specifications refer to the data sheet.

## A.1 GPIB Bus Interface

### Pin assignment

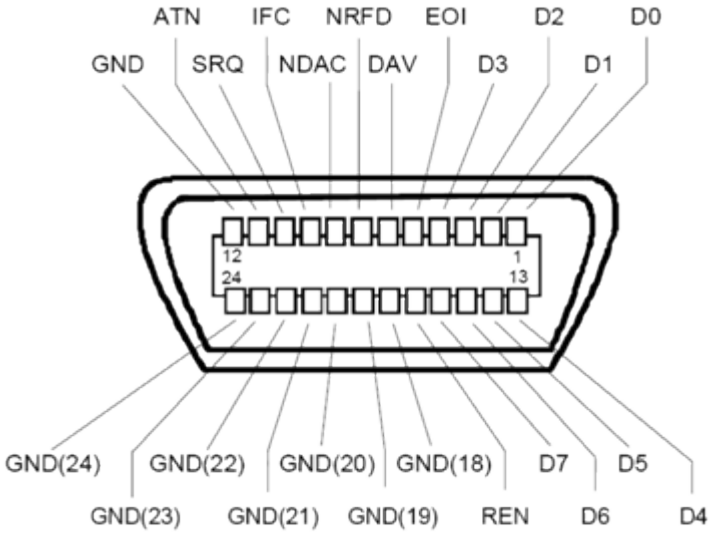



*Fig. 1-1: Pin assignment of GPIB bus interface*

### 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 SMB 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 |

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