R&S®SMA100A
Signal Generator
Operating Manual

1400.0075.32 — 14

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the R&S®SMA100A, stock no. 1400.0000k02 and its options.

- R&S®SMA-B20
- R&S®SMA-B22
- R&S®SMA-B29
- R&S®SMA-B46
- R&S®SMA-B80/-B81
- R&S®SMA-B103/-B103L
- R&S®SMA-B106/-B106L
- R&S®SMA-K23/-K27
- R&S®SMA-K24
- R&S®SMA-K25
- R&S®SMA-K26
- R&S®SMA-K28

This manual describes firmware version FW 3.50.057.xx and later of the R&S®SMA100A.

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The following abbreviations are used throughout this manual: R&S®SMA100A is abbreviated as R&S SMA.

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 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.

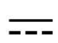
Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any purpose 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.

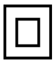
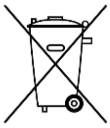
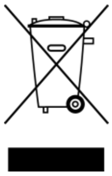
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. 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. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

The following safety labels are used on products to warn against risks and dangers.

Symbol	Meaning	Symbol	Meaning
	Notice, general danger location Observe product documentation		ON/OFF Power
	Caution when handling heavy equipment		Standby indication
	Danger of electric shock		Direct current (DC)

Symbol	Meaning	Symbol	Meaning
	Caution ! Hot surface		Alternating current (AC)
	Protective conductor terminal To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth		Direct/alternating current (DC/AC)
	Earth (Ground)		Class II Equipment to identify equipment meeting the safety requirements specified for Class II equipment (device protected by double or reinforced insulation)
	Frame or chassis Ground terminal		EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1.
	Be careful when handling electrostatic sensitive devices		EU labeling for separate collection of electrical and electronic devices For additional information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

Signal words and their meaning

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

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

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

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

NOTICE Indicates information considered important, but not hazard-related, e.g. messages relating to property damage.
In the product documentation, the word ATTENTION is used synonymously.

These signal words 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 signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words 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, 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, overvoltage category 2, pollution degree 2.
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 even 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 even death.

Electrical safety

If the information on electrical safety is not observed either at all or 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 mains-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 a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor 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 there is no power switch for disconnecting the product from the mains, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the mains. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 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, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fuse-protected 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 provided for this purpose. 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, fuse protection, 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 IEC 60950-1 / EN 60950-1 or IEC 61010-1 / 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 protective conductor terminal on site and the product's protective 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 fuse-protected 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/Environmental protection", 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. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. 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).
8. EMC classes (in line with EN 55011/CISPR 11, and analogously with EN 55022/CISPR 22, EN 55032/CISPR 32)
   - Class A equipment:
     Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings
     Note: Class A equipment is intended for use in an industrial environment. This equipment may cause radio disturbances in residential environments, due to possible conducted as well as radiated disturbances. In this case, the operator may be required to take appropriate measures to eliminate these disturbances.
   - Class B equipment:
     Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings

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, protective 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. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
5. 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.
6. 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.
7. 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/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. 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.
4. 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.

For additional information about environmental protection, visit the Rohde & Schwarz website.

Instrucciones de seguridad elementales

¡Es imprescindible leer y cumplir 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 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.

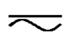
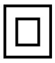
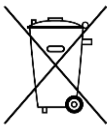
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa 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.

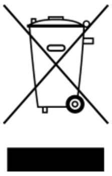
Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto 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. Los datos específicos del producto figuran en la hoja de datos y en la documentación del producto.

Señalización de seguridad de los productos

Las siguientes señales de seguridad se utilizan en los productos para advertir sobre riesgos y peligros.

Símbolo	Significado	Símbolo	Significado
	Aviso: punto de peligro general Observar la documentación del producto		Tensión de alimentación de PUESTA EN MARCHA / PARADA
	Atención en el manejo de dispositivos de peso elevado		Indicación de estado de espera (standby)
	Peligro de choque eléctrico		Corriente continua (DC)
	Advertencia: superficie caliente		Corriente alterna (AC)
	Conexión a conductor de protección		Corriente continua / Corriente alterna (DC/AC)
	Conexión a tierra		El aparato está protegido en su totalidad por un aislamiento doble (reforzado)
	Conexión a masa		Distintivo de la UE para baterías y acumuladores Más información en la sección "Eliminación/protección del medio ambiente", punto 1.

Símbolo	Significado	Símbolo	Significado
	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)		Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2.
	Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7.		

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 Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.

ADVERTENCIA Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.

ATENCIÓN Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.

AVISO Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales.
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, 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. Categoría de sobrecarga eléctrica 2, índice de suciedad 2.
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, se pueden causar lesiones o, en determinadas circunstancias, 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, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
   El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
   Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor 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/protección del medio ambiente", 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. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. 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).
8. Clases de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

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. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. 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.
6. 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).
7. 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/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado.
   Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. 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.
4. 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.

Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

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.

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ROHDE & SCHWARZ

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Contents

1 Preface

1.1 Documentation Overview

This section provides an overview of the R&S SMA user documentation. You find it on the product page at:

http://www.rohde-schwarz.com/product/SMA100A.html > "Downloads"

Quick start guide

Introduces the R&S SMA and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

Online help

Offers quick, context-sensitive access to the complete information directly on the instrument.

Operating manual

Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the quick start guide manual.

The **online version** of the operating manual provides the complete contents for immediate display on the Internet.

Service manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS, https://gloris.rohde-schwarz.com).

Instrument security procedures manual

Deals with security issues when working with the R&S SMA in secure areas.

Basic safety instructions

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the instrument.

Data sheet and brochure

The data sheet contains the technical specifications of the R&S SMA. It also lists the options and their order numbers as well as optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

Release notes and open source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The open source acknowledgment document provides verbatim license texts of the used open source software.

See http://www.rohde-schwarz.com/product/SMA100A.html > "Downloads" > "Firmware"

Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics, see http://www.rohde-schwarz.com/appnotes.

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.

1.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic test situations.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 Preparing for Use

The following topics 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 SMA 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 56 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 67.

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 SMA 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.

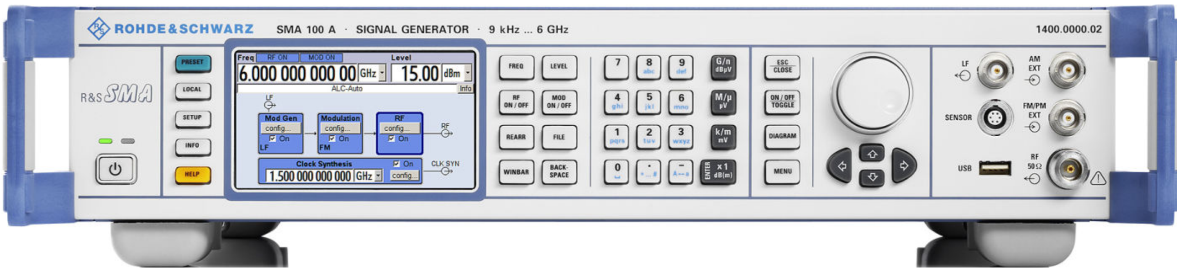


Figure 2-1: Front panel view

2.1.1 Utility Keys

The keys to the left of the display cause the R&S SMA 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 2.3.5.4, "Default Settings", on page 31).

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

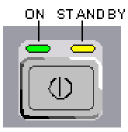
SETUP
Opens the "Setup" dialog for configuring presettings.

For more information, see Chapter 5.2.3, "General Configuration of Instrument - Setup Key", on page 95.

INFO
Displays status messages, error messages and warnings.

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 2.3.5.1, "Standby and Ready state", on page 30.

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 70.

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 Parameters

These keys provide direct access to the settings in the header of the instrument and can be used for fast changing the state of the modulation and the RF signal.

For more information refer to chapter "Instrument Functions".

FREQ
Activates frequency entry.

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

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

LEVEL
Activates level entry.

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.

REARR
Adjusts the size of the active menu to use the whole hight of the dislay.

FILE
Activates the menu for storing or loading files (see Chapter 4.7, "File Management", on page 85).

WINBAR
Toggles between the active menus.

BACKSPACE
Deletes the character to the left of the cursor.

2.1.4.2 Display Keys

The keys left of the rotary knob arrange different windows on the display.

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.

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.

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

The display of the header section can be enlarged so that it completely covers the display by pressing the DIAGRAM key twice. The frequency, level and status information is indicated in extra large letters.

MENU
Calls the menu tree.

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 80). 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.

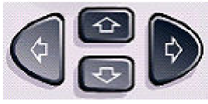
ROTARY KNOB

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:

- In a numeric edit dialog box, increase or decrease the instrument parameter.
- In a list, table, window or dialog box, scroll vertically.

LEFT/ RIGHT KEYS

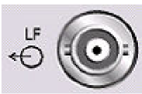
The left and right arrow keys do the following:

- In an alphanumeric edit dialog box, move the cursor forward and back.
- In a list, table, window or dialog box, scroll horizontally.

2.1.7 Front Panel Connectors

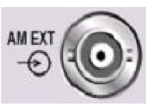
The RF and LF connectors and various additional interface connectors are located on the front panel.

LF



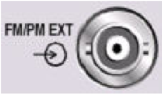
Output for internal LF modulation generator signal.

See also data sheet and Chapter 5.5.1, "Overview of LF Generator", on page 322, Chapter 5.5.3, "LF Output", on page 329.



AM EXT

Input for external AM modulation signals.



FM/PM EXT

Input for external FM or PhiM modulation signals (option R&S SMA-B20/-B22).

RF

Outputs for RF signal.

NOTICE! Maximum Input Levels. Do not overload the RF output.
The instrument is equipped with a reverse power protection that prevents the RF output against back feed, see Chapter 5.3.5.7, "Reverse Power Protection", on page 175.
Nevertheless, the maximum permisssible reverse power is specified in the data sheet.

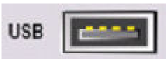
The RF signal is output via an N female connector.

NOTICE! Risk of RF connector and cable damage. Excessive tightening of the connectors can damage the cables and connectors. Too weak tightening leads to inaccurate results.
Always use an appropriate torque wrench suitable for this type of connector and apply the torque specified in the application note 1MA99.

The application notes are available on the Internet and provide additional information on care and handling of RF connectors.

Rohde & Schwarz offers appropriate torque wrenches for various connectors. For ordering information see the R&S SMA data sheet or product brochure.

USB

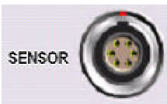


USB (universal serial bus) interfaces of type A (host USB).

- Connection of peripherals such as mouse or keyboard
- Connection of memory stick for file transmission
- Firmware update

See also Chapter 2.4.1, "Connecting USB Devices", on page 33.

SENSOR



Connector for R&S NRP-Zxx sensors.

With the aid of the "User Correction" function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables.

The power sensors are connected by inserting the male connector. To disconnect hold the connector by its sleeve. Pulling on the sensor cable will not release the sensor connector.

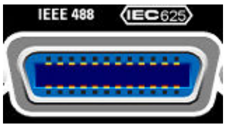
See also Chapter 5.3.6.2, "NRP-Z Power Viewer", on page 176.

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.

Figure 2-2: Rear panel view

2.2.1 Description of the Connectors



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 696 and Chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353.

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.

INSTR TRIG

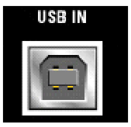
Input for external trigger for sweeps, list mode and Fast Hopping Mode.

AUX I/O

Parallel input for FM/PhiM digital data signals as well as control signals for Fast Hopping mode.

NOTICE! Risk of instrument damage. The maximum permissible input voltage is 3.3 V DC.

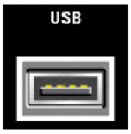
For detailed description of the AUX I/O connector, refer to Chapter A.2, "AUX I/O Connector", on page 697.



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

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

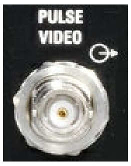
Further USB interface type A are available on the front panel.

See also Chapter 2.4.1, "Connecting USB Devices", on page 33.

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 261 .



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 261 .

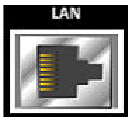
PULSE SYNC

Output of sync signal for pulse generator signal. The sync signal is generated at the beginning of each pulse. For double-pulse generation, the sync signal is generated at the beginning of the first pulse.

EXT TUNE

Tuning input for the internal reference frequency.

See Chapter 5.3.4, "Reference Oscillator", on page 151.



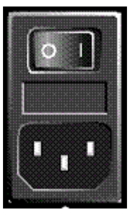
LAN CONNECTOR

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 36
- Chapter 6.1.3, "LAN Interface", on page 349



AC SUPPLY AND POWER SWITCH

When the R&S SMA 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 2.3.4, "Connecting the Instrument to the AC Supply", on page 29.

CF MEMORY SLOT

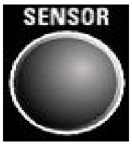
Slot for removable CompactFlash™ Card (option R&S SMA-B80).

REF OUT
Output of internal reference signal.

See also Chapter 5.3.4, "Reference Oscillator", on page 151.

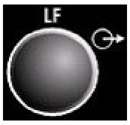
REF IN
Input for external reference signal.

See also Chapter 5.3.4, "Reference Oscillator", on page 151.



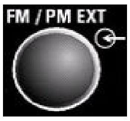
SENSOR
Rear panel connector for R&S NRP-Zxx power sensors (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).



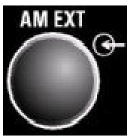
LF
Rear panel output for internal LF generator signal (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).



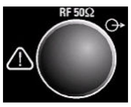
FM/PM EXT
Rear panel input for external FM or PhiM modulation signals (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).



AM EXT
Rear panel input for external AM modulation signals (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).



RF OUT
Rear panel output for RF signal (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).

NOTICE! Maximum Input Levels. Do not overload the RF output.
The instrument is equipped with a reverse power protection that prevents the RF output against back feed, see Chapter 5.3.5.7, "Reverse Power Protection", on page 175. Nevertheless, the maximum permisssible reverse power is specified in the data sheet.

CLK SYN

Output of clock synthesizer (option R&S SMA-B29).

NOTICE! Maximum Input Levels. Do not overload the Clock Synthesizer output. The maximum permissible back-feed is specified in the data sheet.
See data sheet and Chapter 5.6, "Clock Synthesis", on page 344

2.3 Putting into Operation

This section describes the basic steps to be taken when setting up the R&S SMA 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" delivered as a printed brochure with the instrument.
  In addition, read and observe 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 prevent damage to the instrument. The instrument's data sheet can contain additional operating conditions.

NOTICE

Risk of electrostatic discharge (ESD)

Electrostatic discharge (ESD) can damage the electronic components of the instrument and the device under test (DUT). ESD is most likely to occur when you connect or disconnect a DUT or test fixture to the instrument's test ports. To prevent ESD, use a wrist strap and cord and connect yourself to the ground, or use a conductive floor mat and heel strap combination.

For details, refer to the basic safety instructions delivered as a printed brochure with the instrument.

NOTICE

Risk of instrument damage during operation

An unsuitable operating site or test setup can damage the instrument and 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.

2.3.1 EMI Suppression

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated Electromagnetic Interference (EMI),

- Use suitable shielded cables of high quality. For example use double-shielded RF and LAN cables.
  Note: USB cables are of varying and often poor quality. Therefore, check the quality of each individual USB cable as described in the service manual.
- Always terminate open cable ends.
- Note the EMC classification in the data sheet

2.3.2 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.
2. Carefully remove the pads from the instrument handles at the front.
3. Pull off the corrugated cardboard cover that protects the rear of the instrument.
4. Carefully unthread the corrugated cardboard cover at the front that protects the instrument handles and remove it.
5. Check the equipment for completeness using the delivery note and the accessory lists for the various items.
6. 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.

2.3.3 Placing or Mounting the Instrument

The R&S SMA 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

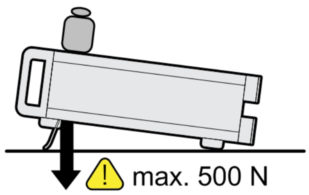
If the R&S SMA is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

CAUTION

Risk of injury if feet are folded out

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.



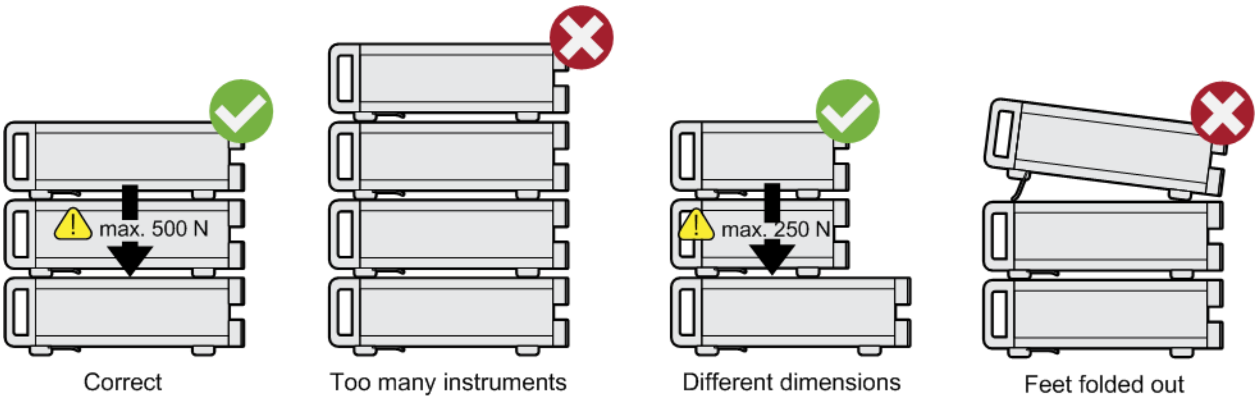
CAUTION

Risk of injury and instrument damage if stacking instruments

A stack of instruments may tilt over and cause injury. Furthermore, the instruments at the bottom of the stack may be damaged due to the load imposed by the instruments on top.

Observe the following instructions when stacking instruments:

- Never stack more than three instruments with the same dimensions (width and length). If you need to stack more than three instruments, install them in a rack.
- The overall load imposed on the lowest instrument must not exceed 500 N.
- All instruments should have the same dimensions (width and length).
  If you need to stack smaller instruments on the top, the overall load imposed on the lowest instrument must not exceed 250 N.
- If the instruments have foldable feet, fold them in completely.



Rackmounting

The R&S SMA 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 insufficient 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.

2.3.4 Connecting the Instrument to the AC Supply

The R&S SMA 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.

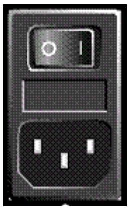
► Connect the instrument to the AC power source using the AC power cable delivered with the instrument.

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

2.3.5 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.

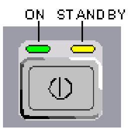


Starting up instruments with power switch

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.

2.3.5.1 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 SMA 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.

2.3.5.2 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.

2.3.5.3 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, "Status Information, Error Messages and Troubleshooting", on page 688.

Additionaly to the automatic monitoring, the R&S SMA 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.

2.3.5.4 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 SMA 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 5.2.3.21, "Factory Preset", on page 123.

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

Settings that are not affected by the PRESET key

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

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

2.3.6 Shutting Down the Instrument

To shut down the R&S SMA, 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.

2.3.7 Power Fuses

The R&S SMA 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 SMA 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 36).

2.4.1 Connecting USB Devices

Via the USB ports, you can connect external devices directly to the R&S SMA. If you need more interfaces, you just use an USB hub.

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

- Memory stick for easy transfer of data to/from a computer (for example 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, for example 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 SMA, 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 uses an embedded Linux operating system. To make sure that the instrument software works 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 36). After the R&S SMA is started, the operating system boots and the instrument firmware is started automatically.

Accessing Operating System

No access to the operating system is required for normal operation.

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

The R&S SMA provides a internal CompactFlash™ Card, it does not contain a disk drive. The CompactFlash™ Card holds the firmware and the stored data. However, data transfer is only possible via a memory stick connected to a USB interface. The memory stick and the CompactFlash™ Card are accessed via the "File Manager".

Accessing 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/SMB file access use the user "instrument" with the default password "instrument".

It is highly recommenced that you change this password in the Chapter 5.2.3.19, "Security", on page 117 dialog before connecting the instrument to the network!

Refer also to Application Note 1GP72 "Connectivity of Signal Generators", provided on the Rohde & Schwarz website, at http://www.rohde-schwarz.com/appnotes.

Screen saver

A screen saver can be activated in the R&S SMA. 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 SMA 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 instrument, e.g. in order to run a remote control program.
  See Chapter 6, "Remote Control Basics", on page 347.
- To access or control the measurement from a remote computer using the R&S VISA or Ultr@VNC programs (or similar tools, like another VNC client or any Web browser supporting Java)
- 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 36
- Chapter 2.6.2, "Assigning the IP Address", on page 37

Accessing Operating System

No access to the operating system is required for normal operation.

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
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer

In both cases, an IP address has to be assigned to the instrument and the computer, which is usually accomplished automatically. See also Chapter 2.6.2, "Assigning the IP Address", on page 37.

To set up a network (LAN) connection

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.

► Connect the instrument to the network or to a single PC.

  If the instrument is connected to the LAN, the operating system automatically detects the network connection and activates the required drivers.
  By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically.

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

NOTICE

Risk of network connection failure

Network cables and cable connectors of poor quality may cause network connection failures.

If the network connection to the instrument fails, check the network infrastructure and contact your network administrator.

For details, see section "Status Information, Error Messages and Troubleshooting".

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 (APIPA) 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.

Use computer names to identify the instrument

In networks using a DHCP server, it is recommended that you address the instrument by its unambiguous computer name, see Chapter 2.6.3, "Using Computer Names", on page 38.

A computer name (*hostname*) is an unique dedicated identification of the instrument, that remains permanent as long as it is not explicitly changed. Hence, you can address an instrument by the same identification (computer name), irrespectively if a network or a point-to-point connection is used.

To assign the IP address manually on the remote computer

► Obtain the necessary information from your network administrator. If you use more than one LAN connector, you need separate address information for each connector.
  For information on how to perform the configurations, refer to the documentation of the operating system the remote computer uses.

2.6.3 Using Computer Names

In a LAN that uses a DNS server (Domain Name System server), each PC or instrument connected in the LAN can be accessed via an unambiguous computer name instead of the IP address. The DNS server translates the host name to the IP address. This is especially useful when a DHCP server is used, as a new IP address may be assigned each time the instrument is restarted.

Each instrument is delivered with an assigned computer name, but this name can be changed.

The default instrument name is a non-case-sensitive string that follows the syntax `rs<instrument><serial number>`.

The serial number can be found on the rear panel of the instrument. It is the third part of the device ID printed on the bar code sticker:

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 default password is *123456*.

   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 SMA 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 56.

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.

For example, 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
Any web browser for example Windows Internet Explorer or Mozilla Firefox, see Chapter 2.7.1, "Using a Web Browser for Remote Access", on page 40	required	no	*Java Runtime* must be installed and activated in the browser settings.
Web browser with HTML5 for example LXI Browser, see Chapter 2.8.2.4, "Web Control", on page 52	required	no	*Web sockets* must be supported.
VNC Client for example Ultr@VNC or other dedicated client software for PCs with Linux/Unix or Windows operating system see Chapter 2.7.2, "Remote Access via a VNC Client Software", on page 41	required	required	VNC Viewer required

When the connection is set up with a VNC client software (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 5.2.3.19, "Security", on page 117).

2.7.1 Using a Web Browser for Remote Access

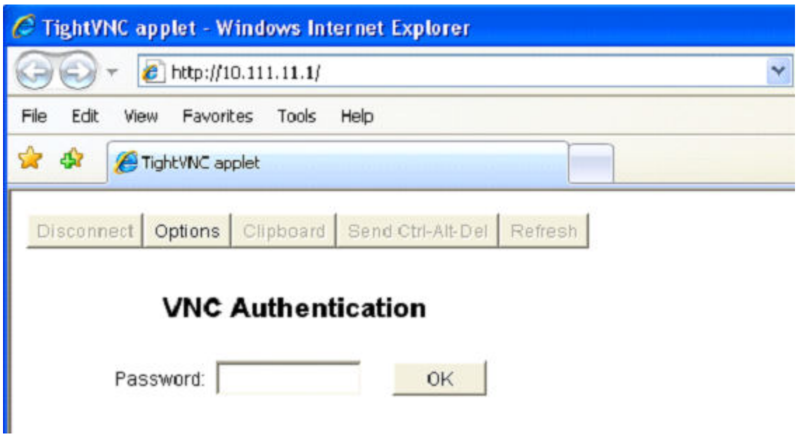
The instrument can be remote-accessed via any web browser, as for example the Windows Internet Explorer or Mozilla Firefox.

Alternatively, you can also make use of the LXI browser, as described in Chapter 2.8.2.4, "Web Control", on page 52.

To remote access the instrument via a 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 36.
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 a VNC Client Software

A VNC client software is an application which can be used to access and control the instrument from a remote computer via LAN.

The following description explains how to establish the remote access, represented by means of the client software Ultr@VNC. The software is included in Linux/Unix operating system, but it is also available as a free-of-charge download on the Internet http://www.uvnc.com/download/index.html. Thus, it is also available for remote computers with Windows operating system.

The GUI appearance of Ultr@VNC may vary if you use a later release. Also, similar programs may deviate in some details, but the basic procedure is the same.

NOTICE

Risk of Unauthorized Access

If the VNC service is enabled on the instrument, any user in the network who knows the computer name and password can access it.

Disable the VNC service on the instrument to prevent unauthorized access.

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 36.
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 44.
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 44;
   b) the remote computer with Windows operating system, see "Setting up the VNC connection on the Windows remote computer" on page 45.

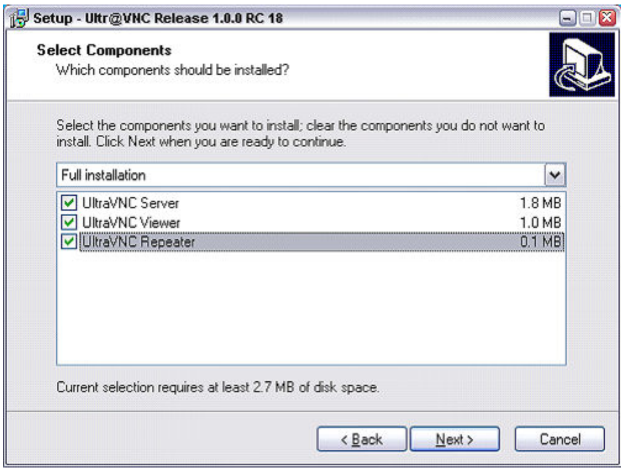
Enabled Direct Control

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.

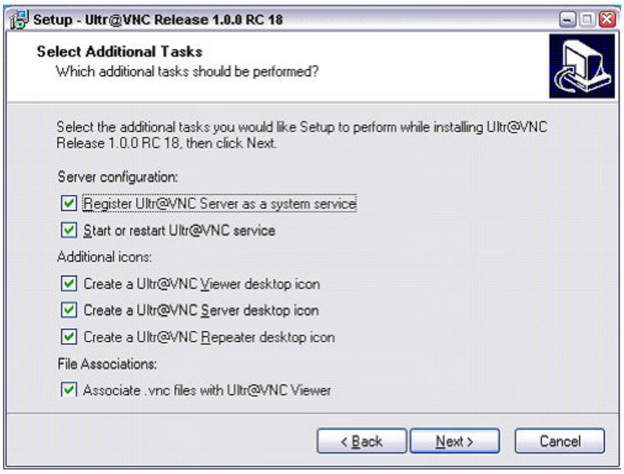
Installing the Ultr@VNC application

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.

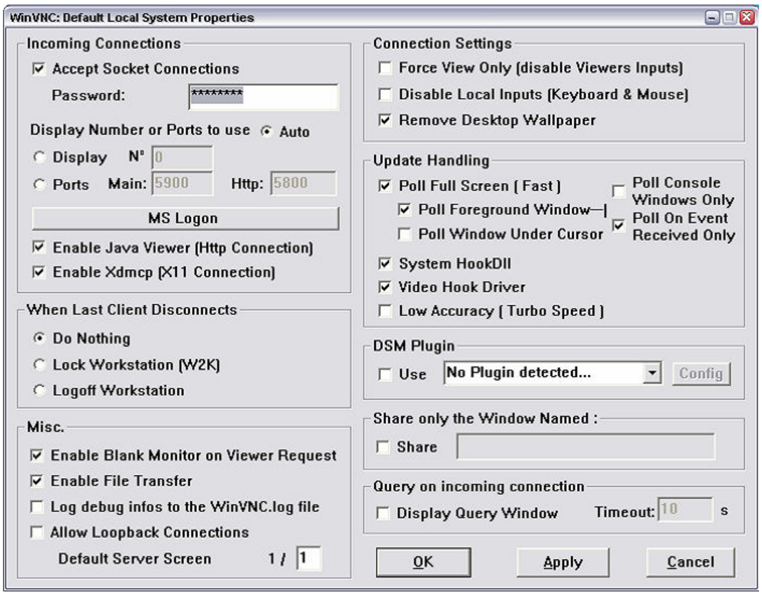


A successful installation is indicated by a message.

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*.

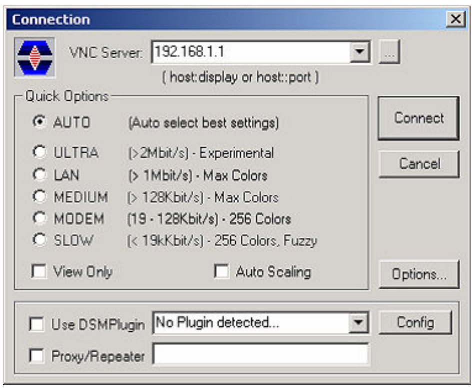
   A dialog is opened and the password for the remote VNC connection is requested.

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 SMA 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 SMA
   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.

2.8 LXI Configuration

LXI ("LAN eXtensions for Instrumentation" is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB.

Like GPIB, LXI determines and standardizes the way the instrument behaves in a LAN. The LXI implementation by the Rohde&Schwarz signal generators allows you to change certain LAN settings, to reset the LAN connection as well as to identify the instrument easily.

For information about the LXI standard, refer to the LXI website at http://www.lxistandard.org. See also "News from Rohde & Schwarz, article 2006/II - 190".

The R&S SMA provides an integrated "LXI Status" dialog for LXI status indication and reset of the LAN configuration ("LAN Configuration Initialize", LCI). To access the LXI status dialog, press the SETUP key and select "Remote > LXI Status".

For further information, see Chapter 5.2.3.17, "LXI Status", on page 115.

Firmware update

After a firmware update, shut down and restart the instrument in order to enable the full LXI functionality.

Default state of the network settings

According to the LXI standard, an LCI must set the following parameters to a default state.

Parameter	Value
TCP/IP Mode	DHCP + Auto IP Address
Dynamic DNS	Enabled
ICMP Ping	Enabled
Password for LAN configuration	LxiWebIfc

The LCI for the R&S SMA also resets the following parameters:

Parameter	Value
Hostname	<Instrument-specific host name>
Description	Vector Signal Generator
Negotiation	Auto Detect
VXI-11 Discovery	Enabled

The LAN settings are configured using the instrument's "LXI Browser Interface".

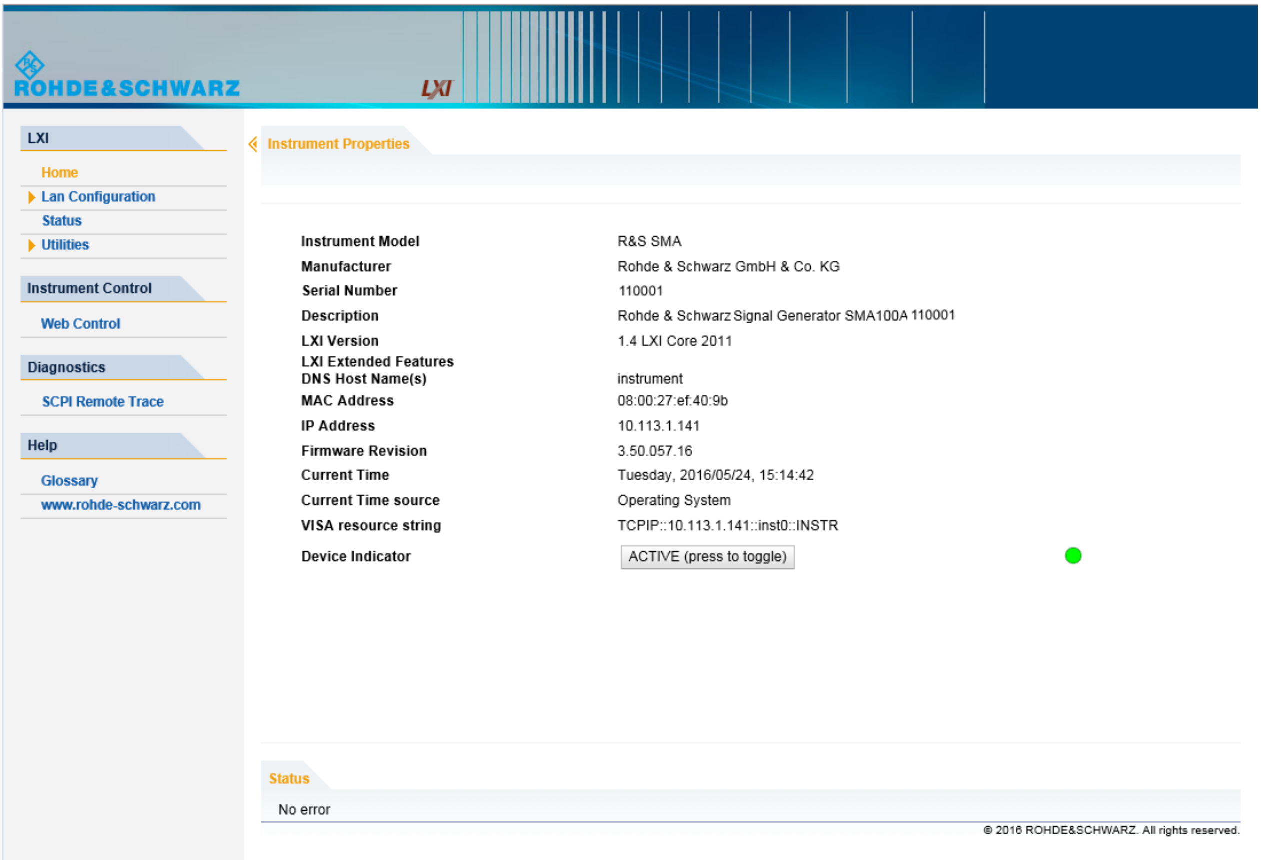
2.8.1 LXI Browser Settings

To access the instrument via the web browser:

► Type in the instrument's host name or IP address in the address field of the browser on your PC, for example "http://10.113.1.205".

Note: Do not add the missing zeros in the IP address, while opening the instrument home page.

The instrument home page (welcome page) opens.



The navigation pane of the browser interface contains the following elements:

- "LXI"
  - "Home" opens the instrument home page.
    The home page displays the device information required by the LXI standard, including the VISA resource string in read-only format.
  - "Device Indicator" activates or deactivates the LXI status indication.
    When activated, the LXI LEDs flash, both in the browser dialog and in the LXI dialog of the connected instrument. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates that no LAN cable is connected.
  - "Lan Configuration" allows you to configure LAN parameters and to initiate a ping, see Chapter 2.8.2.3, "Ping Client", on page 51.
  - "Status" displays information about the LXI status of the instrument.
  - "Utilities" provides access to the LXI event log functionality required by the LXI standard.
- "Instrument Control"

  – "Web Control" provides remote access to the instrument, see Chapter 2.8.2.4, "Web Control", on page 52.
- "Diagnostics"
  – "SCPI Remote Trace" records messages exchanged via the remote control interface, see Chapter 2.8.2.5, "SCPI Remote Trace", on page 53.
- "Help"
  – "Glossary" explains terms related to the LXI standard.
  – www.rohde-schwarz.com opens the Rohde & Schwarz home page.

► Press the "INACTIVE (press to toggle)" button to activate the connection.

A green flashing status LED indicates the active connection. If the LAN connection fails, the LED turns red.
For further information, see section "LXI Status" in the Operating Manual.

2.8.2 LAN Configuration

The "LAN Configuration" web page provides access to the parameters required for identifying the R&S SMA in the network, and allows modification.

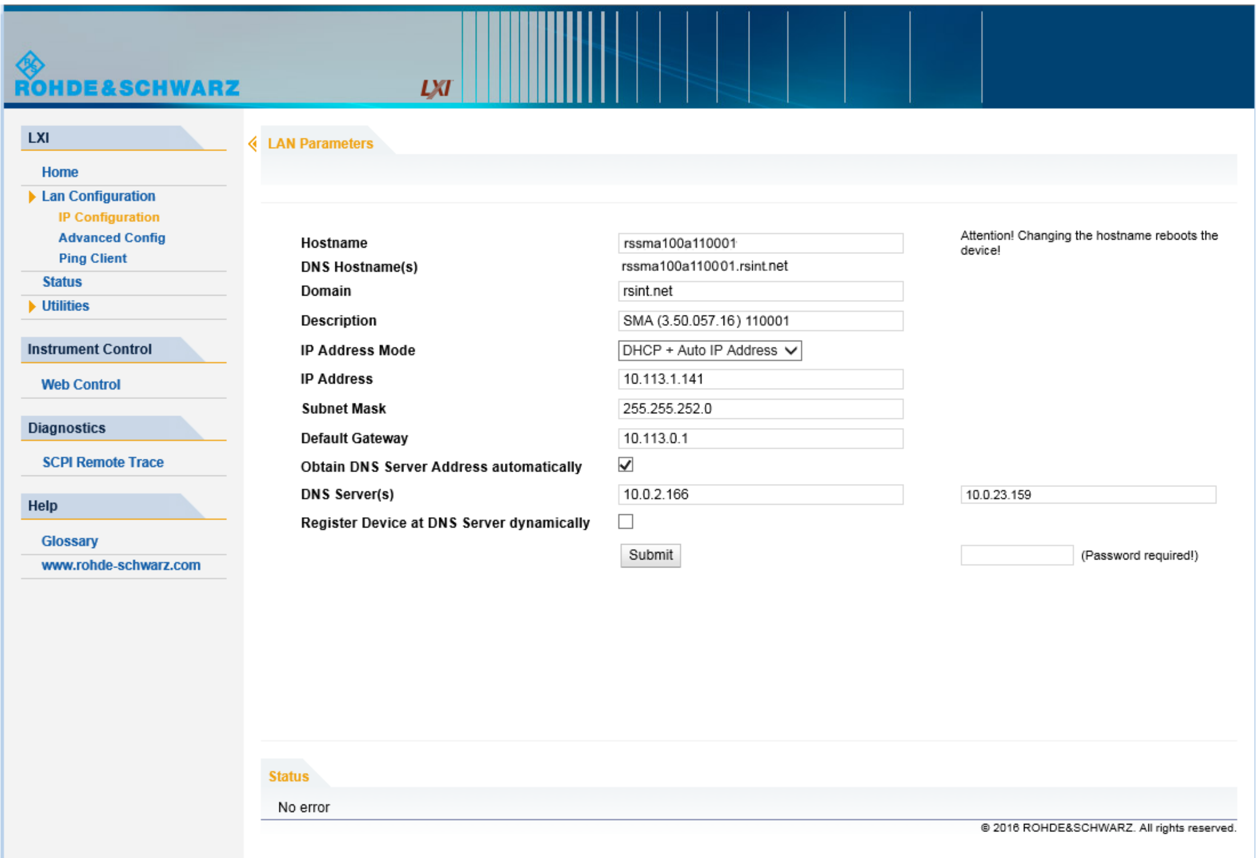
Password protection

Changing the LAN configuration is password-protected. The default password is *LxiWebIfc* (notice upper and lower case characters). This password cannot be changed in the current firmware version.

It comprises the following navigation entries.

2.8.2.1 IP Configuration

The "IP Configuration" page displays all mandatory LAN parameters.

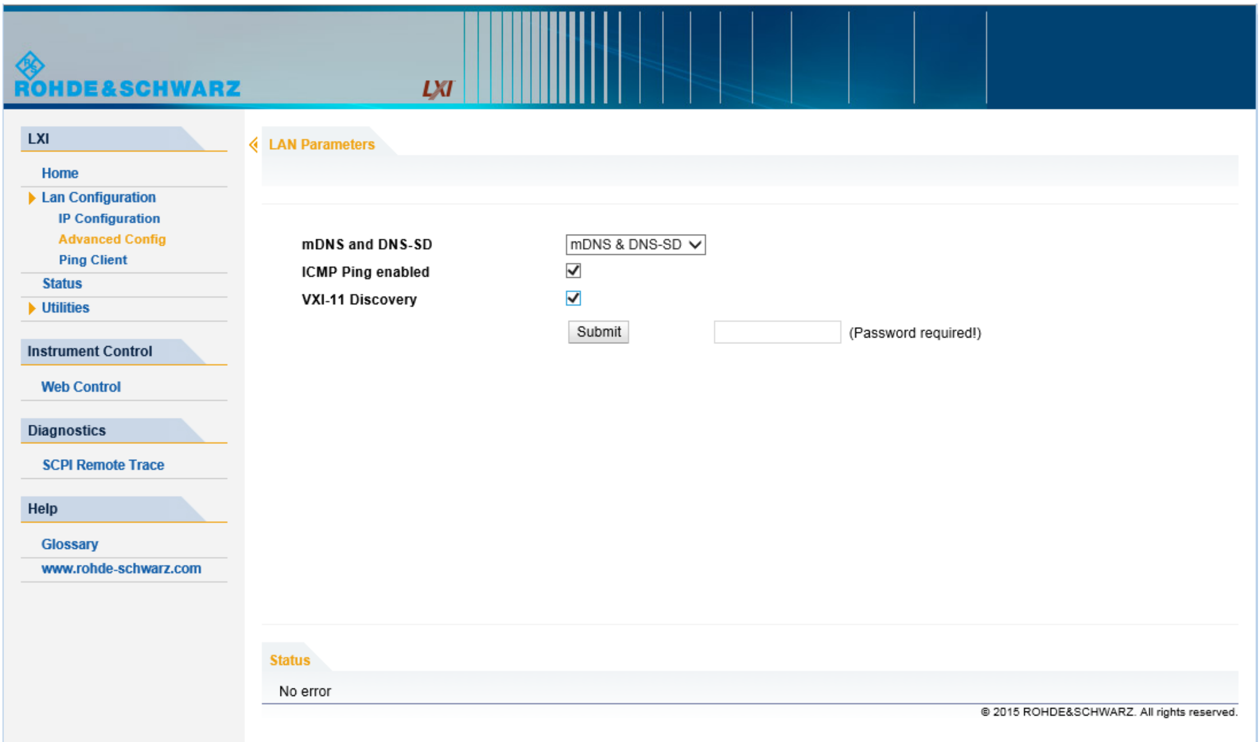


The "IP Address Mode" selects a configuration mode for the IP address of the R&S SMA. With static configuration, the entered IP address, subnet mask, and default gateway are used. With dynamic configuration, DHCP or dynamic link local addressing (automatic IP) are used to obtain the instrument IP address.

See Chapter 2.6.2, "Assigning the IP Address", on page 37.

2.8.2.2 Advanced LAN Configuration

The "Advanced Config" page provides LAN settings that are not declared mandatory by the LXI standard.



The following advanced parameters are available:

- "mDNS and DNS-SD": The additional protocols "multicast DNS" and "DNS service discovery" are used for device communication in zero configuration networks, working without DNS and DHCP.
- "ICMP Ping enabled": Must be enabled to use the ping utility.
  If you disable this setting, the instrument does not answer ping requests. The setting does not affect the LXI ping client. You can ping other hosts from the instrument, even if the setting is disabled.
- "VXI-11 Discovery": Must be enabled to detect the instrument in the LAN.
  If you disable this setting, the instrument cannot be detected by the VXI-11 discovery protocol mechanism. The setting does not affect other detection mechanisms. Setting up a VXI-11 connection via the IP address or the host name is independent of this setting.

2.8.2.3 Ping Client

The "Ping Client" page provides the ping utility to verify the connection between the LXI-compliant instrument and another device.

The ping is initiated from the instrument. Using the `ICMP` echo request and echo reply packets, the function checks whether the communication with a device via LAN works. Ping is useful for the diagnosis of IP network or router failures.

The ping utility is not password-protected.

To initiate a ping from the instrument to the device:

1. Enable "ICMP Ping" on the "Advanced LAN Configuration" page.
2. Select the "Ping Client" page.
3. In the "Destination Address" field, enter the IP address of the device you want to ping (without the ping command and without any further parameters), e.g. *10.113.1.203*.
4. Select "Submit".

2.8.2.4 Web Control

The web control functionality provides remote operation via VNC using a Web browser (with HTML5). This mode does not require additional installation or activation. The VNC protocol allows simultaneous operation from several remote devices. The instrument remains locally operable.

The GUI of the R&S SMA is visible. To perform the settings, you can operate the instrument as with the manual control. The instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available.

Starting a Remote Control via the LXI web browser

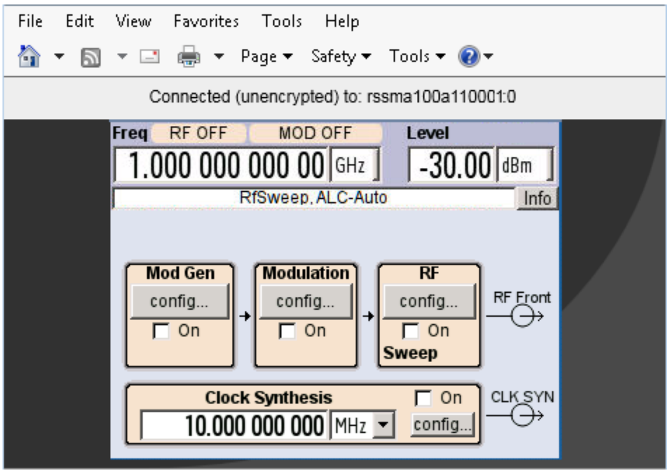
This section assumes that the instrument and the controller PC are connected in the LAN.

1. Start a web browser that supports html5 (W3C compliant).
2. Enter the IP address of the R&S SMA in the browser's address bar.

   The R&S SMA's welcome page is displayed.
3. In the navigation pane, select "Instrument Control" > "Web Control".

   Remote access to the instrument requires the password. The default password is *instrument*.
4. Enter the password.
5. Confirm with the ENTER key.

   After the connection is established, the current screen of the R&S SMA is displayed in the browser window.

6. Use the mouse cursor and keyboard to access the functionality of the instrument as you would directly perform the settings on the instruments front panel.

2.8.2.5 SCPI Remote Trace

The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SMA.

A recorded trace (message log) can be evaluated directly in the dialog. Use the highlighting and navigation functions provided in the lower toolbar to locate error messages and messages containing arbitrary search strings. You can also export the message log to a `*.csv` file and evaluate the file using a suitable program.

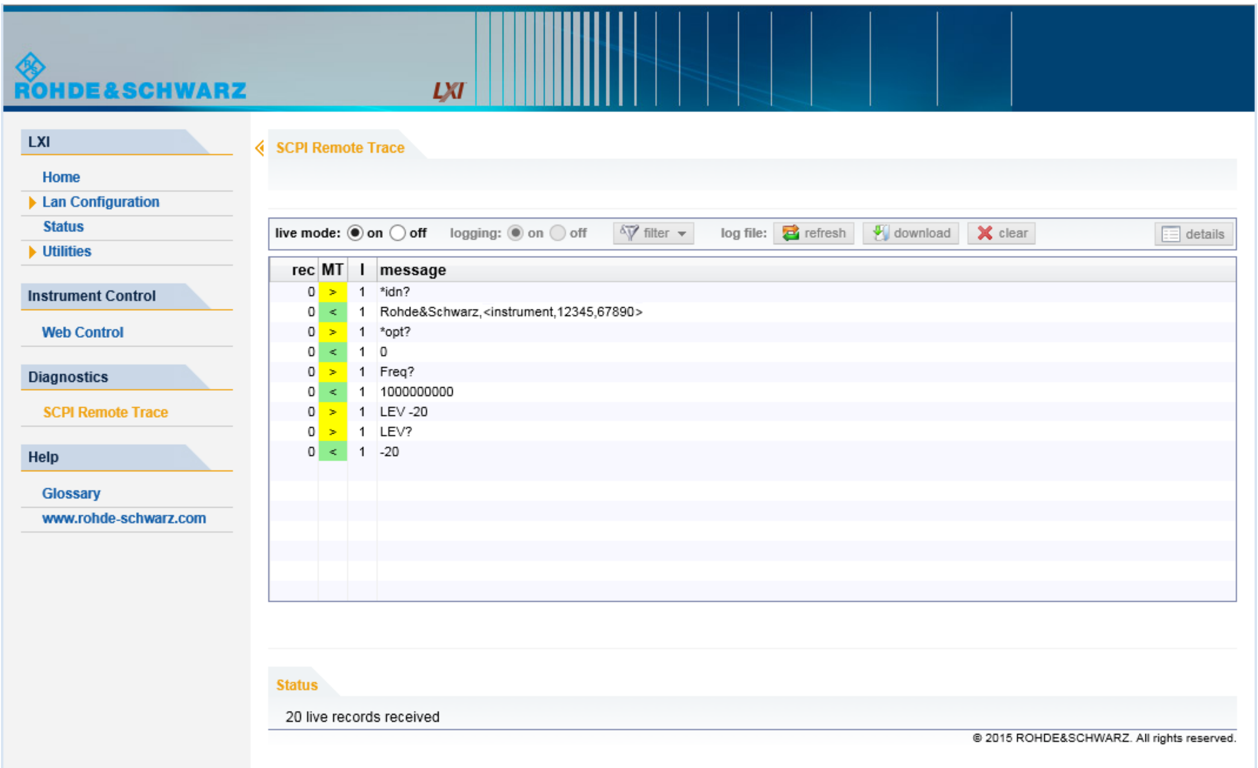
To trace and display messages:

1. In the navigation pane, select "Diagnostics" > "SCPI Remote Trace".

2. In the toolbar bar of the "SCPI Remote Trace" page, select "live mode" > "on" and "logging" > "on".

   "live mode > on" displays all commands and responses, and "logging > on" also traces messages.

3. If you now control the R&S SMA with SCPI commands, using an appropriate tool, the SCPI remote trace records the information sent and received.

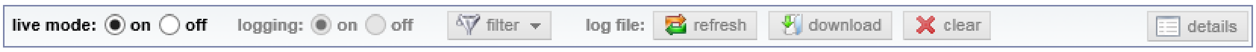


The function records all sent commands, received responses and messages, and stores them in an internal database. If "live mode" is disabled, you can display the recent traces upon request, using the "refresh" button. You can also store the log in a file.

Note: The diagnostics functionality is extended in later releases, e.g. to download or upload SCPI command files from / to the instrument.

Toolbars

The toolbar at the top of the dialog provides basic settings and functions.



- "Live mode" / "logging": If logging is switched on, messages are traced. They are stored in an internal database and can be displayed upon request, using the refresh button (live mode off) or they can be displayed automatically (live mode on).
- "Filter": applies a filter to columns and/or rows when working (live mode off)
- "Refresh": reads the message log from the internal database and displays it

- "Download": stores the SCPI trace log to a `*.csv` file
- "Clear": deletes all message log entries in the database and on the screen
- "Details": displays details of the selected message, for example an SCPI command in hex format (also possible by double\-clicking a message)

Columns

The following columns are available if no column filter is applied:

- "Rec": record number of the message within the message log
- **I**: number of the subinstrument
- "MT": indicates the type of the message. Possible values and related message contents are:
  – > = incoming command
  – < = outgoing response to a query
  – E = error message, highlighted by red color
  – T = execution time, i.e. time required by the instrument to process the command internally
- "message": indicates the type of the message. Possible values and related message contents are:
  – > = incoming command
  – < = outgoing response to a query
  – E = error message, denoted in red
  – T = execution time, i.e. time required by the instrument to process the command internally

3 Getting Started

This section helps you to get familiar with the R&S SMA. It provides an introduction to the general concept of the instrument with a sample of the possible application fields, and 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 SMA employs the following three ways of instrument control:

- Manual operation
- Remote control
- Remote access

Manual Operation

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

The R&S SMA 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 you always know the position at which a parameter affects 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.

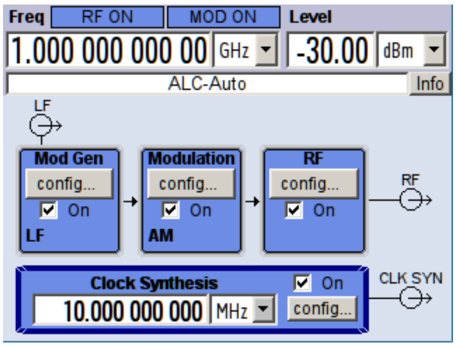


Figure 3-1: Block diagram of a fully equipped R&S SMA

With the rotary knob, you can navigate in the block diagram and the dialogs, and 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. You can access the context-sensitive help with the HELP (F1) key at any time. 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 67.

For an in-depth description of the dialog boxes and the instrument functions, refer to section Chapter 5.1, "Overview of Instrument Functions", on page 92.

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.

The R&S SMA supports various remote control connections:

- Connecting the instrument to a (LAN) network
- Using the LXI browser interface in a LAN network
- Connecting a PC via the IEC-bus (IEEE 488) interface
- Remote control via the USB interface

Tip: For remote control over LAN or USB, you can use the R&S VISA (Virtual Instrument Software Architecture) library provided for download at the Rohde & Schwarz website http://www.rohde-schwarz.com/rsvisa.

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 347. The description of the remote control commands is provided in Chapter 7, "Remote Control Commands", on page 391.

Remote access

Remote access is the operating of the instrument from a remote computer. Both the R&S SMA 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 39.

3.2 Application Field of the Instrument

The main field of application of the R&S SMA is the generation of sine wave signals with very high spectral purity. These signals are needed for example for adjacent channel or phase noise measurements.

In addition, the RF signal can be modulated with a wide variety of internal modulations waveforms, like sine waves, triangle/rectangular/trapeze signals, and noise. Several modulation signals can be combined with variable weight.

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 including synthesizer, output section and attenuator (optional without attenuator).

One of the following options must be installed.

- R&S SMA-B103 (up to 3.2 GHz)
- R&S SMA-B103L (up to 3 GHz without attenuator)
- R&S SMA-B106 (up to 6 GHz)
- R&S SMA-B106L (up to 6 GHz without attenuator)
- R&S SMA-B131 (up to 31,8 GHz)

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

See data sheet for detailed information.

Up-to-date information is available at R&S SMA homepage on the internet http://www.rohde-schwarz.com/product/sma100a.html.

Mod Gen block

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

Two internal LF generators (second is optional) are available as the internal source(s) for the analog modulations AM, FM and PhiM. Different modulation shapes - sine, triangle, rectangle and noise - are offered for the second LF generator. Bandwidth and level distribution can be selected for the noise signal of the noise generator (optional).

Available modulation shapes are:

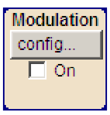
- sine
- triangle (optional)
- square (optional)
- trapeze (optional)
- noise with selectable bandwidth and level distribution (optional)

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 SMA 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. The modulation inputs AM EXT, FM/PHIM EXT and PULSE EXT at the rear of the instrument are provided for external amplitude, frequency, phase and pulse modulation. AC or DC coupling for external feed is possible.

Modulation signals of up to three sources (two internal sources and one 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, optional)
- Phase modulation (PhiM, optional)
- Pulse modulation (Pulse)
- Chirp modulation (internal only)

In addition, external digital modulation signal can be used. The external signal for digital FM/PhiM modulation is fed in via the AUX I/O interface.
- Digital Frequency modulation (optional)
- Digital Phase modulation (optional)

Note: For modulation modes that can be simultaneously used, refer to the R&S SMA 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.

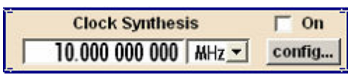
RF settings include:
- Frequency and reference frequency
- Level settings; if required.
- NRP-Z Power Viewer and Power Analysis using power sensors
- Frequency and level sweep
- List Mode settings. In this mode, extremely fast frequency and level settings can be made.

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.

Clock Synthesis



In this block, the clock synthesis is switched on or off and the frequency of the clock signal is set. For instruments equipment with modules with order number 1400.2749.02 DC offset can be defined, in addition.

The clock frequency is displayed in the block. Use the TOGGLE ON/OFF key to switch the generation of clock signal on or off.

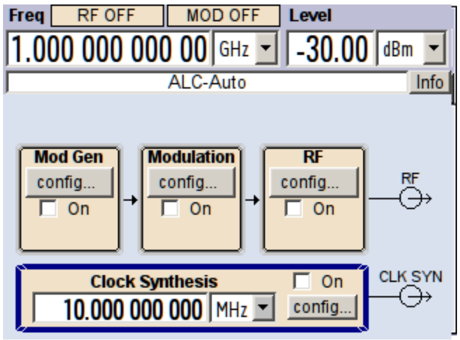
3.4 Example of Setup

This section provides an example on how to configure the instrument for generating of an amplitude modulated signal and of a frequency modulated signal with noise.

Generation of an Amplitude-Modulated Signal

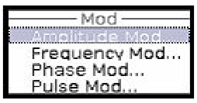
To generate a simple AM-modulated signal, proceed as follow:

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

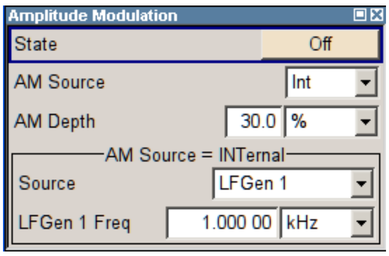


2. Select and activate AM modulation
   a) Turn the rotary knob and select the "Mod" block.

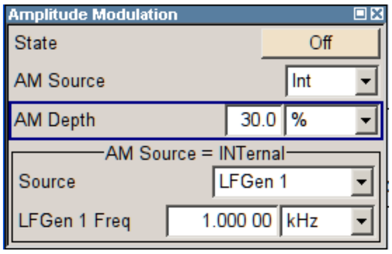
   b) Press the rotary knob to open the dialog where the modulation can be selected (different modulation modes are available depending on the options installed).



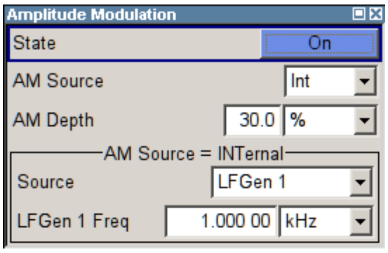
   The "Amplitude Mod..." menu is the first menu and is highlighted per default.
   c) Turn the rotary knob and highlight "Amplitude Mod...".
   Press the rotary knob to open the "Amplitude Modulation" dialog.



d) Turn the rotary knob to select parameter "AM Depth", press the rotary knob to allow editing and enter the preffered 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.

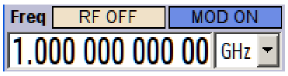


f) Press the DIAGRAM key to display the complete block diagram.

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

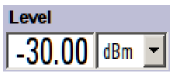
3. Set frequency and level and activate RF signal

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.

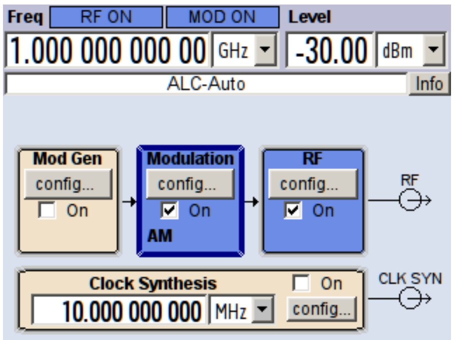
b) Press the LEVEL key and enter the level settings in the same way.



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.

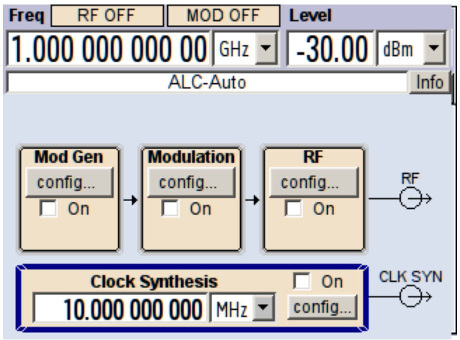


Generation of a Frequency Modulated Signal with Noise

To generate a simple FM-modulated with noise signal, proceed as follow:

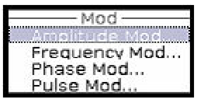
This setting requires option Multifunction Generator, R&S SMA-K24.

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

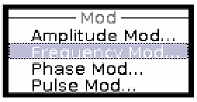


2. Select and activate FM modulation with internal noise signal and a deviation of 500 kHz
   a) Turn the rotary knob and select the "Mod" block.

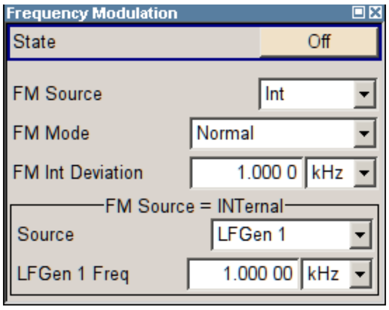
   b) Press the rotary knob to open the dialog where the modulation can be selected (different modulation modes are available depending on the options installed).



c) Turn the rotary knob and highlight "Frequency Mod...".

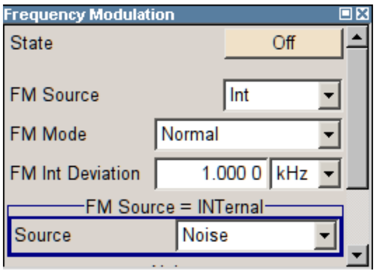


Press the rotary knob to open the "Frequency Modulation" dialog.



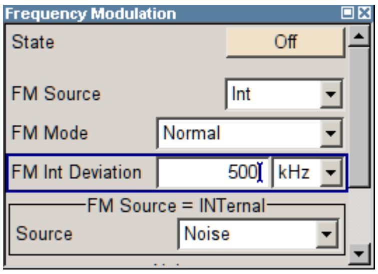
The internal source is the LF generator 1 by default. This setting is not changed.

d) Turn the rotary knob to select parameter "FM Internal Source", press the rotary knob to open the selection list and select "Noise".

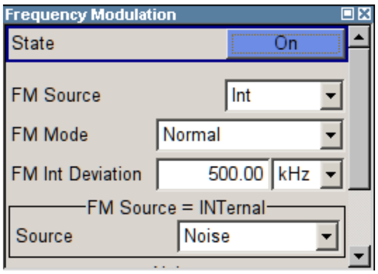


Gauss distribution and full bandwidth (10 MHz) are the default settings for the noise signal. These settings are not changed.

e) Turn the rotary knob to select parameter "FM Int Deviation", press the rotary knob to allow editing and enter the preffered deviation with the aid of the numeric keypad and the unit keys.



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

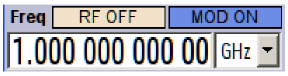


g) Press the DIAGRAM key to display the complete block diagram.

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

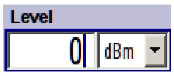
3. Set frequency and level and activate RF signal

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.

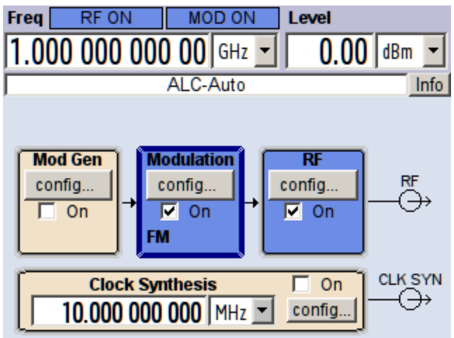


The noise now modulates the RF carrier.

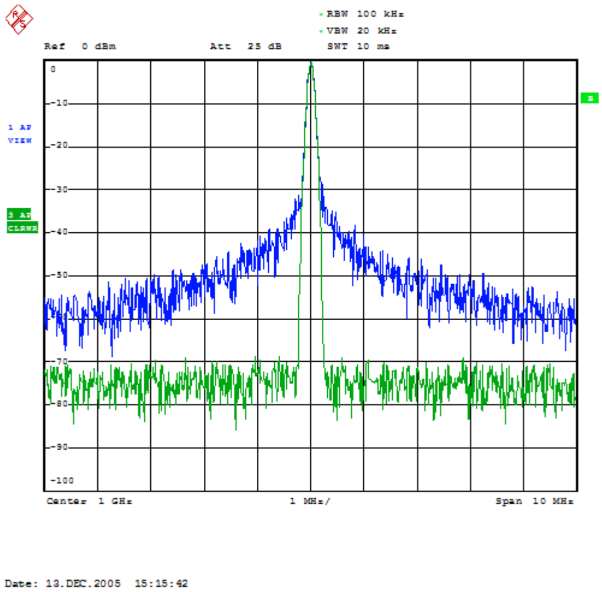
c) Press the DIAGRAM key to display the complete block diagram.

d) Turn the rotary knob to select the "RF" block.
Press the RF ON/OFF key to activate the "RF" block.

The FM modulation signal is now present at the RF output. The LF output is not yet activated, i.e, the modulation signal is not output there.



The graph below shows the FM modulated signal with noise (upper blue trace) and the unmodulated signal (lower greentrace).


RBW 100 kHz
VBW 20 kHz
Ref 0 dBm
Att 25 dB
SWT 10 ms
0
-10
-20
-30
-40
-50
-70
-80
-90
-100
1 AP
VIEW
3 AP
CLRWR
Center 1 GHz
1 MHz/
Span 10 MHz
Date: 13.DEC.2005 15:15:42

4 Manual Operation

The R&S SMA 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 SMA 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

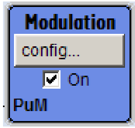
The main characteristics of the RF signal, frequency and level, are permanently displayed in the header section of the screen and can be directly set in the display fields after the FREQ (CTRL+F) or LEVEL (CTRL+L) key is pressed. Status messages for the output signal are displayed in addition to frequency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

Operation via Graphical User Interface

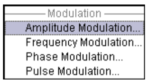
- **Functional blocks**
  Menus are assigned to the specific function blocks in the block diagram. The function blocks represent elements of signal generation. Function blocks displayed with

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.

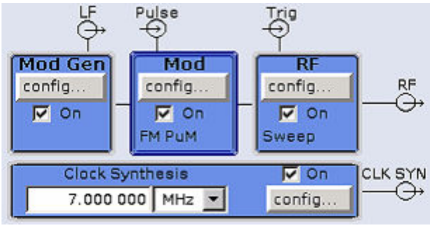
– **Example:**
  The "Modulation" block contains all menus required for modulation signal configuration.



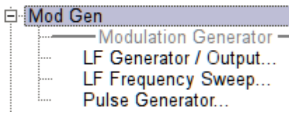
In this block all modulations can be selected.



- **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.

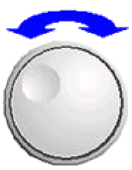


Operation corresponds to the Windows concept

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.

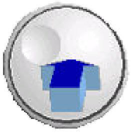
A blue frame indicates that the selected item is active. In the highlighted element, entries can be made.

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 SMA directly perform a simple function.

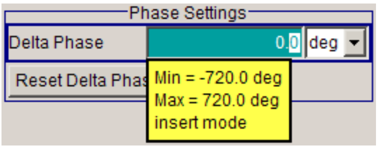
Since a great number of settings can thus be made by a keystroke, operation is easy. For instance, the CLOSE (ESC) key closes the active menu; with the RF ON/OFF (CTRL+R) key the RF output signal can be switched on or off.

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.

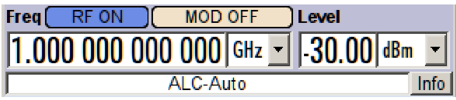
- **Value ranges**
  The valid setting range is displayed for each numeric parameter. This requires a short wait after activation of the entry field. The range is then displayed automatically after a few seconds.

  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 labeled softkeys for menu display.

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

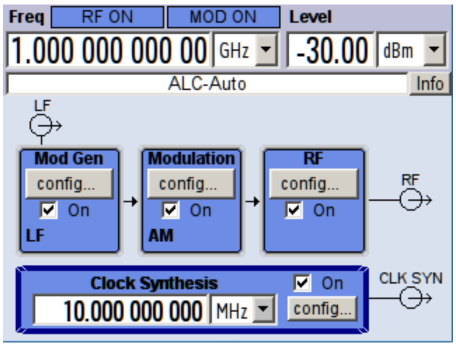


Figure 4-1: Block diagram of a fully equipped R&S SMA

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 71) 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 values displayed in the "Freq" and "Level" fields include a set offset or multiplier factor.

For more See alos Chapter 5.3.2, "RF Frequency", on page 140 and Chapter 5.3.5.1, "Overview of RF Level", on page 156.

The frequency and level indication can be enlarged so that it covers the complete display of the R&S SMA 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 111.

4.2.2 Status Information and Messages

The instrument indicates status information and messages 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), and require different treatment

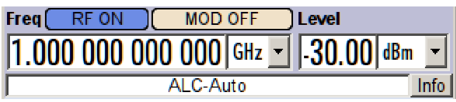
For additional information refer to the info window (see Chapter 4.2.3, "Info Window", on page 72).

Refer to Chapter 9, "Status Information, Error Messages and Troubleshooting", on page 688 for an overview of all status information and messages and corrective actions.

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 the commands `:SYSTem:ERRor[:NEXT]?` and `:SYSTem:ERRor: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.

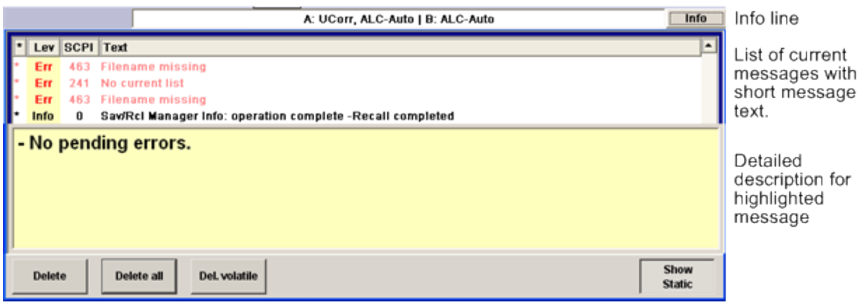
The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

These messages can be read from remote using the command `:SYSTem:SERRor?`.

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.

Remote command:
`:SYSTem:ERRor[:NEXT]?` on page 665 or `:STATus:QUEue[:NEXT]?` on page 662
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.

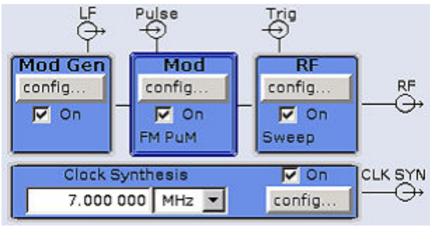


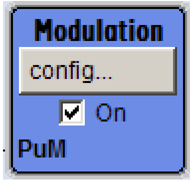
Figure 4-2: Block diagram of the R&S SMA

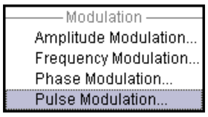
4.2.4.1 Function Blocks in the Block Diagram

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





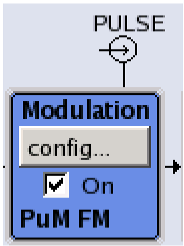
In this block, the modulation signals are set. The status information of the "Modulation" block indicates the selected modulation.

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.

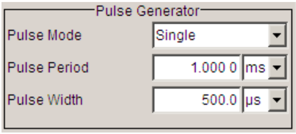
Working with menus and dialog boxes is described in Chapter 4.3, "Accessing Dialogs", on page 75; the setting of parameters in Chapter 4.4, "Setting Parameters", on page 76.

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 89).

4.4 Setting Parameters

The R&S SMA 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 89 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 SMA 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 77

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:

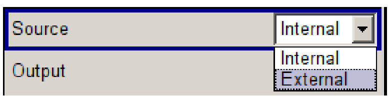
1. Press a UNIT key on the front panel.
2. Select"Unit" in the selection field next to the parameter value.

   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 80) .

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.

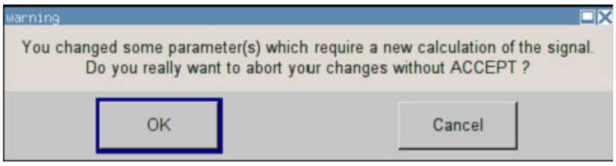
► To restore the values, press the ESC key.

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 SMA 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 85.

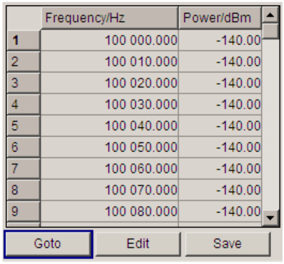
4.5.1 Working with List Editor

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.

	Frequency/Hz	Power/dBm
1	100 000.000	-140.00
2	100 010.000	-140.00
3	100 020.000	-140.00
4	100 030.000	-140.00
5	100 040.000	-140.00
6	100 050.000	-140.00
7	100 060.000	-140.00
8	100 070.000	-140.00
9	100 080.000	-140.00

   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 86).

   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 85) 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.

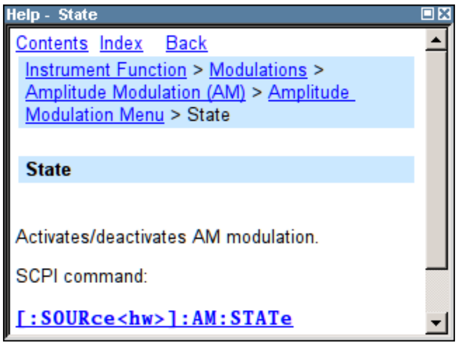
4.6 How to Use the Help System

The R&S SMA 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.

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 navigate within the table of 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 follow a cross-reference, select the link text.
3. To return to the previous page, select "Back".
   This function scrolls back all steps that you have performed before.

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 SMA 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 on the CompactFlash™ card of the instrument. 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 `var/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 88 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:

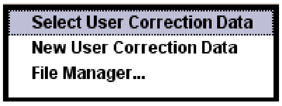
- Chapter 4.8, "Legend of Front-Panel Controls", on page 89 for an overview of key functions and a cross-reference between the front panel keys and the keyboard shortcuts
- to section "Instrument Functions" for a detailed description of key functions.

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

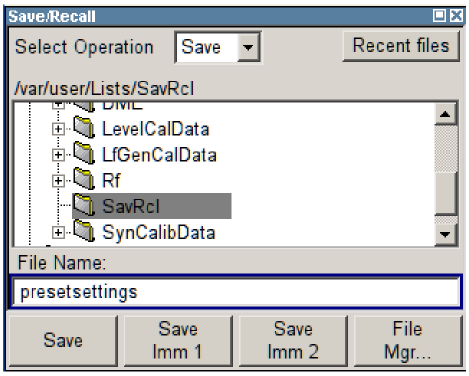
All instrument settings are saved and loaded in the "File" menu.

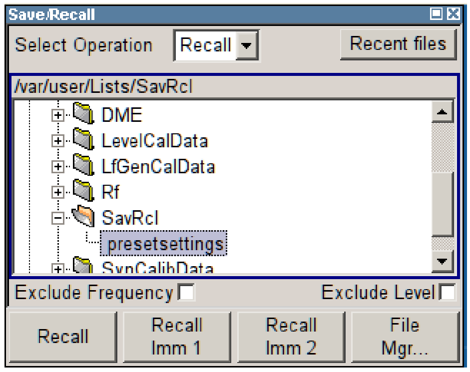
To access the "File" menu, press the FILE (CTRL+S) key.

For more information, see Chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 129.

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.

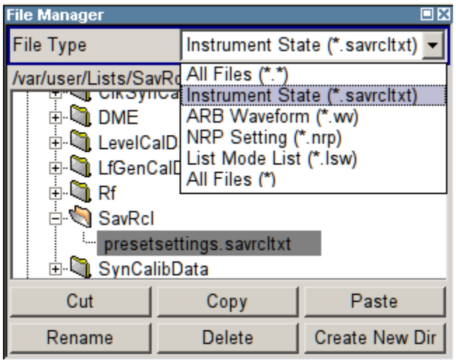
Working with the File Select dialog

1. Access the "File Select" dialog (see "Accessing files with user data" on page 86).
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 from 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 88 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 86).
2. Navigating in the "File Manager" dialog.
   Operation is very similar to the operation of a standard Windows explorer.
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 lists all available file extensions for user files. The currently available files on the instrument depend 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

Function	List type	Contents	File suffix
		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) 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.
ENTER / *1 / dB(m)	Enter ALT + F12	Terminates an entry. Confirms entries in the base unit and values without a unit. Selects dBm for the RF level and dB for level offset and level step width.
. / *...#	. / *...#	Enters a period/decimal point. Enters a special character.
- / A<->a	- / (shift+) a—z	Enters the sign. 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)
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. Closes an active menu.

Front-panel key	Key of PC keyboard	Function
DIAGR	CTRL+ D	Sets the cursor on the block diagram and hides all menus.
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.
MENU	CTRL + M	Calls the menu selection list.
MOD ON/OFF	CTRL + O	Switches modulation on/off. "MOD OFF" is indicated in the status line.
TOGGLE	CTRL + T	Switches a block or parameter on/off. Toggles between the different possibilities of setting a selection parameter.
PRESET	CTRL + P	Restores a defined basic instrument setup.
REARR.	CTRL + A	Adjusts the size of the active dialog to use the whole height of the display.
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 SMA 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 SMA 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 94
- Switching from remote control to manual control using the LOCAL key
  see Chapter 5.2.4, "Switching to Manual Control - Local Key", on page 124
- 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 95
- Calling up the online help using the HELP key
  see Chapter 5.2.7, "Help System - Help Key", on page 128
- Querying messages using the INFO key
  see Chapter 5.2.6, "Messages - Info Key", on page 128
- Loading and storing complete instrument settings in the "File" menu
  see Chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 129

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 138
- List mode
  see Chapter 5.3.7.4, "List Mode", on page 234
- Frequency and Level Sweep mode
  see Chapter 5.3.7.1, "Overview", on page 221
- Reference Oscillator
  see Chapter 5.3.4, "Reference Oscillator", on page 151
- RF Level
  see Chapter 5.3.5.1, "Overview of RF Level", on page 156

- RF Level Sweep
  see Chapter 5.3.7.3, "RF Level Sweep", on page 229
- ALC
  see Chapter 5.3.5.4, "Automatic Level Control - ALC", on page 161
- Power Sensors
  see Chapter 5.3.6.1, "Power Sensors", on page 175
- User Correction
  see Chapter 5.3.5.6, "User Correction", on page 167

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 247
- Frequency Modulation
  see Chapter 5.4.3, "Frequency Modulation (FM)", on page 250
- Phase Modulation
  see Chapter 5.4.4, "Phase Modulation (PhiM)", on page 256
- Pulse Modulation
  see Chapter 5.4.5, "Pulse Modulation (PM)", on page 261
- Chirp Modulation
  see Chapter 5.4.6, "Chirp Modulation", on page 264
- Test signals for avionic systems
  – see Chapter 5.4.7, "DME Modulation", on page 268
  – see Chapter 5.4.8, "VOR Modulation", on page 290
  – see Chapter 5.4.9, "ILS-GS Modulation", on page 298
  – see Chapter 5.4.10, "ILS-LOC Modulation", on page 304
  – see Chapter 5.4.11, "Marker Beacon Modulation", on page 313
  – see Chapter 5.4.12, "ADF Modulation", on page 318

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 323
- LF output
  see Chapter 5.5.3, "LF Output", on page 329

The clock synthesis is configured in the "Clock Synthesis" function block:

- see Chapter 5.6, "Clock Synthesis", on page 344

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 SMA (from top left to bottom right).

5.2.2 Default Instrument Settings - Preset Key

The PRESET key performs 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 further settings.

However, functions concerning the integration of the instrument in a measurement setup are not changed, for example the GPIB address or reference oscillator 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.

An exception is the state of the RF output. The state of the RF output power-on state can be set to be always off in the "EMF" menu of the "RF" block.

User-defined instrument states can be accessed and stored 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
- "Offsets" = 0
- "Modulations State" = Off
- Uninterrupted level settings are switched off
  "Level Attenuator Mode" = AUTO
- Internal level control "Level ALC" = AUTO
- User correction "Level Ucor" = OFF

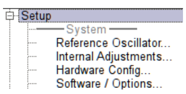
- "LF output State" = Off
- "Sweep State" = Off
- "List mode State" = Off

Settings that are not affected by the PRESET key

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

Remote command:
*RST on page 394

5.2.3 General Configuration of Instrument - Setup Key



The "Setup" menu provides access to basic instrument settings, regardless of the currently set operating mode or measurement. It contains information on the insstrument's equipment, and comprises all settings for the general configuration of the instrument and its interfaces.

To access the "Setup" menu, press the SETUP key.

The "Setup" menu is divided into functional sections as follows:

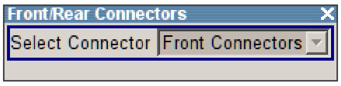
- "System": covers general instrument parameters.
- "Test": used to perform function tests.
- "Environment": used to configure the controller interfaces.
- "Remote": used to configure the remote control interfaces.
- "Protection": used to set the protection level for service functions and security settings.
- "Settings": 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 accessed in the "RF" block and is therefore described in the section on this block (see Chapter 5.3.4, "Reference Oscillator", on page 151).
- The "Save/Recall" dialog can also be accessed 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 129).

5.2.3.1 Front/Rear Connectors

In the "Front/RearConnectors" dialog, you can map the signal output to the rear panel connectors. The function is protected, but can be accessed with disabled protection level 1.



Select Connector

Selects the front or rear panel for assigning the output signals to the corresponding connectors.

The output connector mapping is a protected parameter, therefore unlock protection level 1 first, see Chapter 5.2.3.18, "Protection", on page 116. The password is 123456.

Remote command:
n.a.

5.2.3.2 Internal Adjustments

The R&S SMA is extremely accurate due to the integrated adjustment procedures, which you can execute directly on the instrument.

Self-calibration routines that do require additional (external) measurement equipment are either described in the Service Manual of the instrument, or they require to be performed by a Rohde & Schwarz service center.

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.

When to perform adjustments?

It is recommended to perform internal adjustments prior to any application that requires a maximum of level and frequency accuracy, especially when a long period of time has passed or if the ambient temperature of the instrument significantly differs from the one of the last adjustment.

Additional Information to the Adjustments

During adjustments, a progress indicator shows the status of the process. If any error occurs, the process aborts and an error message appears in the info line.

The extent of the adjustments depends on the installed options.

NOTICE

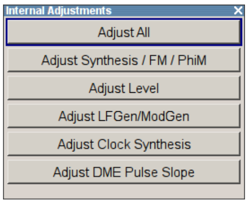
Risk of damage to the DUT

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

During level adjustments instruments without step attenuator, that means with frequency options R&S SMA-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 the adjustments.

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

► To access the settings for internal adjusmtents, press the SETUP key and select "System > Internal Adjustments".



In this dialog you can perform internal calibration routines.

The remote commands required to define these settings are described in Chapter 7.4, "CALibration Subsystem", on page 398.

Adjust All

Performs all available internal calibration routines of the instrument.

Remote command:
`:CALibration<hw>:ALL[:MEASure]?` on page 398

Adjust Synthesis

Performs all adjustments which affect the frequency.

This includes adjustment of following options:

- R&S SMA-B20, FM/PhiM Modulator
- R&S SMA-B22, Enhanced Phase Noise Performance and FM/PhiM Modulator
- R&S SMA-B106/106L, Frequency Extension 6GHz with/without attenuatior.

Remote command:
`:CALibration<hw>:FREQuency[:MEASure]?` on page 399

Adjust Level

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

Remote command:
`:CALibration<hw>:LEVel[:MEASure]?` on page 400

Adjust LF Gen/Mod Gen

Performs all adjustments which affect the internal modulation generator.

Remote command:
`:CALibration:LFOutput[:MEASure]?` on page 400

Adjust Clock Synthesis
Performs all adjustments which affect the clock synthesis.

Remote command:
`:CALibration:CSYNthesis[:MEASure]?` on page 398

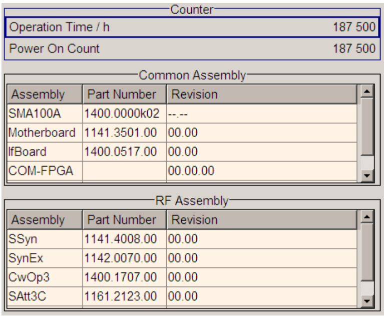
Adjust DME Pulse Slope
Activates internal adjustment of the DME pulse slope for best linearity.

Remote command:
`:CALibration:DME[:MEASure]?` on page 399

5.2.3.3 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"

Operation Time / h
Displays the operation time in hours.

Remote command:
`:DIAGnostic:INFO:OTIMe?` on page 405

Power On Count
Displays the number of power-on.

Remote command:
`:DIAGnostic:INFO:POCount?` on page 405

Assembly

The tables list the installed assemblies.

"Assembly" Assembly name

"Part Number" Part Number of assembly

"Revision" Revision state of assembly

Remote command:
:DIAGnostic<hw>:BGINfo? on page 404

5.2.3.4 Software / Options

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

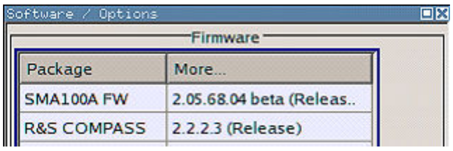
Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in Chapter 4 of the Service Manual (supplied with the instrument).

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.

Remote 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

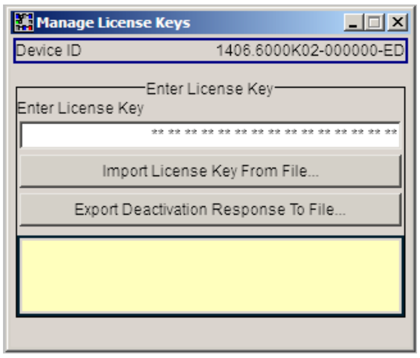
Remote command:
`*OPT?` on page 393
`*IDN?` on page 393

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.

Remote command:
n.a.

5.2.3.5 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 SMA 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.

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

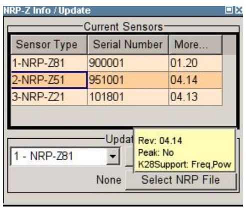
Displays status information.

5.2.3.6 NRP-Z Info/Update

The "NRP-Z Info/Update…" dialog covers information on connected power sensors, like serial number, revision state and features of the particular sensor. You can directly perform an update of the sensor firmware.

Additionally, the dialog supports some special features in terms of support of the R&S SMA-K28 Power Analysis option.

► To access this dialog, select "Setup > System > NRP-Z Info/Update…".



The "NRP-Z Info / Update" dialog indicates the connected R&S NRP-Z Power Sensors with specific information and contains the functions to update the firmware of a connected sensor.

The remote commands required to remotely configure the power sensor settings are described in Chapter 7.13, "Power Sensor Measurement Subsystems", on page 430.

How to update an R&S NRP sensor

To perform an R&S NRP sensor update proceed as follows:

1. Open the R&S website http://www.rohde-schwarz.com in section "Power Meters & Voltmeters > R&S NRP-Z Sensors".
2. Select the respective sensor, e.g. R&S NRP-Z81.
3. Select "Downloads > Firmware" and the offered firmware suitable for your sensor.
4. Transfer and save the firmware on the instruments, for example in the `/var/` directory.
5. Connect the sensor to the R&S SMA and select "Setup > System > NRP-Z Info Update" to open the dialog.
6. Select the sensor in the left sensor selection field.
7. Select the update file with "Select NRP File".
8. Start the update procedure with "Run Update".

   The update starts and a bar indicates the progress.

How to restart an interrupted update of an R&S NRP sensor

An accidental removal of the sensor during the update process interrupts the update.

If no other sensor is connected to the instrument, proceed as follows to restart the update process:

1. Do not reconnect the sensor but keep it ready to be connected.
2. In the "Setup > System > NRP-Z Info Update" dialog, select "Rescue" in the left sensor selection field
3. Activate "Run Update".
4. Confirm query in message box
5. Connect sensor within 4 seconds

   The update starts, a bar informs about the progress.

Current Sensors
Shows the sensors that are connected to the generator with information on 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.

"K28Support" indicates the R&S SMA-K28 measurement functions provided bxy the sensor.

Remote command:
SENSe<ch>[:POWer]:TYPE? on page 476
SENSe<ch>[:POWer]:SVERsion? on page 446
SENSe<ch>[:POWer]:SNUMber? on page 445

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.

Note: If the update is interrupted for example by accidental removal of the sensor during the process, the button "Rescue" appears. Thus, you can restart the update process.
Prerequisite is that no other sensor is connected to the instrument.

Refer to "How to update an R&S NRP sensor" on page 102 and "How to restart an interrupted update of an R&S NRP sensor" on page 102 for detailed instructions.

Remote command:
n.a.

5.2.3.7 Update

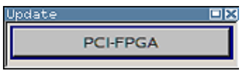
After a firmware update it is occasionally required to also update the "PCI-FPGA". This is enabled in the "Update" dialog.

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

NOTICE

Impairment of instrument functions

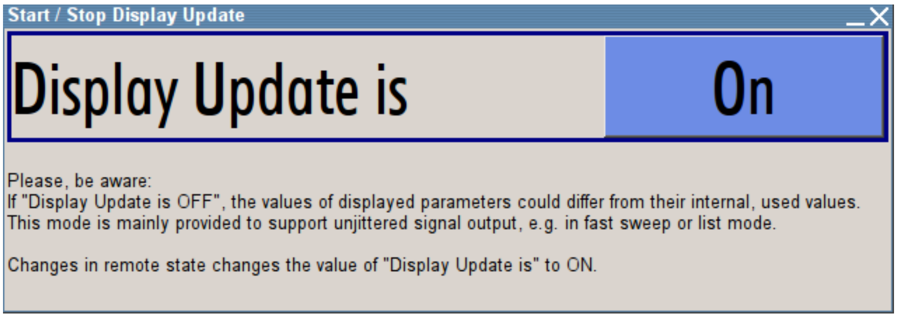
To avoid impairment of instrument functions, the update of the "PCI-FPGA" must not be cancelled and the instrument must not be switched off during this update.



5.2.3.8 Display Update

The "Start/Stop Display 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.



Display Update is On/Off
Switches on/off update of the displayed parameters.

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

Note: For optimum sweep performance with short dwell times and for fast settling times, it is recommended to switch off the display update .

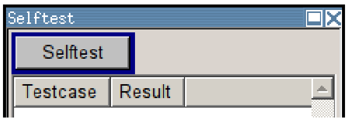
Remote command:
:SYSTem:DISPlay:UPDate on page 675

5.2.3.9 Selftest

A selftest is provided for service purposes.

Access:

1. Select "Setup > Test > Selftest"
2. Select "Start Selftest".



The following tests are only available via remote control:

- :TEST<hw>:DIRect on page 679

Start Selftest
Performs a selftest on all installed hardware options.

When completed, the R&S SMA displays a list of all performed test cases and the test results (passed or failed).

Note: While the self test is in progress, the actual signal level at the RF output is -50 dBm. This value is not indicated in the status bar.

Remote command:
:TEST<hw>:ALL:STARt on page 678
:TEST<hw>:ALL:RESult? on page 678

5.2.3.10 Check Front Panel

With the functions provided in this dialog you can verify the functionality of the control keys of the R&S SMA.

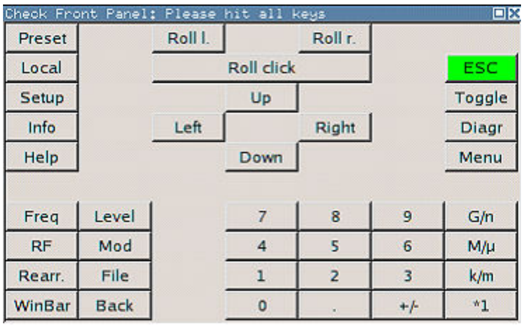
In case of malfunctions, contact your Rohde & Schwarz Customer Support Center for technical support, see http://www.customersupport@rohde-schwarz.com.

Accessing the online help in the check front panel dialog or exiting via ESC

During the test, the actual functions of all keys are disabled, including the HELP and the ESC keys.

Check Front Panel Settings

► To access this dialog, Press the "setup" key and select "Setup > Test > Check Front Panel".



Reflecting the front panel, the "Check Front Panel" dialog contains all functions to test the operating elements of the instrument.

Performing the Front Panel Tests

To perform the front panel test, you operate the keys at the front panel, and check the response of the instrument in the "Check Front Panel" dialog. To perform this test properly, it is essential that you check each key of the front panel. The test is only completed, when you have veryfied all keys.

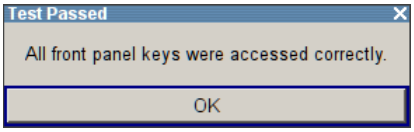
During the test, the actual functions of the keys are disabled.

Proceed as follows:

1. Press the SETUP key.
2. Select "Test > Check Front Panel"
   The "Check Front Panel" dialog opens.
3. Press a key on the front panel.
   Check if the corresponding key in the "Check Front Panel" dialog turns green.
4. Press the same key a second time.
   Check that the key in the dialog turns red.

Note: Pressing the same key again has no further effect, with the exception of the ESC key, see Press the ESC key a third time.

5. Continue with the next key on the front panel and repeat step 3 to step 5 until all keys are tested.



The test is completed, when each key is verified successfully, confirmed by a "Test passed" message.
Select "OK" to exit the test.

► Press the ESC key a third time.
Exits the "Check Front Panel" dialog, even if you have not yet checked all the keys.

Expected responses:

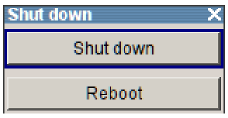
- Pressing a key once (green), pressing twice (red)
- Pressing the ESC key a third time exits the dialog.

If you detect a malfunction, for example, you press the front panel key the first time, and the color of the button in the dialog turns red (instead of green), the front panel key may be stuck. In this case, contact the Rohde & Schwarz Customer Support Center for technical support, see http://www.customersupport@rohde-schwarz.com.

5.2.3.11 Shutting Down and Rebooting the Instrument

The POWER ON/STANDBY front panel key switches the instrument from the standby to the ready state or vice versa. In remote operation form a remote computer or in manual control, the R&S SMA provides you with another possibility to shut the instrument down or to reboot the system.

► To access the required settings, select "Setup > Environment > Shut Down".



Remote control commands:

- `:SYSTem:SHUTdown` on page 675
- `:SYSTem:REBoot` on page 674
- see also `:SYSTem:RESTart` on page 674

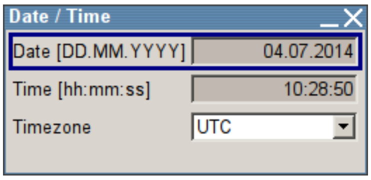
5.2.3.12 Date and Time

The R&S SMA uses an internal real time clock to determine the date and time. It adjusts the time and date to the timezone of your location automatically, by providing a selection list of continents and cities.

The instrument records the time whenever you create or modify files on your instrument or you use timed licences.

To access the required settings:

► Select "Setup > Environment > Date/Time" via the SETUP or MENU key.



The "Date / Time" dialog contains the time and data settings of the operating system.

The parameters "Date" and "Time" are protected to prevent accidental changes.

To enable editing, unlock protection level 1, see Chapter 5.2.3.18, "Protection", on page 116.

Date
Displays the date set in the operating system in the format [dd.mm.yyyy].

Remote command:
`:SYSTem:DATE` on page 675

Time
Displays the time set in the operating system in the format [hh.mm.ss].

The time setting corresponds to the selected Time Zone.

Remote command:
`:SYSTem:TIME` on page 676

Time Zone
Selects the time zone.

You can select the time zone according to the major cities on the respective continents.

Note: By typing the first letter, you can quickly navigate through the lists to find the desired destination.

Remote command:
`:SYSTem:TIME:ZONE` on page 676
`:SYSTem:TIME:ZONE:CATalog?` on page 676

5.2.3.13 Network Settings

The "Network Settings" dialog shows the parameters relevant for identifying the instrument in a network. The R&S SMA 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 36.

NOTICE

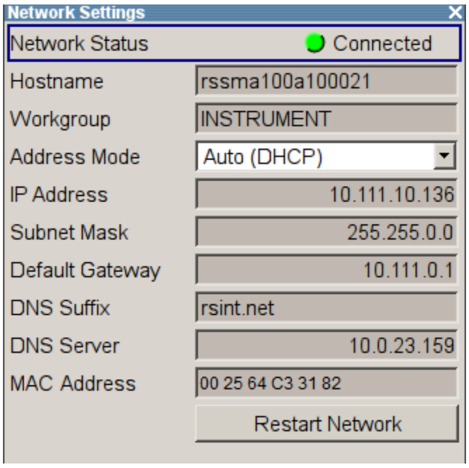
Risk of network errors!

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.

► To access this dialog, press the SETUP or MENU key and select "Environment > Network Settings".



In the "Network Settings" dialog, you can configure the settings of the general network environment and specific identification parameters of the instrument in the network.

The remote commands required to remotely configure the network are described in Chapter 7.16, "SYSTem Subsystem", on page 663.

Network Status

Indicates that the instrument is connected to the network.

Remote command:

`:SYSTem:COMMunicate:NETWork:STATus?` on page 670

Hostname
Displays the host name.

Each instrument is delivered with an assigned host name, a logical name which can be used instead of the IP address. With the default network settings, the IP address is allocated by the DHCP server. This address may change each time the instrument is reconnected. Unlike the IP address, the host name does not change.

Note: Since the host name of the instrument is a protected parameter, you must first unlock protection level 1 to enable the entry (see Chapter 5.2.3.18, "Protection", on page 116).
It is recommended that you neither change the default network settings nor the host name in order to avoid problems with the network connection.

However, if you change the host name be sure to use an unique name.

Remote command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 668

Workgroup
Sets the individual windows workgroup name of the R&S SMA. This parameter is required in case the instrument is integrated in a windows network.

Note: Since the workgroup name of the instrument is a protected parameter, you must first unlock protection level 1 to enable the entry (see Chapter 5.2.3.18, "Protection", on page 116).

Remote command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup` on page 668

Address Mode
Selects the mode for assigning the IP address.

"Auto (DHCP)"	Assigns the IP address automatically, provided the network supports DHCP (**D**ynamic **H**ost **C**onfiguration **P**rotocol) The network used must support automatic assignment of the IP address via DHCP or APIPA (Zeroconf) in order to use this function.
"Static"	Enables you to assign the IP address manually.

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress:MODE` on page 669

IP Address
Displays the IP address.

By default, the R&S SMA is configured to use dynamic TCP/IP configuration and to obtain the whole address information automatically.

If the network does not support DHCP or the attempt does not succeed, the instrument tries to obtain the IP address via Zeroconf (APIPA) protocol. IP addresses assigned via Zeroconf start with the number blocks `169.254.*.*`.

Note: An IP address that is assigned via the Zeroconf protocol while the network requires an IP address assigned via the DHCP server may cause network connection failures.
See Chapter 9.5, "Resolving Network Connection Failures", on page 694.

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

Remote command:
:SYSTem:COMMunicate:NETWork:IPADdress on page 669

Subnet Mask
Displays the bit group of the subnet in the host identifier.

To assign the subnet mask manually, select Address Mode "Static".

Remote command:
:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK on page 670

Default Gateway
Displays the gateway address.

To assign the gateway address manually, select Address Mode "Static".

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

Remote command:
:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway on page 669

DNS Suffix
Displays the primary DNS (**D**omain **N**ame **S**ystem) suffix, that means the DNS name without the host name part.

The DNS system uses the suffix for registration and name resolution to uniquely identify the instrument in the entire network.

To assign the DNS suffix manually, select Address Mode "Static".

Remote command:
:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain on page 668

DNS Server
Determines the preferred server for name resolution. The DNS server contains the underlying numerical values that are required for name resolution of the host name as part of the IP address.

To select the DNS server manually, select Address Mode "Static".

Remote command:
:SYSTem:COMMunicate:NETWork[:IPADdress]:DNS on page 669

MAC Address
Indicates the MAC (**M**edia **A**ccess **C**ontrol) address, a unique identifier of the network adapter in the R&S SMA.

Remote command:
:SYSTem:COMMunicate:NETWork:MACaddress on page 670

Restart Network
Terminates the network connection to the instrument and subsequently re-establishes it.

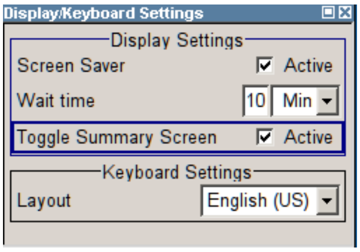
Used this function to resolve network problems.

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

Remote command:
`:SYSTem:COMMunicate:NETWork:RESTart` on page 670

5.2.3.14 Display/Keyboard Settings

In the "Display/Keyboard Settings" dialog 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.

Remote command:
`:DISPlay:PSAVe[:STATe]` on page 407

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

Remote command:
`:DISPlay:PSAVe:HOLDoff` on page 407

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

Remote command:
n.a.

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

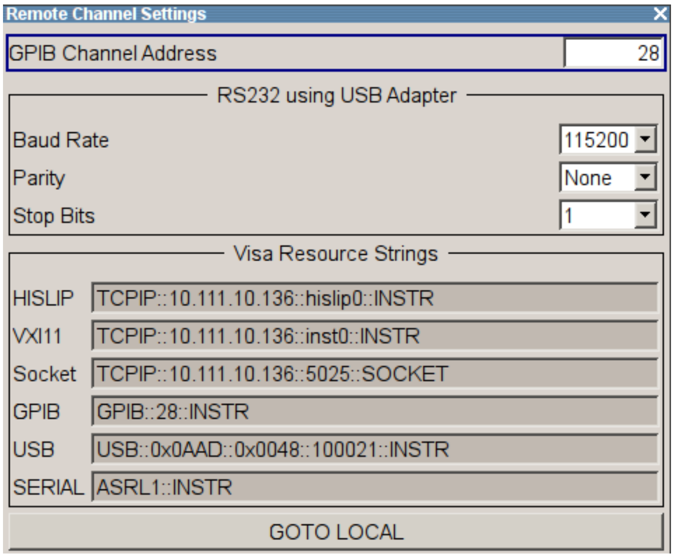
The assignment of some keys depends on the selected layout and language.

Remote command:
`:KBOard:LAYout` on page 417
`:KBOard:LANGuage` on page 417

5.2.3.15 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".

► To access this dialog, press the SETUP or MENU key and select "Remote > GPIB,...".



The "Remote Channel Settings" dialog contains the GPIB address and displays the VISA resource strings provided for remote control via the various interfaces.

GPIB channel address
Sets the address of the GPIB channel the instrument is connected to.

Remote command:
`:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` on page 668

RS232 using USB adapter
Remote control via a serial interface is possible via a USB. The controller and the instrument must be connected with the external USB/serial-adapter R&S TS1-USB (see recommended extras in the 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 SMA automatically when the USB connection is established.

In addtion, you can also use a Bluetooth connection for remote control via the serial interface. The settings are effective for both interfaces (see also Chapter 5.2.3.19, "Security", on page 117).

Baud Rate ← RS232 using USB adapter
Sets the baudrate for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:BAUD` on page 672

Parity ← RS232 using USB adapter
Sets the parity for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:PARity` on page 672

Stop Bits ← RS232 using USB adapter
Sets the number of stop bits for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:SBITs` on page 673

Visa Resource Strings
Displays the visa resource strings, used for remote control of the instrument. Each interface requires an individual unique address, to identify the instrument for remote control.

Remote command:
`:SYSTem:COMMunicate:HISLip:RESource?` on page 671
`:SYSTem:COMMunicate:NETWork:RESource?` on page 671
`:SYSTem:COMMunicate:SOCKet:RESource?` on page 673
`:SYSTem:COMMunicate:GPIB:RESource?` on page 671
`:SYSTem:COMMunicate:USB:RESource?` on page 671
`:SYSTem:COMMunicate:SERial:RESource?` on page 672

Goto Local
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.

Remote command:
`&GTL`

5.2.3.16 Instrument Emulations

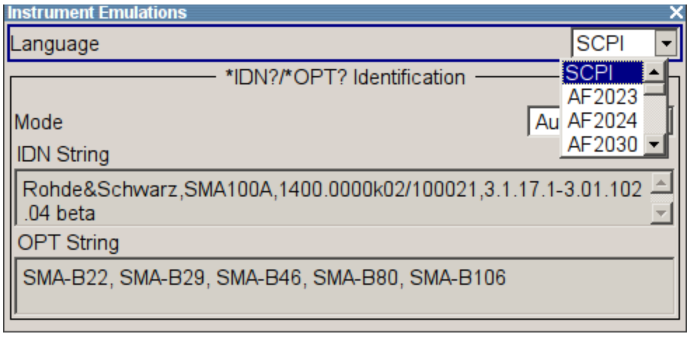
It is also possible to remotely control the R&S SMA via the command set of another signal generator, as for example of an HP generator. With this function you can, for example, replace a signal generator with an R&S SMA in an automated test setup, without adjusting the command scripts used.

You find all the remote control command sets supported by the R&S SMA in a selection list. For more information on this topic, an application note describes in detail how to use this feature. See the product site of the R&S SMA.

The selected instrument also defines the identification string that is retrieved with query `*IDN?`. In addition to the preset values, you can enter a user-defined identification string, for example to provide individual identification for each generator, like 'MY_R&S SMA' (see Mode and IDN String).

As any other parameter, you can additionally change the remote control command set to be emulated via the Language command. However, once you have switched to an emulation, the R&S SMA specific command set is disabled, that means this command is no longer effective. To return, you need to know the corresponding remote control command of the simulated instrument. If you emulate an HP generator for example, the HP command `EX` returns to the SCPI command set.

► To access this dialog, press the SETUP or MENU key and select "Remote > Instrument Emulations".



The "Instrument Emulations" dialog enables you to emulate a remote control command set of several other signal generators.

The remote commands required to remotely configure the emulation settings are described in Chapter 7.16, "SYSTem Subsystem", on page 663.

Language

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

Remote command:

`:SYSTem:LANGuage` on page 673

Mode

Selects the way the instrument identification is performed.

"Automatic"	Sets the "IDN String" and the "OPT String" automatically for the instrument selected with the parameter Language.
"User Defined"	Enables you to define the "IDN String" and the "OPT String" for the instrument selected with the parameter Language.

Remote command:

`:SYSTem:IDENtification` on page 673

Set to default

Enables you to reset the `*IDN` and `*OPT` strings in user defined mode, see "Mode" on page 114 .

The default strings vary depending on the selected emulation mode (Language)

IDN String

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

To assign a user defined identification string, select Mode "User defined".

Remote command:
`*IDN?` on page 393

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

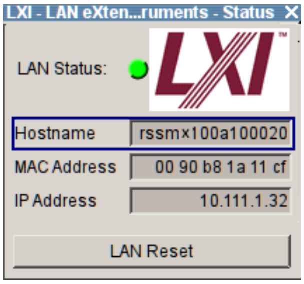
If a "User defined"(see Mode) IDN String is selected, you can create a user defined option string in addition to the automatically created one.

Remote command:
`*OPT?` on page 393

5.2.3.17 LXI Status

The "LXI - LAN eXtensions for Instruments - Status..." dialog displays the settings and status of the LAN and allows to reset the LAN connection.

For more information on LXI, see Chapter 2.8, "LXI Configuration", on page 46.



LAN Status
The LED indicates the LXI status.

The LAN Status is also indicated with the LED "LAN Status" on the front panel of the instrument.

"green" normal operation

"green (flashing)"
device identification

"red" LAN fault

Remote command:
n.a.

LAN Reset
Initiates the network configuration reset mechanism for the instrument and resets the hostname, MAC address, and IP address.

According to the LXI standard, a LAN Reset must place the following network settings to a default state:

Parameter	Value
TCP/IP Mode	DHCP + Auto IP Address
Dynamic DNS	Enabled
ICMP Ping	Enabled
Password for LAN configuration	LxiWebIfc

The LAN Reset for the R&S SMA also resets the following parameters:

Parameter	
Hostname	`Instrument-specific host name`
Description	signal generator
Negotiation	Auto Detect
VXI-11 Discovery	Enabled

The LAN settings are configured using the instrument's LXI Browser Interface described in Chapter 2.8, "LXI Configuration", on page 46.

To open the "Instrument Home Page" (welcome page), type the instrument's computer name (host name) or IP address in the address field of the browser on your PC, for example *http://10.111.10.175*.

Note: Do not add the missing zeros in the IP address, while opening the Instrument Home Page.

Remote command:
n.a.

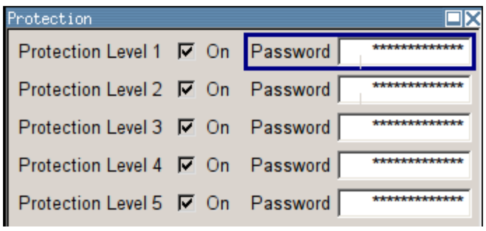
5.2.3.18 Protection

This "Protection" dialog provides access to the unlocking of different protection levels .

Access:

► Select "Setup > Protection"

After power on the instrument, all protection levels are locked. To unlock the protection, the correct password must be entered, see "To unlock or lock a protection level..." on page 117.



The following functions are protected in the respective levels:

- Protection Level 1
  Protects against accidental changes to certain settings, e.g. clock and date, network settings or instrument names. You can access this protection level with the password *123456*.
- Protection Level 2
  Provides access to the unlocking of protected service functions. It is accessible for authorized personnel of Rohde & Schwarz service departments.
- Protection Level 3-5
  Are reserved for factory internal use.

To unlock or lock a protection level...

1. In the "Password" entry field, enter the password for the corresponding protection level.
2. Confirm with the ENTER key.
   The checkbox of the protection level is disabled, i.e. the protection is unlocked.
3. To lock a protection level again, select the checkbox.

Protection Level/Password
Locks or unlocks the corresponding protection level.

E.g. protection level 1 expands the functionality of the internal adjustment and to access the selftests.

The password is *123456*.

Remote command:
`:SYSTem:PROTect<ch>[:STATe]` on page 674

5.2.3.19 Security

The security concept of the R&S SMA helps you to protect your instrument against uncontrolled access and changes. All provided security services require that you enter the security password.

Provided security services are:

- **Password** management secures controlled user access to the instrument
  With the two-step password concept, you can assign a user-defined password for the operating system, as well as a security password for accessing the mass storage of the instrument.
  For more information concerning the security password, see the description *Resolving Security Issues when Working with an R&S SMA*. You can find this document on the R&S SMA product page at "Downloads" > "Manuals".
- **LAN Services** secures controlled network access.
  You can individually lock and unlock the supported LAN interface services, see "LAN Services" on page 120.
  Remote control via LAN interface requires that the interface is activated, but you can enable the required services specifically.

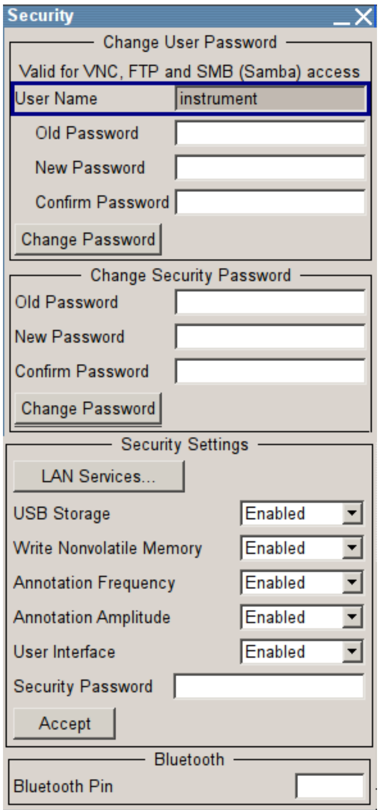
- **General** security parameters as:
  – **USB Storage** secures controlled access to the mass memory of the instrument.
  – **Write nonvolatile memory** protects against modification or deletion of data in the file system.
  – **Annotation** frequency and amplitude prevents reading the display.
  – **User Interface** prevents front panel operation and/or reading the display
  – **Bluetooth** enables operation of the instrument via Bluetooth.

Changing the password for the operating system or the security password requires that you enter the old password, the new password and that you confirm the new password.

To assign the password, press the "Accept" button. This action can not be undone!

Keep also in mind, that security settings are never reset, even if you perform a factory preset.

► To access this dialog, press the SETUP or MENU key and select "Protection " > "Security".



The "Security" dialog comprises the parameters for configuring the passwords, as well as the security settings of the mass storage and the LAN services.

The settings in this dialog will not be assigned until you enter the Security Password and confirm with the Accept button.

User Name
Indicates the user name used for access to the Linux operating system.

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

Change User Password
Allows you to change and confirm the user password.

Old Password ← Change User Password
Enters the current 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 ← Change User Password
Enters the new user password.

Confirm Password ← Change User Password
Confirms the new user password by reperating.

Note: The new password will not be assigned until you select the Change Password button.

Change Password ← Change User Password
Changes the user password accordingly.

Note: Keep in mind, that a changed password is never reset, even if you perform a factory preset.

Change Security Password
Enables you to change and confirm the security password.

Old Password ← Change 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.

New Password ← Change Security Password
Enters the new security password.

The security password may contain decimal characters only.

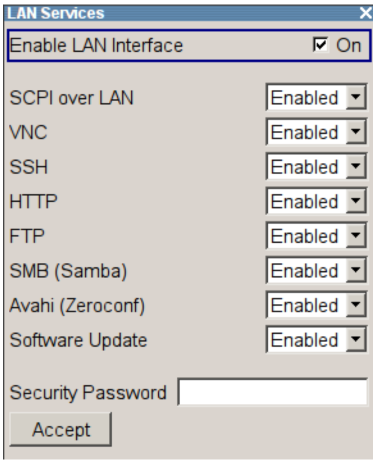
Confirm Password ← Change Security Password
Confirms the new password by repeating.

Note: The new password will not be assigned until you select the Change Password button.

Change Password ← Change Security Password
Changes the password accordingly.

Note: Keep in mind, that a changed password is never reset, even if you perform a factory preset.

LAN Services
Opens the "LAN Services" dialog for individually enabling or disabling the available LAN interface services.



Enable LAN Interface ← LAN Services
Enables the LAN interface in general, and thus provides remote access via all unlocked services.

Note: The activated LAN services will not be assigned until you enter the Security Password and confirm with Accept.

Enable LAN Services individually ← LAN Services
Enables or disables the following interface services individually.

"SCPI over LAN"	activates access over LAN to remotely control the instrument using SCPI (**S**tandard **C**ommands for **P**rogrammable **I**nstruments) commands.
"VNC"	activates access via VNC (**V**irtual **N**etwork **C**omputing) interface, a graphical desktop sharing system that uses RFB protocol to remotely control the instrument.
"SSH"	activates access via SSH (**S**ecure **Sh**ell), a network protocol for secure data communication.
"HTTP"	activates access via HTTP (**H**yper **T**ext **T**ransfer **P**rotocol), the application protocol for hypermedia information systems.
"FTP"	activates access via FTP (File Transfer Protocol), used to transfer files from a host to the instrument and vice versa.

"SMB (Samba)"
activates access to SMB (**S**erver **M**essage **B**lock), used for providing shared access to files, printers and serial ports of a network.

"Avahi (Zeroconf)"
activates Avahi, a service for automatic configuration of the instrument in a network environment.

"Software Update"
allows updating the instrument firmware via the LAN interface.
For more information on this topic see the release notes of the instrument, provided on the Internet at the download site or the Rohde & Schwarz Signal Generator home page.

USB Storage
Activates the access to external USB storage media.

This setting has no effect on a mouse or a keyboard, connected via USB.

Note: The setting will not be assigned until you enter the Security Password and confirm with Accept.

Write Nonvolatile Memory
Acitivates write protection on the file system to prevent modification or erasure of valuable data.

Note: The setting will not be assigned until you enter the Security Password, confirm with Accept, and reboot the instrument.

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

Note: The setting will not be assigned until you enter the Security Password and confirm with Accept.

Remote command:
`:DISPlay:ANNotation:FREQuency` on page 406

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

Note: The setting will not be assigned until you enter the Security Password and confirm with Accept.

Remote command:
`:DISPlay:ANNotation:AMPLitude` on page 406

User Interface
Allows you to lock the manual of the controls of the instrument, and to hide even the entire display.

The setting requires the entry of the security password *123456* and is only accepted after the "Accept" button is pressed.

Tip: Section "Enabling a locked user interface for manual operation" on page 122 describes how you can unlock the control elements and the user interface.

"Enabled"
Enables the display and all controls for the manual operation of the instrument.

"Display only"
Locks the manual operation of the instrument. The display on the screen remains and shows the current settings and changes.
This security feature protects the instrument against unauthorized access, but still shows the current settings and processes, for example when you operate the instrument via remote control.

The function disables:
- the keys at the front panel of the instrument
- the external mouse and keyboard

The instrument indicates the locked controls by a padlock softkey in the taskbar.

"Disabled"
Locks the display and all controls for the manual operation of the instrument.
This security feature protects the instrument against unauthorized reading and access, for example when you operate the instrument via remote control.

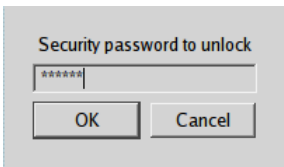
The function disables:
- the display
- the keys at the front panel of the instrument
- the external mouse and keyboard

The screen shuts off and shows a padlock instead.

Remote command:
`:SYSTem:ULOCk` on page 667
`:SYSTem:DLOCk` on page 666
`:SYSTem:KLOCk` on page 666

Enabling a locked user interface for manual operation

To unlock the user interface for manual operation you have the following options:
- On the instrument's keypad or external keyboard, enter the security password *123456*.
  Even if you press any key, the instrument prompts you to enter the security password for unlocking.

  Note The character of the first key you pressed is immediately added in the input field. Prior to inserting the password delete this entry.

- In remote control mode, send the command `SYST:ULOC ENABled` to release all locks at once.
  Alternatively, you can use the command `SYST:KLOC OFF` to unlock the keyboard, or `SYST:DLOC OFF` to release the display.
  Via remote control, there is no password required.

Remote command:
`:SYSTem:ULOCk` on page 667
`:SYSTem:DLOCk` on page 666
`:SYSTem:KLOCk` on page 666

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 that you to change the default security password before connecting the instrument to the network.

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

Accept
Applies the modified settings, provided the security password is entered correctly.

Note: This action can not be undone. Keep in mind, that a changed password is never reset, even if you perform a factory preset.

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

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

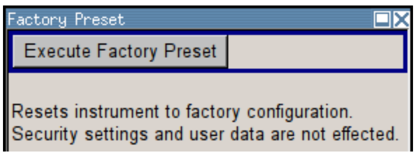
The interface parameters are identical to the RS232 interface parameters and can be set in the "Remote Channel Settings" dialog (see "RS232 using USB adapter" on page 112).

5.2.3.20 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 129).

5.2.3.21 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: "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 display 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.

Remote command:
`:SYSTem:FPReset` on page 397

5.2.3.22 Help

The "Help" dialog offers comprehensive online help for the R&S SMA. 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 128).

5.2.4 Switching to Manual Control - Local Key

The local key switches from remote control to manual control (local state).

In remote control mode the instrument indicates the remote state in the display header. The rest of the display remains unchanged and shows the current instrument status, that means the status which exists under the remote control settings. The instrument can be operated (for example dialogs 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.

The following states are indicated:

- "REMOTE"

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.

- "REM-LLO"
  The LOCAL key is locked, inititated by the `&LLO` (local lockout) command. The instrument can be switched from remote state to local state only via remote control, for example with `&GTR` or the Visual Basic command `CALL IBLOC (generator%)`. The LOCAL key has previously been locked by the remote command `&LLO`.

When switching from remote to manual control, the display update function is automatically deactivated ("SETUP" > "Start/Stop Display Update" > "Off").

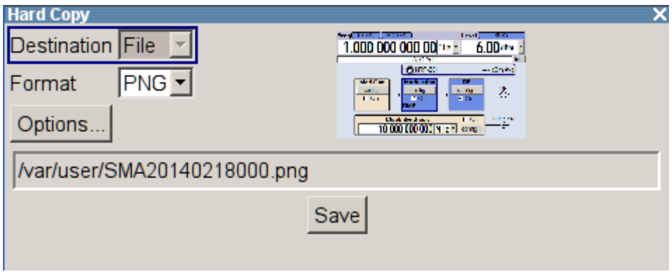
5.2.5 Generating a Hard Copy of the Display

The save/recall function enables you to store the settings in a file. In addition, you can create a hard copy of the current display to save the most important settings of a performed signal generation in an image file.

5.2.5.1 Hard Copy Settings

Creating a hardcopy of the display requires that you have an external keyboard connected to the instrument.

► To access the dialog, use the key combination CTRL+Z, or CTRL+Y depending on the used keyboard settings.



The dialog contains the parameters for configuring the output format and location of a hardcopy.

The remote commands required to define the hard copy settings are described in Chapter 7.9, "HCOPy Subsystem", on page 410.

Destination
Indicates that the hardcopy is stored in a file (see also "File Options" on page 126).

Remote command:
`:HCOPy:DEVice` on page 411

Options
Opens the "Hardcopy Options" dialog for configuring the corresponding parameters (see "File Options" on page 126.

Remote command:
n.a.

File
Some configuration parameters are already offered in the Hardcopy dialog. All configuration parameters are available in "File Options" on page 126.

Automatic Naming
Activates automatic generation of the file name. Automatic naming is configured in the "Options…" sub dialog , see "File Options" on page 126.

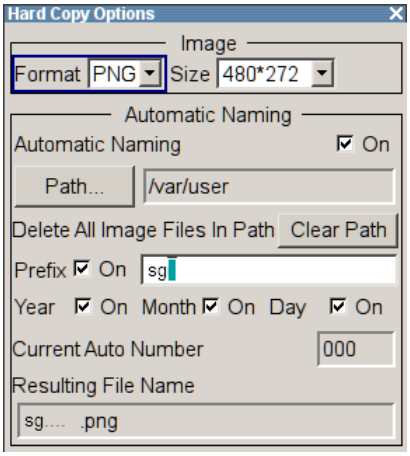
Remote command:
`:HCOPy:FILE[:NAME]:AUTO:STATe` on page 416

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.

Remote command:
`:HCOPy:FILE[:NAME]` on page 412
`:HCOPy:FILE[:NAME]:AUTO:FILE?` on page 413

5.2.5.2 Hardcopy Options

This section describes the "Hardcopy Options" dialog.



File Options
Dialog for setting the file parameters.

"Format" Selects the output file format, for example `*.bmp`, `*.jpg*.xpm*.png`.

Remote command:
`:HCOPy:IMAGe:FORMat` on page 416
`:HCOPy:DEVice:LANGuage` on page 411

"Automatic Naming" If enabled, creates the output filenames automatically according to rules following the activated components.

"Path..." Selects the directory.

Note: To select the destination path, you have to specify a file name as well. Otherwise an error message is displayed and the selection is canceled.

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

Remote command:
`:HCOPy:FILE[:NAME]:AUTO:DIRectory` on page 412
`:HCOPy:FILE[:NAME]:AUTO?` on page 412

"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.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar` on page 413

"Prefix, Year, Month, Day" Determines the rules for "Automatic Naming".
Per default, the automatically generated file name is composed of: `<Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`, where `Y`, `M` and `D` mean Year, Month, Day; `Number` is the "Current Auto Number".
You can deactivate/activate each component separately.
The "Resulting File Name" indicates the current file name syntax.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe` on page 415
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix` on page 415
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe` on page 416
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe` on page 414
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe` on page 414

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

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

Remote command:
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?` on page 415

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

Remote command:
`:HCOPy:FILE[:NAME]:AUTO:FILE?` on page 413

Save
Stores the hardcopy.

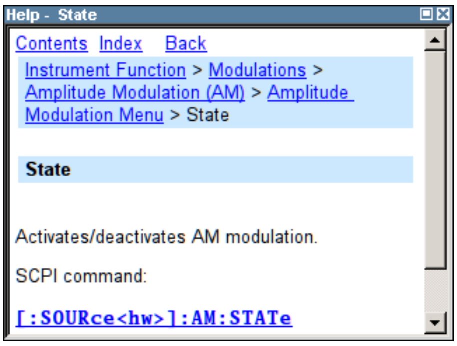
Remote command:
`:HCOPy[:EXECute]` on page 411

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 72 and Chapter 9, "Status Information, Error Messages and Troubleshooting", on page 688.

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.
- Back
  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 SMA allows complete instrument settings to be stored in files on the CompactFlash™ Card.

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

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

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

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

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

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

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

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

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

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

5.2.8.1 Save/Recall 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 86.

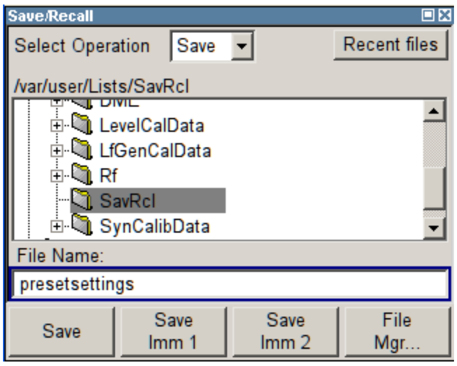
Select Operation
Selects the file function.

Accesses the settings for storing ("Save") and loading ("Recall") of the instrument settings.

"Save…"	Calls the menu for storing the current instrument setting (see Chapter 5.2.8.2, "Storing Instrument Settings", on page 130).
"Recall..."	Calls the menu for calling up a stored instrument setting (see Chapter 5.2.8.3, "Loading Instrument Settings", on page 132).

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.

Directory, File List and File Name
Note:
You access this generic standard function each time you perform one of the following:
- store or load (settings) files
- define a folder these files are to be stored in or
- navigate through the file system.

The name of the dialog is context sensitive but the provided functions are self-explanatory and very similar.

With the provided settings, you can perform the following:
- to navigate through the file system, use the directory tree
- to load and store files, use the dedicated functions "Select", "Save" and Recent files
- to perform standard file management functions, like create new directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see "File Manager" on page 132).

Remote command:
to list all files in a directory:
`:MMEMory:CDIRectory` on page 422
`:MMEMory:CATalog?` on page 421
`[:SOURce]:CORRection:CSET:CATalog?` on page 501

Save
Stores the current instrument settings under the specified path.

Remote command:
`*SAV` on page 395
`:MMEMory:STORe:STATe` on page 426

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.

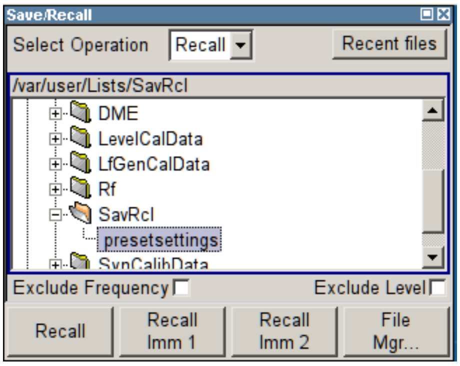
Remote command:
`*SAV` on page 395

File Manager
Accesses the "File Manager" dialog, see Chapter 5.2.8.4, "File Manager", on page 134.

Remote 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 files
Displays the files last used.

Directory, File List and File Name
Note:
You access this generic standard function each time you perform one of the following:
- store or load (settings) files
- define a folder these files are to be stored in or
- navigate through the file system.

The name of the dialog is context sensitive but the provided functions are self-explanatory and very similar.

With the provided settings, you can perform the following:
- to navigate through the file system, use the directory tree
- to load and store files, use the dedicated functions "Select", "Save" and Recent files
- to perform standard file management functions, like create new directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see "File Manager" on page 132).

Remote command:
to list all files in a directory:
`:MMEMory:CDIRectory` on page 422

:MMEMory:CATalog? on page 421
[:SOURce]:CORRection:CSET:CATalog? on page 501

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

Remote command:
[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL on page 542

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

Remote command:
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL on page 611

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.

Remote command:
:MMEMory:LOAD:STATe on page 425
*RCL on page 394

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.

Remote command:
*RCL on page 394

File Manager
Accesses the "File Manager" dialog, see Chapter 5.2.8.4, "File Manager", on page 134.

Remote command:
n.a.

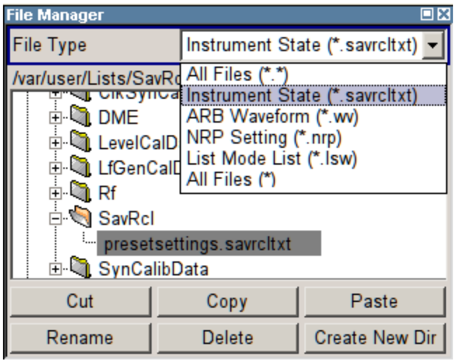
5.2.8.4 File Manager

The "File Manager" is a tool very similar to a standard Windows Explorer and helps you manage mass storage media and files stored on the R&S SMA.

You can perform the following tasks:

- Copying multiple files from disk to other media and vice versa, see Chapter 5.2.8.5, "Accessing the File System of the Instrument and Transferring Files from and to the Instrument", on page 135
- Copying files into another directory, see Copy and Paste
- Renaming and deleting files, see Rename and Delete
- Creating new directories on the follwoing drives:
  – hard disk
  – CompactFlash™ Card
  – memory stick

  See Create New Directory



For more information, see Chapter 4.7.2, "File Manager", on page 87.

File Type

Selects the file type to be listed. If you select a file type with a specific file extension, only files with this extension are listed in the directory.

Remote command:
n.a.

Directory and File Name

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

Unlike the "Save/Recall" and "File Select" dialogs, the "File Manager" displays the full file names including extensions.

Remote command:
`:MMEMory:CDIRectory` on page 422

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

Remote command:
`:MMEMory:DELete` on page 424

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.

Remote command:
`:MMEMory:COPY` on page 422

Paste
Pastes the file that has been copied or cut before.

Remote command:
n.a.

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

Remote command:
`:MMEMory:MOVE` on page 425

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

Remote command:
`:MMEMory:DELete` on page 424

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/MEAS`) or the path relative to the current directory (e.g. `../MEAS`).

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

Remote command:
`:MMEMory:MDIRectory` on page 425

5.2.8.5 Accessing the File System of the Instrument and Transferring Files from and to the Instrument

To access files and the file system of the instrument or to use the general file management functions such as copying and moving data, use the standard "File Manager" dialog.

To transfer files from and to the instruments or to exchange files, use one of the following alternatives:

- Connect a memory stick to one of the USB interfaces.
  The instrument recognizes automatically a connected memory stick.
- Connect the instrument to a LAN.
  For information on how to set up a LAN connection, refer to Chapter 2.6, "Setting Up a Network (LAN) Connection", on page 36.

  An instrument connected to a LAN supports the standard file transfer methods from a remote client:

  – FTP (file transfer protocol)
    see "To access the file system of the R&S SMA via ftp" on page 136
  – File sharing according to the SAMBA/SMB (server message block) protocol
    see "To access the file system of the R&S SMA via SMB (Samba)" on page 137

  Both file transfer methods access the folder `/var/user/share`.

This section provides an introduction to this topic. For comprehensive information, refer to the Application Note 1GP72 "Connectivity of Rohde&Schwarz Signal Generators".

To access the file system of the R&S SMA via ftp

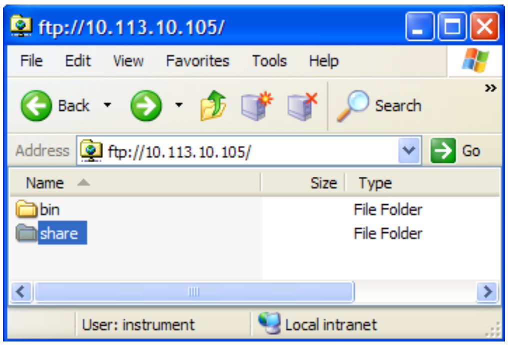
If the R&S SMA is connected to a LAN and the required configurations are completed, you can use File Transfer Protocol (ftp) to access the file system and to transfer files from and to the instrument.

1. Connect the instrument and the remote PC to a LAN.
2. Find out the "IP Address" of the instrument:
   a) Select "Setup > Environment > Network Settings".
   b) Write down the "IP Address" of the instrument, e.g. *10.113.10.105*.
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter `ftp://<"IP Address" of the Instrument>`, e.g. *ftp://10.113.10.105*

   A log on dialog opens and requests a password.

   Tip: Default password. The FTP file access use the user *instrument* with default password *instrument*.
   It is highly recommended that you change the user password in the "Security" dialog before connecting the instrument to the network!

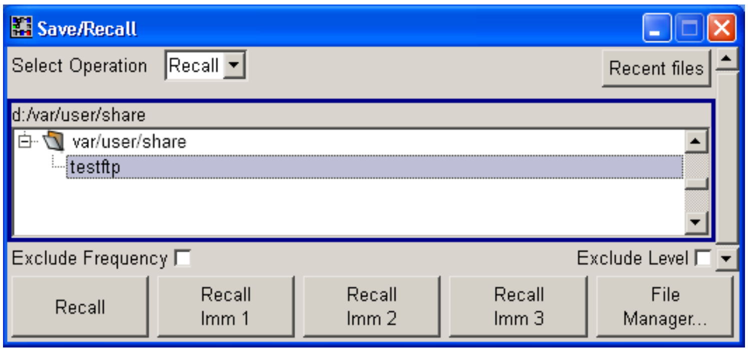
   See Chapter 5.2.3.19, "Security", on page 117.
5. Enter the password to access the `/var/user/share` directory.



You can access the files in the `/var/user/` directory, perform standard function like creating directory, etc.

6. Open the `/var/user/share` directory and create a new directory, e.g. `testftp`.
7. On the instrument, press the FILE key and open the `/var/user/share` directory.

   The dialog displays the `testftp` dircetory.



To access the file system of the R&S SMA via SMB (Samba)

The SMB (Samba) protocol is an alternative way to access the file system of the instrument form a remote PC, if both the instrument and the PC are connected to a LAN.

1. Connect the instrument and the remote PC to a LAN.
2. Find out the "IP Address" of the instrument:
   a) Select "Setup > Environment > Network Settings".
   b) Write down the "IP Address" of the instrument, e.g. *10.113.10.105*.
3. On the remote PC, start the Windows Explorer and open the "Map Network Drive" dialog.
   a) Select a valid "Drive", e.g. *W*.
   b) In the "Folder" field, enter:
   `//<"IP Address" of the Instrument>/share` or
   `//<"Hostname" of the Instrument>/share`, e.g. *//10.113.10.105/share*
   c) Select "Finish".

   A log on dialog opens and requests an user name and a password.
4. Enter the user name and the password of your instrument.

The default user name and password is *instrument*.

Tip: Default password. The SAMBA/SMB file access use the user *instrument* with default password *instrument*.
It is highly recommended that you change the user password in the "Security" dialog before connecting the instrument to the network!

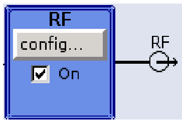
See Chapter 5.2.3.19, "Security", on page 117.

The `/var/user/share` directory of the instrument is mapped to and displayed as a network drive of the remote PC.
You can access the files in this directory, perform standard function like creating directory, storing files, etc.

5.3 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 SMA + frequency option) without additional equipment options.

5.3.1.1 RF Output

Basically, the RF output signal is deactivated. The previous state is restored, when the signal is reactivated.

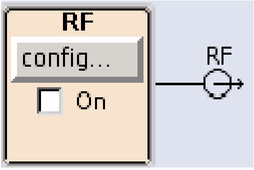
Activating RF Signal Output

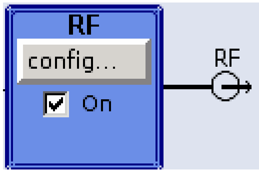
If the settings for the RF signal are done, you can activate RF signal output via:

- the RF ON/OFF key (the current entry focus is irrelevant)
- the checkbox in the "RF" block (see "RF On" on page 139)
- the "RF Frequency > RF ON" checkbox in the RF block (see "RF Output State" on page 139).
  To open the menu, select the "Configure" button in the RF block.

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

The disconnected connection to the output is additionally shown when the output is deactivated.





To query the impedance of the RF outputs, use the command :OUTPut<hw>:IMPedance? on page 428.

RF On

Activates RF signal output.

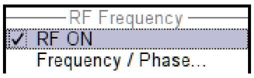
This function corresponds to the RF ON /OFF key.

See also Chapter 5.3.1.1, "RF Output", on page 138.

Remote command:
:OUTPut<hw>[:STATe] on page 429

RF Output State

Activates the RF output signal by selecting the RF checkbox in the "Configure" dialog of the "RF" block.



Remote command:
:OUTPut<hw>[:STATe] on page 429

5.3.1.2 RF Signal Modes and Characteristics

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

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

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

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

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

The R&S SMA 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 AM EXT/FM/PM EXT and PULSE EXT.

An external trigger signal for 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

The value of the RF frequency is displayed in the header of the display ("Freq"). This field provides the direct input of the RF frequency. Alternatively, you can enter the RF frequency in the "Frequency/Phase" dialog.

Note 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

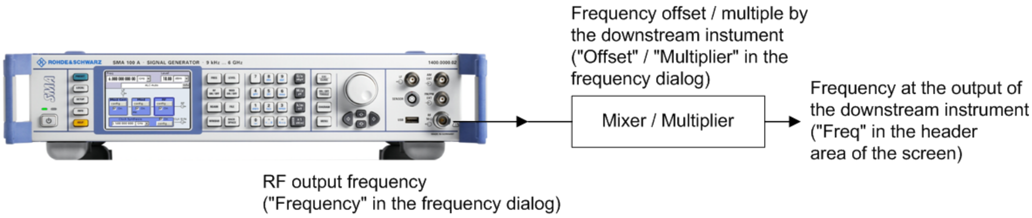
If you are working with a downstream instrument, e.g. a mixer or a frequency multiplier, you can enter the related parameter value in the frequency settings dialog ("Offset", "Multiplier").

The generator includes these parameters and displays the result in the "Freq" field in the status bar, as if the downstream instrument and the generator were one unit. This displayed frequency corresponds to the value at the RF output of the downstream instrument. However, the frequency provided at the RF output of the signal generator corresponds to the frequency value set in the "Frequency/Phase" dialog.

The instrument activates the "Freq Offset" icon in the status bar, when a frequency off-set or multiplication factor is set.

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)



5.3.2.2 Setting the 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.

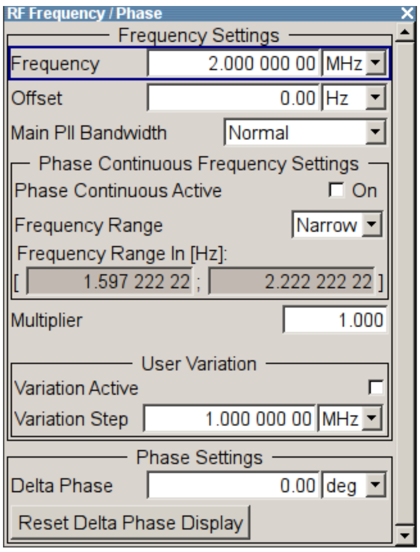
Note: The SCPI command sets the level of the "Freq" display, that means an entered frequency offset and multiplier factor are considered in the frequency value.

Remote command:

`[:SOURce<hw>]:FREQuency[:CW|FIXed]` on page 541

5.3.2.3 RF Frequency Dialog

The combined "RF Frequency / Phase..." dialog contains the parameters required for configuring the frequency and settings like a frequency offset, or a multiplier factor of an externally connected multiplier, see Chapter 5.3.2.4, "Frequency Settings", on page 142.

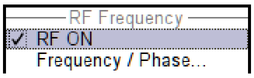


Furthermore, the dialog provides additional settings parameters which are described in:

- Chapter 5.3.3.2, "Phase Continuous Frequency", on page 146
- Chapter 5.3.2.5, "User Variation Settings", on page 143

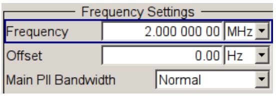
- Chapter 5.3.3, "Phase", on page 146

5.3.2.4 Frequency Settings



Access:

▶ Select "RF > config... > RF Frequency > Frequency/Phase".



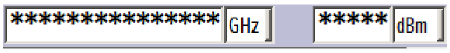
In the upper section of the combined "RF Frequency / Phase ..." settings dialog, you can configure the frequency of the RF signal.

The remote commands required to define the settings are described in Chapter 7.14.7, "SOURce:FREQuency Subsystem", on page 540.

Frequency
Sets the RF frequency of the RF output connector. The frequency entered and displayed here corresponds to the frequency at the RF output, that means any offset entry is not considered.

Note: Suppressed values in the status bar

For security concerns or certain operating modes you can hide the frequency and level display in the status bar.

- 

  The display has been disabled for security reasons, see Annotation Frequency and Annotation Amplitude.
- 

  The display is disabled when list mode is running, see "State - List Mode" on page 237.

Remote command:
`[:SOURce<hw>]:FREQuency[:CW|FIXed]` on page 541
Note: This command sets the frequency of the "FREQ" display, that is the frequency containing offset.

Offset
Sets the frequency offset relative to the RF frequency. The frequency offset of a downstream instrument (for example 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, see also Chapter 5.3.2.1, "RF Frequency vs. RF Output Frequency", on page 140.

Remote command:
`[:SOURce<hw>]:FREQuency:OFFSet` on page 544

Main Pll Bandwidth

Selects the PLL (Phase Locked Loop) bandwidth of the main synthesizer.

Refer to Chapter 5.3.2.7, "The Configurable Main PLL Bandwidth", on page 144 for details.

"Normal" Sets the default main PLL bandwidth. The instrument provides the maximum modulation bandwidth and FM / PhiM deviation.

"Narrow f<3GHz"
Sets the narrow PLL bandwidth.

Remote command:
`[:SOURce<hw>]:FREQuency:PLL:MODE` on page 546

Multiplier

Sets the multiplication factor for the RF frequency.

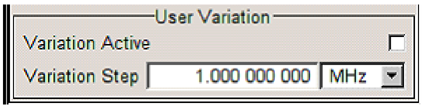
In the frequency field of the status bar, the instrument adjusts its frequency display according to the set multiplication factor. This frequency value shows the frequency at the output of the downstream multiplier. The entry does not change the RF frequency at the RF output of the R&S SMA, see also Chapter 5.3.2.1, "RF Frequency vs. RF Output Frequency", on page 140.

Remote command:
`[:SOURce<hw>]:FREQuency:MULTiplier` on page 544

5.3.2.5 User Variation Settings

Access:

► Select "RF > config... > RF Frequency > Frequency/Phase".



The combined "RF Frequency / Phase ..." settings dialog contains the parameters determine the step size for adjusting the frequency with the rotary knob.

Variation Active

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).

Remote command:
`[:SOURce<hw>]:FREQuency:STEP:MODE` on page 549

Variation Step
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".

Remote command:
`[:SOURce<hw>]:FREQuency:STEP[:INCRement]` on page 548

5.3.2.6 Phase Continuous Frequency Settings

A phase continuous mode can be enabled in the "Phase Continuous Frequency Settings" section (see Chapter 5.3.3.2, "Phase Continuous Frequency", on page 146).

5.3.2.7 The Configurable Main PLL Bandwidth

The latest generation of the R&S SMA provides an extended SynEx RF assembly which improves the phase noise performance. It is achieved by reducing the PLL bandwidth of the main synthesizer (see "Main Pll Bandwidth" on page 143) for a certain frequency range and offset.

- To change the PLL bandwidth requires that your device is equipped with the enhanced phase noise and FM/ϕM modulator (R&S SMA-B22) and the extended synthesis assembly (SynEx) with part number 1413.1800.02. This assembly is installed in all instruments with serial number 112000 or higher.
  If your instrument is equipped with the previous version of the SynEx assembly, the normal bandwidth is provided and th Main Pll Bandwidth parameter is suppressed in the settings dialog.
- The range of the adjustable PLL bandwidth is limited to 3 GHz. For frequencies higher than 3 GHz, the instrument uses the standard bandwidth automatically. The Main Pll Bandwidth selection switches to "Normal" mode.
- The narrow bandwidth increases the frequency settling time to approximately 1 ms. Therefore, the narrow PLL bandwidth mode and the list mode exclude each other. To generate a signal in list mode, the standard PLL bandwidth setting is required.

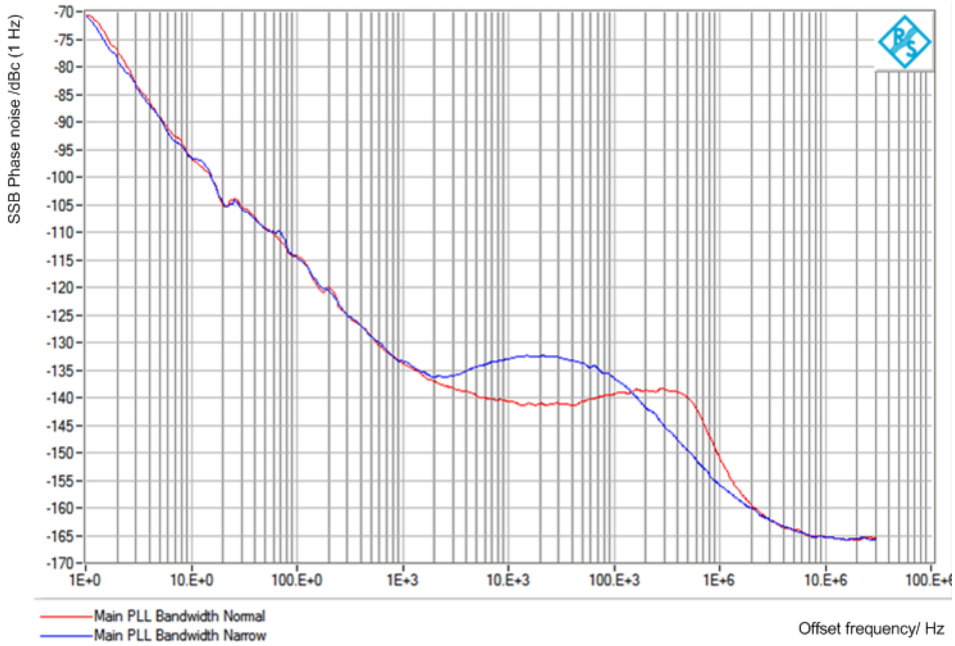


Figure 5-1: SSB Phase Noise, comparison of the main synthesizer PLL bandwidth "Narrow" and "Normal"

The phase noise performance for frequency offsets higher than 100 kHz is improved in the narrow PLL bandwidth mode (blue measurement curve). In the offset range 10 kHz to 100 kHz, the pedestal phase noise deteriorates.

Interactions of the Frequency and Phase Modulation Modes and the Configurable Main PLL Bandwidth

If you generate a frequency- or phase-modulated RF signal, you can also set the narrow PLL bandwidth, provided you perform the modulation in "Low Noise" mode. Consequently, some operation modes exclude each other.

The table shows the operating modes which can be activated simultaneously (+) or which deactivate each other (-):

Main PLL Bandwidth	FM Mode "Normal"	FM Mode "Low Noise"	ϕM Mode "Low Noise"	ϕM Mode "High Bandwidth"	ϕM Mode "High Deviation"
Normal	+	+	+	+	+
Narrow	-	+	+	-	-

Behavior of the instrument when you change the frequency or modulation modes

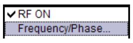
When you enable a mode, while another excluding mode is already active, the R&S SMA automatically adjusts the parameters of this previously set mode. Consequently, the instrument always performs the signal generation with the current settings and adjusts the foregoing settings accordingly, if required.

A message in the info line indicates when there is a conflict between the modulation mode and the PLL bandwidth setting.

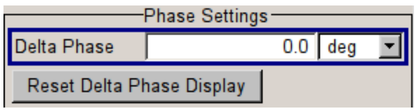
5.3.3 Phase

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

5.3.3.1 Phase Settings



► To access the dialog for configuring the phase settings, perform one of the following:
- Select "RF > config... > RF Frequency > Frequency/Phase".
- Press the MENU key and select "RF > RF Frequency > Frequency/Phase".



The combined "RF Frequency / Phase ..." settings dialog contains the parameters to configure the phase settings of the RF signal.

The remote commands required to define the settings are described in Chapter 7.14.16, "SOURce:PHASe Subsystem", on page 602.

Delta Phase
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.

Remote command:
`[:SOURce<hw>]:PHASe` on page 602

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

Remote command:
`[:SOURce<hw>]:PHASe:REFerence` on page 602

5.3.3.2 Phase Continuous Frequency

The phase continuous mode can be enabled in the "Phase Continuous Frequency Settings" section of the "Frequency" dialog. In this mode, the output sinewave is phase continuous, that means there is no phase discontinuity or glitch when changing the frequency.

At the transition from one frequency to another an intermediate frequency (switching transient) occurs, which causes spurs (see figure below). The transient is due to changes of the synthesizer settings (e.g. dividers, filters, phase detectors).

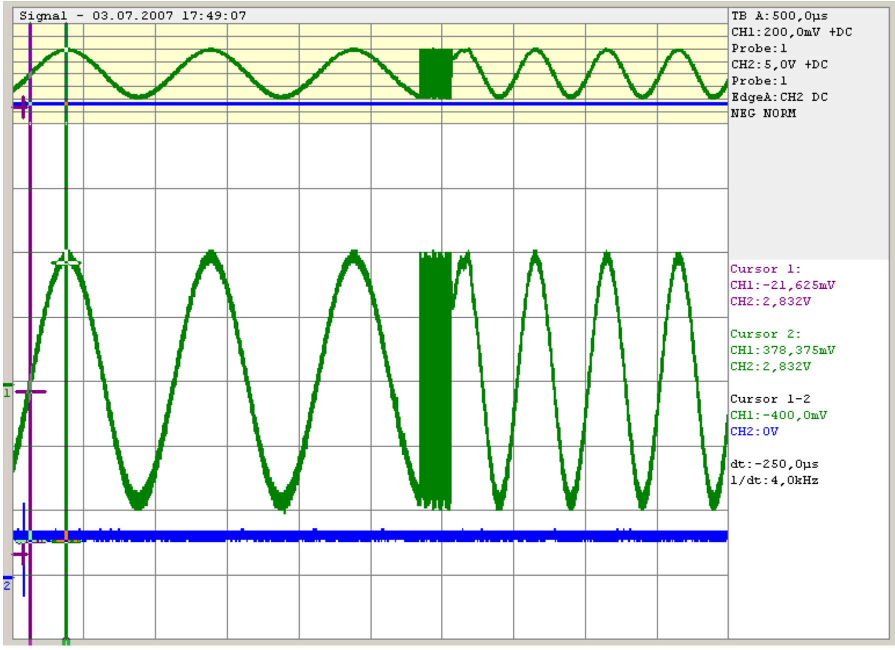


Figure 5-2: Transition for a 1 kHz step at 1 GHz without phase continuous mode active. For the graphical display the signal is down converted into the kHz range.

The phase continuous mode freezes the settings of the synthesizer (for example dividers, filters, phase detectors) which could generate phase discontinuities when changed. The frequency change is effectively performed by changing the fine resolution synthesizer. This allows a phase continuous change from one frequency to another without any transients (see figure below).

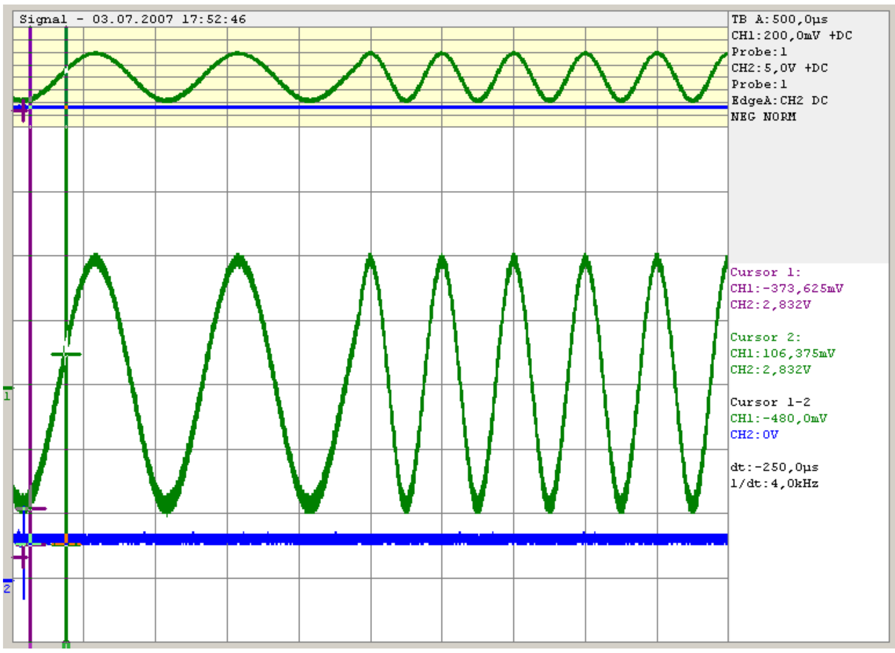


Figure 5-3: Transition for a 1 kHz step at 1 GHz with phase continuous mode active. For the graphical display the signal is down converted into the kHz range.

The available frequency range for phase continuous settings is limited by the fine resolution synthesizer used and varies with the RF frequency setting at the point of activating the phase continuous mode.

Depending on the instrument equipment - with or without option R&S SMA-B22 - the fine resolution synthesizer used is a DDS (Direct Digital Synthesizer, with option R&S SMA-B22) or a Fractional N-Synthesizer (without option R&S SMA-B22). The DDS provides generally a wider frequency range for phase continuous settings. In addition, two modes (narrow and wide) allow a selection either in favor of higher signal quality or in favor of an especially wide frequency range.

When phase continuous frequency setting is active, data sheet values no longer apply

Activating frequency or phase modulation deactivates phase continuous settings and vice versa.

Setting a Phase Continuous Frequency Sweep

1. In the "RF Frequency Sweep" Menu, if the sweep is active, switch it off.
2. In the "RF Frequency" Menu under the "Phase Continuous Frequency Settings" dialog
   a) If the "Phase Continuous Frequency Mode" is Active, switch it off
   b) Set "Frequency Range" to “Narrow”
   c) Select the RF frequency
   d) Check displayed Frequency Range
   e) If the "Frequency Range" corresponds to the selected frequency range, check the "Phase Continuous Active" box
   f) If "Frequency Range" in Narrow Mode does not, select “Wide” for the Frequency Range and check the Phase Continuous Active box
3. In the "RF Frequency Sweep" dialog
   a) Modify the "Start Freq" and "Stop Freq" or "Center Frequency" and "Span" as needed.
   b) Set the RF frequency sweep State to “ON”.

Optimum user settings for the phase continuous frequency sweep

In the "RF Frequency Sweep" dialog there are some settings that will improve the phase continuous sweep results for both "Narrow" and "Wide" mode choices.

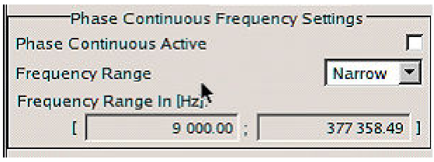
1. "Step Lin": low step size
   In order to get the best spur performance during frequency change, it is recommended to reduce the step size and (if necessary) increase the sweep speed by decreasing the Dwell Time. Effectively, the sweep will be performed in the same amount of time, but with smaller step sizes.
2. "Shape": Triangle sweep

The triangle sweep offers a uniform forward sweep and return to the beginning frequency. The saw tooth sweep produces a uniform forward sweep with an abrupt reset to the starting frequency. The abrupt reset can generate spurs.

Phase Continuous Frequency Settings

To access the settings for configuring the phase continuous mode, perform one of the following:

1. Select "RF > config... > RF Frequency > Frequency/Phase".
2. Press the MENU key and select "RF > RF Frequency > Frequency/Phase".



The "Phase Continuous Frequency Settings" section in the combined "RF Frequency / Phase..." contains the parameters required for configuring the phase settings.

The remote commands required to define the phase settings are described in Chapter 7.14.7, "SOURce:FREQuency Subsystem", on page 540.

Phase Continuous Active

Activates phase continuous frequency settings. For a given RF frequency setting, phase continuous frequency changes are possible in a limited frequency range.

See "Frequency Range - RF Signal" on page 150 for an overview.

For instrument without option R&S SMA-B22:

The range is typically +/-0.5 MHz in the main synthesizer octave of 750 MHz to 1.5 GHz.

Note: If "Phase Continuous" is "Active" a setting of the "RF Frequency" outside the available "Frequency Range" causes an error. A settings conflict is displayed.
Before you activate the phase continuous mode, select the required main PLL bandwidth, provided your instrument supports this feature, see Chapter 5.3.2.7, "The Configurable Main PLL Bandwidth", on page 144 and "Main Pll Bandwidth" on page 143. If you change the main PLL bandwidth while phase continuous is active, the bandwidth setting is not considered.

For instrument with option R&S SMA-B22:

The frequency range is indicated in the table in section "Frequency Range - RF Signal" on page 150. The range indication is active even if phase continuous frequency setting is not yet activated. Thus, the desired range can be determined before activating the function. Two modes are available.

Note: If "Phase Continuous" is "Active" a setting of the "RF Frequency" outside the indicated "Frequency Range" is only possible for mode Wide. A settings conflict is displayed.

Remote command:

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:STATe on page 546

Frequency Range - RF Signal

(instruments with R&S SMA-B22 option only)

Selects the mode for determining the frequency range for the phase continuous signal.

The frequency range depends on the selected mode.

RF frequency [MHZ]	Typ . range without R&S SMA-B22	Range with R&S SMA-B22 Narrow mode	Range with R&S SMA-B22 Wide mode
f <= 6.6	125 kHz	625 kHz	2.5 MHz
6.6 < f <= 11.71875	7.813 kHz	39.625 kHz	156.25 kHz
11.71875 < f <= 23.4375	15.625 kHz	78.125 kHz	312.5 kHz
23.4375 < f <= 46.875	31.25 kHz	156.25 kHz	625 kHz
46.875 < f <= 93.75	62.5 kHz	312.5 kHz	1250 kHz
93.75 < f <= 187.5	125 kHz	625 kHz	2.5 MHz
187.5 < f <= 375	250 kHz	1250 kHz	5 MHz
375 < f <= 750	500 kHz	2.5 MHz	10 MHz
750 < f <= 1500	1 MHz	5 MHz	20 MHz
1500 < f <= 3000	2 MHz	10 MHz	40 MHz
3000< f <= 6000	4 MHz	20 MHz	80 MHz

"Narrow" The available frequency range is smaller than with setting wide. It is asymmetrical around the RF frequency set at the point of activating the phase continuous settings (see table above).

In the narrow mode, a DDS frequency of 15 MHz to 20 MHz is used as reference signal to the phase detector. This provides a tuning range of 5 MHz in the main synthesizer octave from 750 MHz to 1.5 GHz. When activating the phase continuous settings, the current setting of the DDS is anywhere between 15 and 20 MHz, e.g. 17 MHz. Thus, the distribution around the center frequency most likely is asymmetrical, e.g. - 2 MHz and + 3 MHz for the 17 MHz. Signal quality is high because the larger mixing products are filtered by the low-pass filter (IF max. 20 MHz).

The narrow mode is recommended whenever possible due to the better signal quality (spectral purity).

It is not possible to set frequencies outside the available frequency range.

"Wide" The wide mode provides a larger frequency range. The frequency range is symmetrical around the RF frequency set at the point of activating the phase continuous settings (see table above).
Due to an additional divider by 8 in the PLL the signal quality is reduced in this mode. At some frequencies non -harmonics will be present.
Setting frequencies outside the available frequency range is possible, however, a settings conflict is indicated. The usable overrange depends on the currently set RF frequency, e.g. at 1 GHz it reaches from 850 MHz to 1030 MHZ.

Remote command:
`[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:MODE` on page 545

Frequency Range in [Hz] - RF Signal
(instruments with R&S SMA-B22 option only)

Displays the frequency range for phase continuous settings. The available frequency range depends on the mode selection ("Narrow" or "Wide").

The range indication is active even if phase continuous frequency settings are not yet activated. Thus, the desired range can be determined before activating the function.

Remote command:
`[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:HIGH?` on page 544
`[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW?` on page 545

5.3.4 Reference Oscillator

The R&S SMA is equipped with an internal reference oscillator that generates a reference frequency of 10 MHz. It is used as internal reference source for the synthesizer and the local oscillator. Alternatively, you can apply an external reference signal.

Regardless of the used reference source (internal or external), the R&S SMA always provides the configured reference frequency at the output. You can use it, for example to synchronize several interconnected instruments.

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

The following examples briefly explain the possible test setups and the settings to be considered.

- Internal f_{ref} = 10 MHz (10 MHz REF OUT)

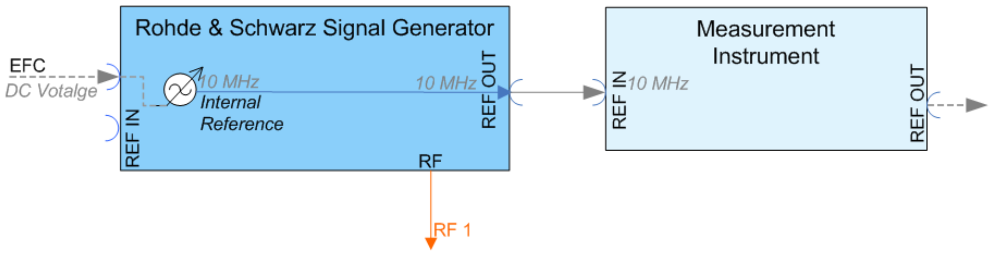


Figure 5-4: Synchronizing a subsequent instrument using the internal 10 MHz reference signal of the R&S SMA

The internal reference oscillator supplies the reference frequency.
In addition, you can shift the frequency by an external tuning voltage within a certain range, **EFC** (External Frequency Control). This function is used, for example, in phase noise measurement systems.
The frequency shift resulting from a tuning voltage value depends on the technical equipment of the instrument. See the data sheet for the associated technical data like sensitivity, input voltage range and impedance. The maximum bandwidth for external tuning signal input is approximately 50 Hz.
Note: The bandwidth of an external PLL (Phase Locked Loop) used in a phase noise measurement system, must be less than the bandwidth of the external tuning signal input. If the measurement requires a higher bandwidth for the PLL, it is recommended that you use the external FM modulation (DC coupling) in low noise mode. The FM-DC mode yields a fixed tuning sensitivity that is independent of the RF output frequency and corresponds to the set FM deviation.

Settings:

– Source: "Internal"

- External f_{ref} = 10 MHz (10 MHz REF OUT)
  If you have a clean external reference signal with 10 MHz frequency, you can directly pass it to the output. The signal quality remains the same.

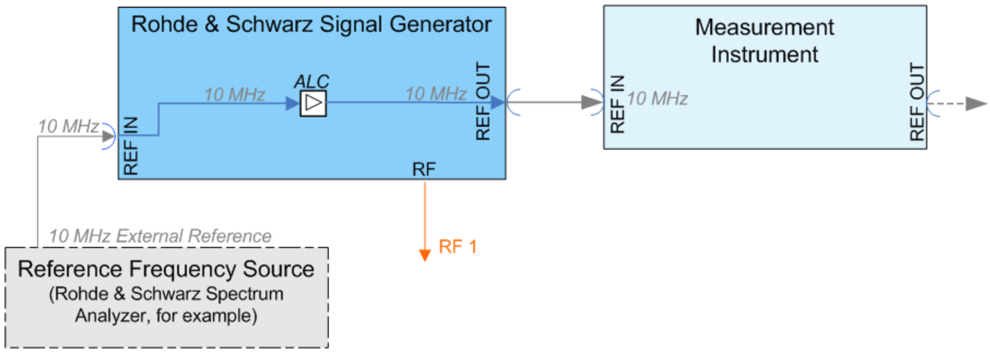


Figure 5-5: Synchronizing instruments by means of an externally applied reference signal having 10 MHz

Settings:

– Source: "External"

– External Reference Frequency: "10 MHz"

Set the additionally provided parameters, as for example the synchronization bandwidth according to the requirements of the application.

- External f_{ref} = 5/10/13 MHz (5/10/13 MHz REF OUT)
  If you have an external reference signal with 5, 10 or 13 MHz, you can directly pass it to the output. The signal quality remains the same.

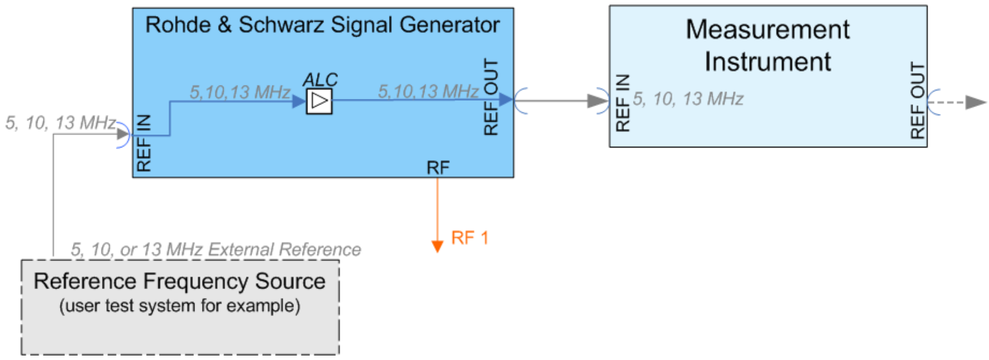


Figure 5-6: Synchronizing a subsequent instrument an externally applied reference frequency of 5, 10, or 13 MHz

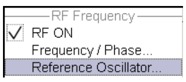
Settings:
– Source: "External"
– External Reference Frequency: "5, 10 or 13 MHz"

Input and output connectors of the reference frequency

The appropriate connectors are located at the rear panel, see "REF IN" on page 25 and "REF OUT" on page 25.

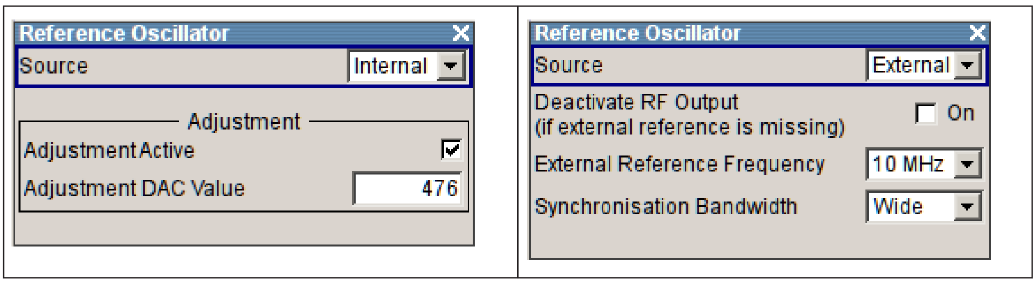
To use the EFC feature, assign this signal at the EXT TUNE input connector at the rear of the instrument, see Chapter 2.2, "Rear Panel Tour", on page 23.

5.3.4.1 Reference Oscillator Settings



To access the settings dialog for configuring the reference signal, perform one of the following:

- In the block diagram, select "RF > config... > RF Frequency > Reference Oscillator"
- Press the MENU key and select "RF > RF Frequency > Reference Oscillator"
- Press the SETUP key and select "Setup > System > Reference Oscillator"



In the "Reference Oscillator Settings" dialog, you can select the signal source and frequency to be used as the reference frequency, and determine a user-defined adjustment value.

The remote commands required to define the reference oscillator settings are described in Chapter 7.14.20, "SOURce:ROSCillator Subsystem", on page 634.

Source
Selects the source of the reference frequency.

See Chapter 5.3.4, "Reference Oscillator", on page 151, which provides an overview of the different test scenarios for configuring the reference frequency.

"Internal" Uses the internal 10 MHz reference signal, either with the calibrated or a user-defined adjustment value.

"External" Uses an external reference signal.
The frequency of the external reference signal must be selected under "External Reference Frequency" on page 154.

Remote command:
`[:SOURce]:ROSCillator:SOURce` on page 637

Deactivate RF Output (if external reference is missing)
Turns the RF output off when the external reference signal is selected, but no signal is supplied.

This function prevents that no improper RF signal due to the missing external reference signal is used for measurements. A message indicates that the external signal is missing and the RF output is deactivated.

This setting is not affected by a reset.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe]` on page 635

External Reference Frequency
Determines the frequency of the external reference signal.

You can use an external reference signal having a frequency of 5 MHz, 10 MHz or 13 MHz.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:FREQuency` on page 635

Synchronization Bandwidth
Selects the synchronization bandwidth for an external reference signal.

"Narrow" The synchronization bandwidth depends on the configuration of the instrument:

- Instruments equipped with option SMA-B22
  The synchronization bandwidth is a few Hz. The internal 10-MHz OCXO is synchronized to the external signal. This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.
- Instruments without option SMA-B22
  The synchronization bandwidth is approximately 20 Hz.

"Wide" The synchronization bandwidth depends on the configuration of the instrument:

- Instruments equipped with the option SMA-B22
  The synchronization bandwidth is approximately 100 Hz. This mode is recommended for very precise reference sources of high spectral purity. The internal 10-MHz OCXO is bypassed and the external signal synchronizes a 100-MHz reference oscillator directly.
- Instruments without option SMA-B22
  The synchronization bandwidth is approximately 750 Hz. This mode is the recommended standard mode.

Note: If the frequency of the external reference signal is outside the tuning range of the internal OCXO, spurs due to the difference of the internal and external reference frequency are generated in the reference PLL. An error message is indicated in this case.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:SBANdwidth` on page 636

Adjustment Active

Selects the adjustment mode.

"OFF" Uses the calibrated internal reference frequency.

"ON" Allows you to apply a deviation to the internal reference frequency, according to your requirements. To enter the value, use Adjustment DAC Value.

Remote command:
`[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]` on page 637

Adjustment DAC Value

Sets a user-defined deviation for the internal reference frequency. This value takes effect when it is activated with Adjustment Active. "0" represents the calibrated state. The setting range depends on the reference oscillator type and its factory calibration value.

Note: A factory preset resets this setting to the calibration value of the instrument.

Remote command:
`[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue` on page 636

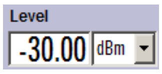
5.3.5 RF Level

5.3.5.1 Overview of RF Level

Message "Level overrange/underrange"

If this message appears in the status line, the set level ("Level") is out of range (see data sheet).

In this case, the signal level at the output can deviate from the set value.



The value of the RF level is displayed in the level field in the header of the display ("Level"). This field provides the direct input of the RF level value. Alternatively, you can enter the level in the "Level/EMF/..." dialog.

Note that the displayed RF level in the header, and the RF output level, set in the "Level/EMF" dialog can be different, as explained in the following section.

RF level vs. RF output level

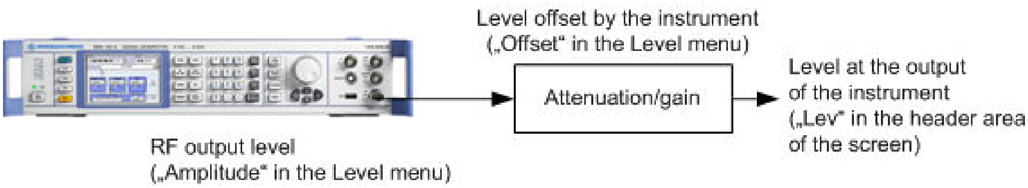
If you are working with a downstream instrument, e.g. an attenuator or amplifier, you can enter the related parameter value in the level settings dialog ("Offset").

The generator includes these parameters and displays the result in the "Level" field in the status bar, as if the downstream instrument and the generator were one unit. This displayed level value corresponds to the value at the RF output of the downstream instrument. However, the level provided at the RF output of the signal generator corresponds to the level value set in the "Level/EMF/..." dialog.

The instrument activates the "Level Offset" icon in the status bar, when a level offset is set.

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 Chapter 5.3.5.7, "Reverse Power Protection", on page 175).

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

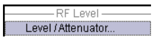
Enters the RF level, considering the level offset (see "RF level vs. RF output level" on page 156).

dBm, dBµV, mV and µV can be used as the level units. The four 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 considered in the level value.

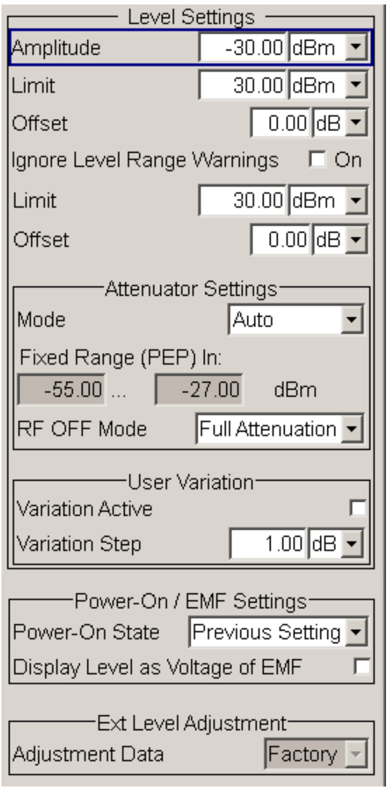
Remote command:
`[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` on page 610

5.3.5.2 RF Level Dialog



Access:

► Select "RF > config... > RF Level > Level/Attenuator".



The offset-free level, level offset and level limit are set in the top section of the dialog. The attenuator mode is set in the "Attenuator Settings" section.
In section "User Variation", you can determine the step size for adjusting the level with the rotary knob (with "Variation Active On").
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 5.3.5.3, "Power-On/EMF Settings", on page 161).

The remote commands required to define the settings are described in Chapter 7.14.18, "SOURce:POWer Subsystem", on page 607.

Level Settings

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

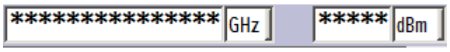
Amplitude

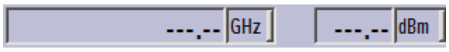
Sets the RF level of the RF output connector.

The level entered and displayed here corresponds to the level at the RF output, that means any offset entry is not considered.

Note: Suppressed values in the status bar

For security concerns or certain operating modes you can hide the frequency and level display in the status bar.

- 

  The display has been disabled for security reasons, see Annotation Frequency and Annotation Amplitude.
- 

  The display is disabled when list mode is running, see "State - List Mode" on page 237.

Remote command:
`[:SOURce<hw>]:POWer:POWer` on page 613

Note: The SCPI command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display, that is the level containing offset.

Limit - RF Level

Sets an upper limit for the RF output power.

You can use it to protect your DUT from damage due to high input power. If you enter an RF level above this value, the instrument limits the output power to this specified value, and generates a warning message.

However, the level indication in the status bar is not affected.

Note: The value is not affected by an instrument preset (PRESET key), `*RST` and the "Save/Recall" function. It is influenced only by the Factory Preset and the factory value is equal to maximum level.

Remote command:
`[:SOURce<hw>]:POWer:LIMit[:AMPLitude]` on page 612

Offset (Level)

Sets the level offset relative to the RF level.

The level offset of a downstream instrument (for example 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.

Remote command:
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet on page 611

Ignore Level Range Warnings

Suppresses warnings the instrument generates when either the level, or the PEP value are out of range. This function prevents automated measurements from being stopped due to a level warning.

The following warnings are suppressed in both, the history and in the error queue:

- Level overrange / level underrange
- PEP value greater than defined upper bound / PEP value less that defined lower bound (fix range)

Remote command:
[:SOURce]:POWer:WIGNore on page 612

Attenuator Settings

The R&S SMA can be configured to provide level settings without interruption. It is possible for instruments with or without step attenuator. The attenuator mode is set in the "Attenuator Settings" section of the "RF level / EMF" dialog.

Attenuator Mode

Sets the attenuator mode at the RF output.

"Auto" Standard mode.
The entire level range is available. The level settings are made in the area of the electronically switching attenuator as well as in the area of the relay-switched high power bypass (longer switchover time, wear).

"Normal" The level settings are made only in the area of the electronically switching attenuator. The high level ranges are not available.
This setting is wear-free, as the relays are not switched.

"High Power" The level settings are made only in the area of the high-power bypass. Only the high level range is available. The relays are not switched.

"Fixed" The level settings are made without switching the attenuator and the relays.
When this operating mode is switched on, the attenuator and the relays 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.

Remote command:
:OUTPut<hw>:AMODe on page 428

Fixed Range (PEP) In

Displays the level range in which the level is set without interruption for the "Attenuator Mode fixed" setting.

Remote command:
`:OUTPut<hw>:AFIXed:RANGe:UPPer?` on page 427
`:OUTPut<hw>:AFIXed:RANGe:LOWer?` on page 427

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 is recommended if a constant VSWR (**V**oltage **S**tanding **W**ave **R**atio) is required.
Furthermore, it provides fast and wear-free operation of the relay-switched high power bypass.

"Full Attenuation"
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.

Remote command:
`[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE` on page 609

User Variation

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

Variation Active

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).

Remote command:
`[:SOURce<hw>]:POWer:STEP:MODE` on page 617

Variation Step

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".

Remote command:
`[:SOURce<hw>]:POWer:STEP[:INCRement]` on page 616

External Level Adjustment

The external level adjustment provides information about the data that has been used for calibrating the RF level.

By default the instrument uses correction data obtained in the factory before delivery. In exceptional cases, you can determine the calibration values with an R&S NRP power sensor, and use these values for the external level correction. This feature is a protected function (see Service Manual, chapter 2, "Adjustment").

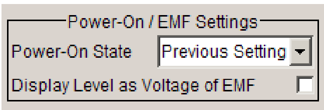
Adjustment Data
Indicates what data has been used for level calibration.

Remote command:
`:CALibration<hw>:LEVel:EXTern:DATA` on page 400

5.3.5.3 Power-On/EMF Settings

The power-on behavior of the R&S SMA 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.

Remote command:
`:OUTPut<hw>[:STATe]:PON` on page 429

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.

Note: This setting is not affected by an instrument preset (PRESET key), `*RST`) or the "Save/Recall" function. Only the Chapter 5.2.3.21, "Factory Preset", on page 123 resets the setting.

Remote command:
`[:SOURce<hw>]:POWer:EMF:STATe` on page 610

5.3.5.4 Automatic Level Control - ALC

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

Automatic **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, some operating modes exclude ALC, as the control loop would detect incorrect values and result in level deviations. These are:

- Pulse modulation
- DME modulation

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 explains 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 SMA 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 additional explanation. Furthermore, find the ALC state settings described in detail in State - ALC.

ALC OFF (Sample & Hold)

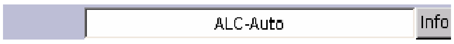
In "S&H" mode, the signal generator switches for a short period of time into CW mode and activates ALC. ALC adjusts the level to the set value and the generator holds the value (freeze). Then, the generator switches ALC off again and back to the operating mode.

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

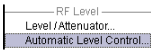
- an **electronic step attenuator**
  The level is decreased by 30 dB.
- a **mechanical step attenuator**
- **no step attenuator**
  The signal generator outputs the set level for 3 to 5 ms after level or frequency setting during a Sample & hold measurement.

Instruments equipped with one of the options R&S SMA-B103L or R&S SMA-B106L come without step attenuator.

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

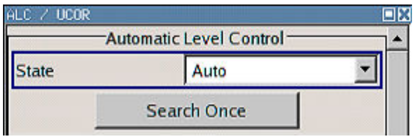


Automatic Level Control Settings



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 5.3.5.6, "User Correction", on page 167).



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.

"Off (Sample & Hold)"
Deactivates internal level control.
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.

Remote command:
[:SOURce<hw>]:POWer:ALC[:STATe] on page 609

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

Remote command:
[:SOURce<hw>]:POWer:ALC:SONCe on page 608

5.3.5.5 NRP-Z Level Control

With the NRP-Z Level Control function, you can achieve a very stable and accurate RF power supplied to your DUT. With the aid of a downstream control circuit, a CLPC (Closed Loop Power Control), you can detect frequency response characteristics of the used components, such as losses due to cables, modules or components like power amplifiers, and compensate these effects accordingly.

Example: How to set up a closed loop power control

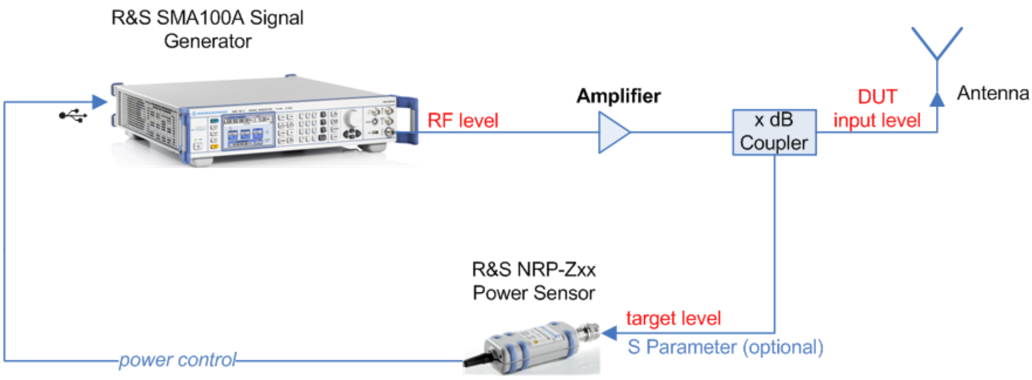


Figure 5-7: Example of a test setup with NRP-Z Level Control

As shown in the example, the sensor measures a proportional power in defined time intervals, derivated from a coupler. It considers optionally given S-parameters and returns the results to the generator. The signal generator compares the measured level with the set value and adjusts its output level accordingly.

This allows you to control the external signal level continuously and reliably reach a constant input level at the DUT in real time.

Impact of the NRP-Z Level Control and the Operating Modes

Since the frequency and level of the RF output signal are continuously adjusted during "NRP-Z Level Control", this operating mode interferes those with varying frequency and level values.

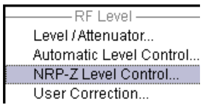
The reason is, that the generator regularly transmits the output frequency to the connected R&S NRP-Zxx power sensor, which in turn requests the signal generator to adjust the output level according to its measurement. In contrast to this real time control loop, for example the list operating mode already generates the RF output signal on previously optimized frequency and level value pairs. In this case, the "NRP-Z Level Control" as a second control loop would impact the already determined RF signal values and also considerably slow down the measurement. Similar impacts occur in sweep mode, and also the "NRP-Z Power Viewer" and "NRP-Z Level Control" affect each other's functionality.

Hence, the operating modes exclude each other as follows:

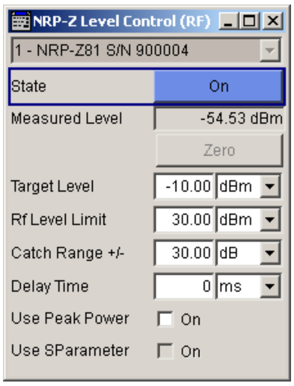
- "NRP-Z Level Control" automatically disables NRP-Z Power Viewer and NRP-Z Power Analysis, and vice versa.
- Activating the RF frequency sweep, RF level sweep or the list mode instantly deactivates a running "NRP-Z Level Control".
- A running list or RF sweep mode blocks "NRP-Z Level Control". It can not be activated.

Also keep in mind that modulated signals may differ from CW signals regarding mean power and peak power. This affects the operation of "NRP-Z Level Control".

NRP-Z Level Control Settings



► To access the dialog for configuring the level control settings, perform one of the following:
- Select "RF > config... > RF Level > NRP-Z Level Control".
- Press the MENU key and select "RF > RF Level > NRP-Z Level Control".



The dialog contains all parameters for configuring the settings for level control test setup.

The remote commands required to define these settings are described in Chapter 7.14.18, "SOURce:POWer Subsystem", on page 607

Sensor
Selects the R&S NRP-Z power sensor for power control.

Note: 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 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 101 dialog to update the sensor software.

Remote command:
`[:SOURce<hw>]:POWer:SPC:SELect` on page 615

State
Activates power control using the selected sensor.

The control loop periodically adjusts the generator output. After switching off, the running loop is completed.

Remote command:
`[:SOURce<hw>]:POWer:SPC:STATe` on page 615

Measured Level
Indicates the current reading of the sensor.

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. If a Rohde & Schwarz power sensor receives an input power during the zeroing process, it aborts zeroing and generates an error message. Zeroing takes a few seconds, depending on the sensor model. Refer to the documentation of your power sensor for more information.

Tips for zeroing

When to perform zeroing:

- 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 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, but do not disconnect it from the power sensor. This proceeding keeps the thermal equilibrium, and the zeroing process also compensates the noise that superimposes the measured signal (e.g. from a broadband amplifier).

Remote command:
`:SENSe<ch>[:POWer]:ZERO` on page 477

Target Level
Specifies the nominal level expected at the input of the sensor. The signal generator adjusts the output power accordingly, in order to meet the target value at the sensor input, and thus the power required at the DUT.

Remote command:
`[:SOURce<hw>]:POWer:SPC:TARGet` on page 615

Limit - RF Level
Sets an upper limit for the RF output power.

You can use it to protect your DUT from damage due to high input power. If you enter an RF level above this value, the instrument limits the output power to this specified value, and generates a warning message.

However, the level indication in the status bar is not affected.

Note: The value is not affected by an instrument preset (PRESET key), `*RST` and the "Save/Recall" function. It is influenced only by the Factory Preset and the factory value is equal to maximum level.

Remote command:
`[:SOURce<hw>]:POWer:LIMit[:AMPLitude]` on page 612

Catch Range +/-
Sets the capture range of the control system.

Within the range:

Target Level +/- Catch Range

the power control locks and tries to achieve the target level. Readings outside the range are not considered.

Remote command:
[:SOURce<hw>]:POWer:SPC:CRANge on page 614

Delay Time
Defines a waiting period between the level adjustment of the generator and the next measurement of the power sensor.

With this parameter, you compensate any dead times in the controlled system.

Remote command:
[:SOURce<hw>]:POWer:SPC:DELay on page 614

Use Peak Power
Activates control by means of the peak power values, provided the power sensor supports this function. Otherwise, the dialog does not show this parameter.

Remote command:
[:SOURce<hw>]:POWer:SPC:PEAK on page 615

Use SParameter - Power Sensors
Activates the use of the S-Parameter correction data of the connected power sensor. For sensors 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 SParameter table.

Remote command:
:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe on page 440

5.3.5.6 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.

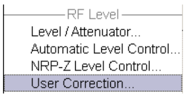
The amplitude can also be linearized automatically by means of an R&S NRP power sensor connected to one of the generator output signals. With the aid of the "Fill with Sensor" function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating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



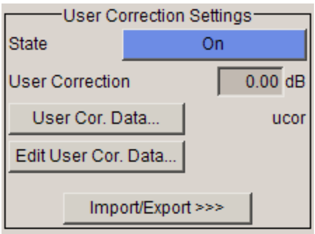
To open the "User Correction" menu, select "RF > Configure > User Correction" or use the MENU key under "RF".

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 5.3.5.4, "Automatic Level Control - ALC", on page 161.



State - User Correction
Activates/deactivates user correction.

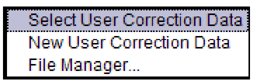
The "UCOR" status message appears in the frequency and level display.

Remote command:
`[:SOURce<hw>]:CORRection[:STATe]` on page 508

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

Remote command:
`[:SOURce<hw>]:CORRection:VALue?` on page 508

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



Remote command:
[:SOURce]:CORRection:CSET:CATalog? on page 501
[:SOURce<hw>]:CORRection:CSET[:SELect] on page 507
[:SOURce]:CORRection:CSET:DELete on page 503

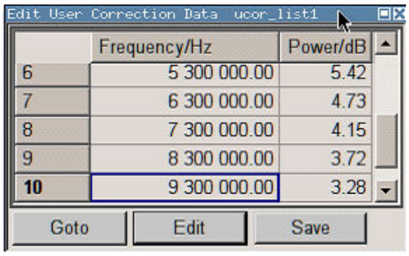
Edit User Cor. Data - User Correction

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.

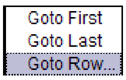


"Frequency / Hz" — Enters the frequency to which the level correction value applies.

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.

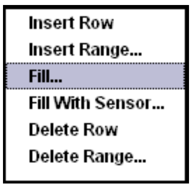
"Power/dB" — Enters the level correction value to which the specified frequency applies. The values can be entered manually or automatically with the "Fill With Sensor" function (available in the "Edit" sub menu).
The "Fill With Sensor" function requires option R&S SMA-K83.

"Goto" — Selects row for editing.



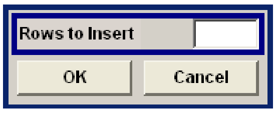
If Goto row is selected, a window opens for entering the requested row.

"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.

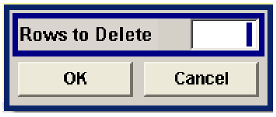


"Fill...." Opens a sub menu for defining a set of list values to be automatically entered in the ucor list (see "Filling the Correction List automatically" on page 172).

"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 173).

"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.

Remote command:
[:SOURce<hw>]:CORRection:CSET[:SELect] on page 507
[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency on page 502
[:SOURce<hw>]:CORRection:CSET:DATA:POWer on page 502

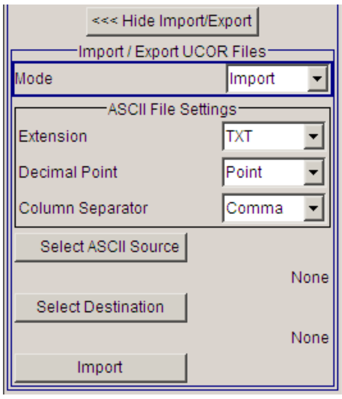
Import/Export

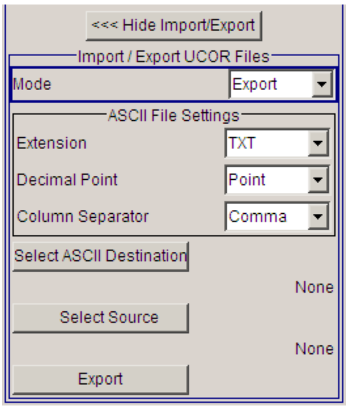
User correction list can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the "Import/Export" button.

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.

Remote command:
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 506

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.

Remote command:
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension` on page 504

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

Remote command:
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal`
on page 505

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.

Remote command:
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn`
on page 505

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.

Remote command:
`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect` on page 504

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.

Remote command:
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 507

Import / Export - User Correction
Starts the export or import of the selected file.

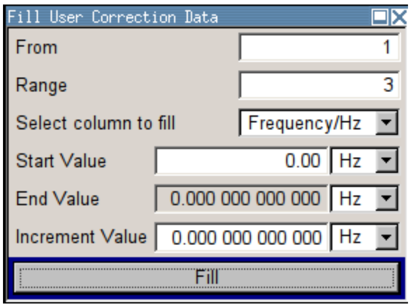
When import is selected, the ASCII file is imported as user correction list.

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

Remote command:
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 506

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.

Remote command:
n.a.

Range
Sets the range for filling the table.

Remote command:
n.a.

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

Remote command:
n.a.

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

Remote command:
n.a.

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

Remote command:
n.a.

Increment value
Sets the increment for the frequency or the level entries.

Remote command:
n.a.

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

Remote 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 5.3.6.2, "NRP-Z Power Viewer", on page 176). The filling of the user correction list with measurement data is performed in the ucor list editor (see "Edit User Cor. Data - User Correction" on page 169).

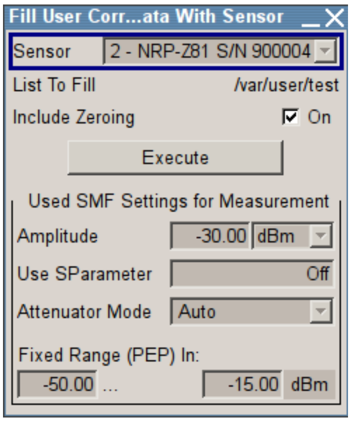
In the editor, the frequencies for which the correction values are to be acquired are entered in the frequency column (either manually or by means of the "Fill..." menu).

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.



This dialog describes all parameters for filling a table automatically with sensor readings.

To select the sensor and determine its parameters, refer to Chapter 5.3.6.2, "NRP-Z Power Viewer", on page 176.

To fill the table, press the "Execute" button.

Fill User Correction Data with Sensor
Enables you to fill the table with correction data acquired by a connected power sensor from Rohde & Schwarz.

"Sensor" Displays connected sensors for selection.

"List To Fill" Indicates the used list file.

"Include Zeroing"
Performs a zeroing procedure before acquiring the user correction data to improve precision. Since during zeroing no signal may be applied to the sensor, RF is temporarily switched off at the generator. When unchecked, the zeroing procedure is skipped. The RF signal level might be blanked shortly. This setting is recommended if blanking of RF is undesirable or the absence of power at the sensor can not be guaranteed.

"Execute" Performs automatic filling of the list, provided a sensor is detected and the user correction list contains at least one frequency value.

Remote command:
`[:SOURce<hw>]:CORRection:ZERoing:STATe` on page 508
`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` on page 503

Used SMA Settings for Measurement
Displays the settings relevant for the measurement.

"RF Source" Shows the path for which the correction menu settings are made.

"Modulation" Indicates the modulation state

"Amplitude" Shows the currently set level.

"Use SParameter"
Indicates whether SParameter correction is used.

"Attenuator Mode"
Displays the selected mode of the attenuator.

"Fixed Range (PEP) In:"
Shows the level range.

Remote command:
n.a.

5.3.5.7 Reverse Power Protection

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

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.

Remote command:
`:OUTPut<hw>:PROTection:TRIPped?` on page 429
`:OUTPut<hw>:PROTection:CLEar` on page 429
`:OUTPut<hw>[:STATe]` on page 429

5.3.6 RF Measurement

5.3.6.1 Power Sensors

The R&S SMA 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 either with the R&S NRP-Z2 extension cable, or via USB using 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 an R&S NRP-Z sensor directly, the R&S SMA provides the SENSOR connector. A sensor connected there is always assigned as Sensor 1. Alternatively, you can connect a sensor at a USB interface, using one of the USB adapters R&S NRP-Z3 or R&S NRP-Z4.

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 Chapter 5.2.3.6, "NRP-Z Info/Update", on page 101. For information on the scope of your power sensor refer to the manual of your R&S NRP-Zxx power sensor.

For a more detailed analysis of the power of the RF signal, use the NRP-Z Power Analysis function. It enables you, e.g. to perform sweep measurements on the DUT, or analyse pulse data with the aid of a R&S NRP-Z81 power sensor.

5.3.6.2 NRP-Z Power Viewer

The R&S SMA features the power viewer function for measuring or monitoring either the RF output power, or a freely selectable signal source with R&S NRP-Z power sensors.

The instrument can perform up to 4 power measurements simultaneously.

To connect the sensors you have the following options:

- connect the sensor directly at a USB connector
  To connect a sensor directly via USB, use one of the appropriate adapter cables R&S NRP-Z3 or R&S NRP-Z4.
- connect the sensor indirectly via USB using the R&S NRP-Z5 USB Sensor Hub.

For the assignment to the available connectors, see Chapter 2, "Preparing for Use", on page 16.

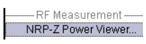
A sensor continuously measures the average signal power of the selected source, such as an external signal, or the output signal of the signal generator with the RF level used as reference value. The signal generator shows the result in the NRP-Z Power Viewer Settings settings dialog, but you can also permanently display the readings in the block diagram.

Further functions of the R&S SMA related to R&S NRP-Z power sensors are:

- Acquisition of level correction data, see Chapter 5.3.5.6, "User Correction", on page 167.
  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.
- NRP-Z Level Control, see Chapter 5.3.5.5, "NRP-Z Level Control", on page 163. Note that "NRP-Z Power Viewer" automatically disables "NRP-Z Level Control", and vice versa.
- Sweep measurements on DUTs (see Chapter 5.3.6.3, "NRP-Z Power Analysis", on page 184). To perform pulse data analysis, use a suitable power sensor, like the R&S NRP-Z81.
- The software version of the connected power sensor can be retrieved by means of the remote control command `SENSe<ch>[:POWer]:TYPE?` on page 476.
  Use the Chapter 5.2.3.6, "NRP-Z Info/Update", on page 101 dialog to update the sensor software.

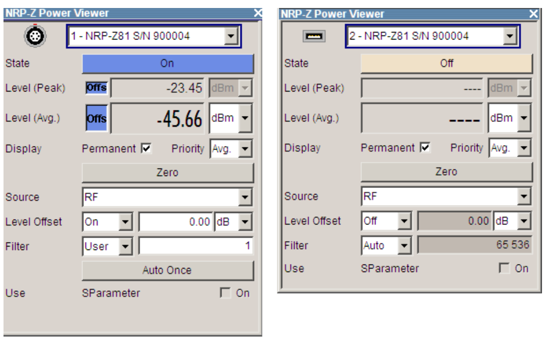
"NRP-Z Power Viewer" automatically disables NRP-Z Level Control and NRP-Z Power Analysis, and vice versa.

NRP-Z Power Viewer Settings



► To access the dialog for configuring the RF signal level, perform one of the following:

- Select "RF > config... > RF Measurement > NRP-Z Power Viewer".
- Press the MENU key and select "RF > RF Measurement > NRP-Z Power Viewer".



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.
The instrument detects connected sensors automatically and lists all in the selection field.

"Sensor 1" is firmly assigned to the sensor on the circled SENSOR socket. If no sensor is connected to this socket, channel 1 remains not assigned. Sensors 2...4 are assigned to the sensors at the USB connectors, according to their sequence of connection.

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.

The remote commands required to define the settings are described in Chapter 7.13, "Power Sensor Measurement Subsystems", on page 430.

Sensor
Selects the R&S NRP-Z power sensor for display.

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 to SENSOR, suffix 2 the one at the first USB interface, and suffix 3 and 4 are assigned to the sensors at the following USB interfaces. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

In order to detect all connected sensors the state of all four connectors (i.e. SENsor1/SENSor2/SENSor3/SENSor4) must be checked.

Note: The software version of the connected power sensor can be retrieved by means of the remote control command `:SENS:POW:TYPE?`.
Use the "Setup >" Chapter 5.2.3.6, "NRP-Z Info/Update", on page 101 dialog to update the sensor software.

Remote command:
`SENSe<ch>[:POWer]:STATus[:DEVice]?` on page 445

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

Remote command:
`SENSe<ch>[:POWer]:TYPE?` on page 476
`SENSe<ch>[:POWer]:SNUMber?` on page 445

State
Activates/deactivates level measurement by the power sensor.

The local state is set with the `INIT` command. Switching the local state off enhances the measurement performance.

In remote control, the sensors are set up using the `SENSe` commands. The remote measurement is triggered by the `READ` query which also provides the measurement results. The state is not influenced by these commands, measurements results can be retrieved with local State on or off.

The sensor is selected by suffix 1, 2, 3 or 4 in key word `SENSe` or `READ` of the command header.

Suffix 1 denotes the sensor connected to SENSOR, suffix 2 the one at the first USB interface, and suffix 3 and 4 are assigned to the sensors at the following USB interfaces. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

In order to detect all connected sensors the state of all four connectors (i.e. SENsor1/SENSor2/SENSor3/SENSor4) must be checked.

To query the availability of a sensor at a given connector, use the command
`SENSe<ch>[:POWer]:STATus[:DEVice]?` on page 445.

Remote command:
`:INITiate<ch>[:POWer]:CONTinuous` on page 436

Level (Peak)
With certain power sensors only, for example R&S NRP-Z81.

Indicates the measured peak level value with the selected unit.

Remote command:
`:READ<ch>[:POWer]?` on page 436

Level (Avg.)
Indicates the measured level value with the selected unit.

Remote command:
`:READ<ch>[:POWer]?` on page 436

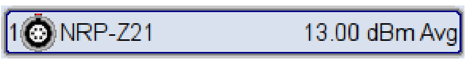
Unit
Selects the unit used for result display.

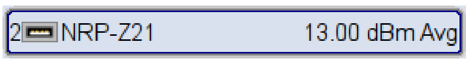
The power sensor provides the measured value in Watt.

In which unit the measured value is indicated is selected here and might be Watt, dBm or dBuV.

Remote command:
`:SENSe<ch>:UNIT[:POWer]` on page 477

Permanent Display State
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.

Remote command:
`:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe` on page 441

Display Priority
Determines whether the instrument displays the measured average or the peak power permanently on the screen.

To select the peak power display, it is required that the R&S NRP-Zxx sensor supports this feature. On power-on or connecting a sensor the average power value is set by default.

To enable the permanent display in the block diagram, select Permanent Display State.

Remote command:
`:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority` on page 440

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. If a Rohde & Schwarz power sensor receives an input power during the zeroing process, it aborts zeroing and generates an error message. Zeroing takes a few seconds, depending on the sensor model. Refer to the documentation of your power sensor for more information.

Tips for zeroing

When to perform zeroing:
- 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 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, but do not disconnect it from the power sensor. This proceeding keeps the thermal equilibrium, and the zeroing process also compensates the noise that superimposes the measured signal (e.g. from a broadband amplifier).

Remote command:
`:SENSe<ch>[:POWer]:ZERO` on page 477

Source
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).

Remote command:
`:SENSe<ch>[:POWer]:SOURce` on page 445

Frequency
Source User only

Enters the frequency for measurement source "User".

Remote command:
`:SENSe<ch>[:POWer]:FREQuency` on page 443

Level Offset
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 considered. The offset is always entered in dB, irrespective of the selected unit for result display.

Remote command:
`:SENSe<ch>[:POWer]:OFFSet:STATe` on page 444
`:SENSe<ch>[:POWer]:OFFSet` on page 444

Filter
Determines the length of the filter used for the measurement. The filter length affects the measurement time directly.

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 do 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 achieving 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, see Filter Length.
"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. **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, see Filter Length.
"Fixed Noise"	The averaging factor is selected so that the sensors 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, see Noise Content. To avoid very long settling times when the power is low, the averaging factor can be limited with the Timeout parameter.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:TYPE` on page 443

Filter Length ← Filter
Indicates the used filter length for filter type "Auto" or "User".

Remote command:
`:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?` on page 441
`:SENSe<ch>[:POWer]:FILTer:LENGth[:USER]` on page 441

Noise Content ← Filter
Sets the noise content for filter type "Fixed Noise".

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio` on page 442

Timeout ← Filter
Sets a time limit for the averaging process.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe` on page 442

Auto Once ← Filter
Calculates the optimum filter length for the current measurement conditions and indicates the value in the Filter Length.

Remote command:
:SENSe<ch>[:POWer]:FILTer:SONCe on page 442

Use Default Aperture Time

Enables you to specify a user-defined aperture time for the respective sensor.

The sensor default setting is usually sufficient. If however, the readings vary, it is recommended that you adjust the aperture time exactly to one modulation period, in order to obtain stable readings. To specify the aperture time, see Aperture Time.

Remote command:
:SENSe<ch>[:POWer]:APERture:DEFault:STATe on page 439

Aperture Time

Defines the acquisition time for the respective sensor, provided the entry field is enabled, see Use Default Aperture Time.

For example you can adjust the aperture time exactly to one signal period, in order to obtain a sufficient low average value.

Remote command:
:SENSe<ch>[:POWer]:APERture:TIMe on page 440

Use SParameter - Power Sensors

Activates the use of the S-Parameter correction data of the connected power sensor. For sensors 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 SParameter table.

Remote command:
:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe on page 440

Enable Logging

Activates recording of R&S NRP-Z power sensor readings.

If enabled, every value measured by a connected power sensor and indicated in the user interface, is written to a log file. Per measurement the function logs the measured value (2 readings when you work with peak sensors), the sensor type and the measurement time (time stamp).

The function automatically creates the file name `SensLog<n>.txt` and stores the file in `*txt` format under `/var/user/SensorLogging` on the hard disk. You can enable logging for each connected sensor separately. If enabled, one file per sensor is written.

Note: This specific function is intended for measurements with long time intervals, or if there is a risk that the connection to the sensor can be interrupted and you need the data for reconstruction.
The simplified recording function continuously writes the values in the file of the corresponding sensor number, like `Sens1Log.txt`. When you start a new measurement, the existing data will not be overwritten, but added to the file.

If you use this function, it is recommended that you regularly remove the files from the hard disk, since they require storage capacity.

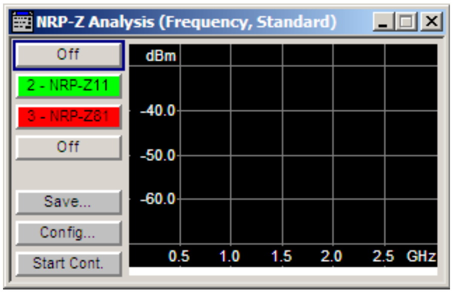
Remote command:
:SENSe<ch>[:POWer]:LOGGing:STATe on page 444

5.3.6.3 NRP-Z Power Analysis

The signal generator in combination with a connected R&S NRP probe allows sweep measurements on DUTs.

Access:

► Select "RF > NRP-Z Power Analysis"



The measurement data of the sensors is displayed in traces in a measurement diagram. Four traces are available. The traces are automatically or manually assigned to the sensors. In addition to the data traces, a reference trace can be stored and recalled and/or the trace indication can be frozen temporarily (hold trace), thus enabling comparison of traces. Readout and comparison of particular values of the traces is possible by means of four markers.

Three measurement modes are provided:

- Power versus frequency (frequency response)
- Power versus power (power sweep, AM/AM)
  These two modes are generator driven, that means, the generator provides the measurement signal.
- Power versus time (power measurement in the time domain R&S NRP trace mode).
  This mode is signal driven, that means besides the generator signal also external signals can be analyzed. Time mode requires an additional trigger event, for which level, hysteresis and dropout time are freely selectable. The generator also features pulse data analysis in this mode, provided that R&S power sensor NRP-Z81 is connected.

The timing can be used for normal and fast measurements in all modes.

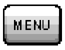
By the use of a separate frequency than the set generator frequency, measurement results retrieved at a different frequency can be displayed in the diagram (for example as provided at the output of the DUT).

Special functions of some hardkeys

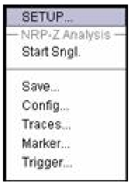
The instrument provides hardkeys with special functions for convenient operation, when the "NRP-Z Power Analysis" dialogs are active.

The REARR key toggles between different views of the diagram, selectable in the "REARR list NRP-Z Analysis dialog", see "REARR list - Power Analysis" on page 199:

- Standard, diagram and buttons are displayed,
- Full display, diagram with marker list but no buttons are displayed,
- Full display, diagram with pulse data list but no buttons are displayed, and
- Full display only diagram is displayed.



The MENU and SETUP keys directly open a special power analysis menu. Either the complete menu tree or the setup menu tree is available in addition to the power analysis menu.



The instrument also provides this context-sensitive menu by pressing the right mouse button in the measurement diagram.

The ON /OFF key toggles between measurement starts and stops.

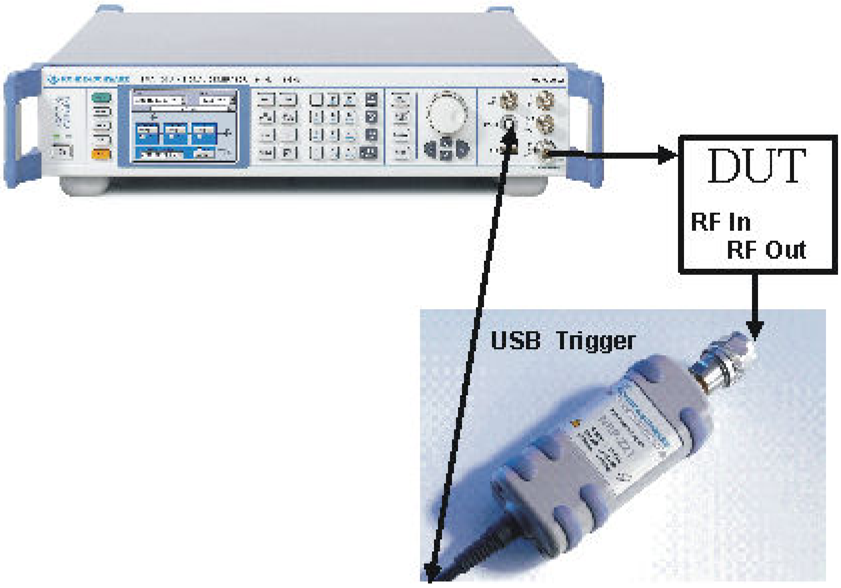
The BACKSPACE key resets the scaling of the y-axis to suitable values after the use of auto scaling in the expanding mode. In this mode, the y scale can get too expanded due to temporary high power values. The reset function resets the diagram again, to indicate smaller power values.

If "Auto Scale" is turned off, press the BACKSPACE button to switch to "Auto Scale" expanding mode, and to reset "Auto Scale".

Test Setup Example

As a power meter has no built-in selection, it is measuring all signal components from nearly DC to 40 GHz and higher. Therefore, the DUT's signal must be rather pure or subjected to external filtering (harmonics, spurious) before measured.

The test setup for the power analysis in the **power versus frequency or power versus power** is as follows:



1. Connect the DUT (for example bandpass) to the RF output of the instrument and the RF input of the R&S NRP-Zxx sensor (like the R&S NRP-Z21).
2. Connect the USB output of the R&S NRP-Zxx to the SENSOR connector of the instrument.
3. Open the "NRP-Z Analysis" dialog in the "RF" block of the generator
4. Set up the measurement and scale diagram in the "Configure…" dialog (for example fast measurement, 200 measurement points, range, x-axis and y-axis scale).
5. Trigger measurement by pressing the "Start" button in the "NRP-Z Power Analysis" diagram.
6. If necessary, perform the further settings:
   a) Set markers with the rotary knob. To access the markers, activate the "NRP-Z Analysis Frequency / Marker" diagram view with the REARR key. The markers are moved by means of the cursor and the roll key to the desired trace position.
   Note: To activate the "NRP-Z Analysis Frequency / Marker" view, see "REARR list - Power Analysis" on page 199. Repeat pressing the REARR key until this view appears.
   b) Store a hardcopy of the measurement results "Configure Diagram" on page 197 ("Save…" submenu).
   c) Apply user correction. "Ucor" is also available for NRP-Z measurements (see Chapter 5.3.5.6, "User Correction", on page 167).

   The diagrams below show the result of the above settings, an RF frequency range of 1 to 6 GHz and the level range of -65 dB to 5 dB.
   The graphs show the different diagram views.

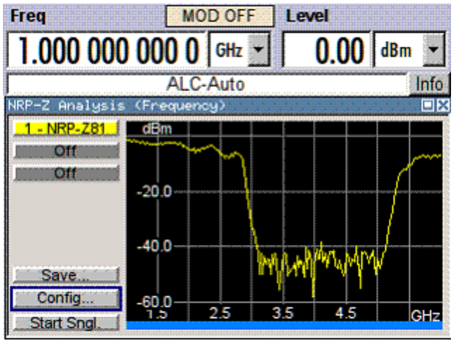


Figure 5-8: Standard view, diagram and buttons are displayed

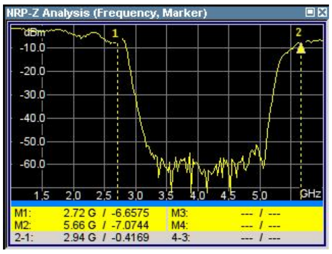


Figure 5-9: Full screen "Marker View", diagram and marker list are displayed

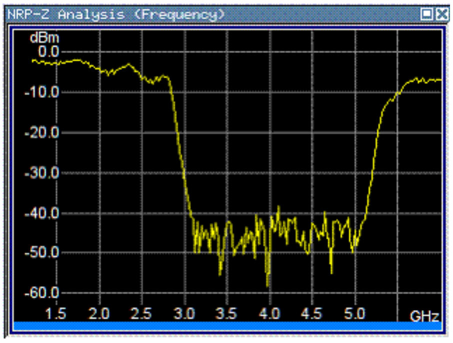
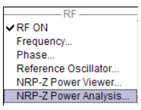


Figure 5-10: Fullscreen view, only the diagram is displayed

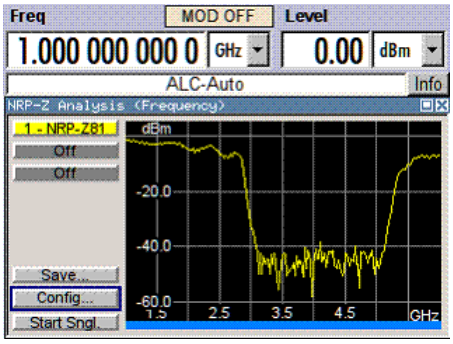
Measurement Diagram



Access:

► Select "RF > Configure > NRP-Z Power Analysis".

The dialog contains the measurement diagram with the "Start" button. It provides access to the dialogs for setting up the measurement and sensor parameters, for configuring the diagram and trace indication, and for storing hardcopies of the measurement results.



The R&S SMA supports various graph views, according to the methods of measurement and also additional functions such as the use of markers.

Note: Activate the relevant diagram views in the "REARR list NRP-Z Analysis" dialog, see "REARR list - Power Analysis" on page 199, and switch to the currently needed view with the aid of the REARR key or STR+<A>.

Markers and the marker list are available in the "NRP-Z Analysis Frequency / Marker" view which is shown in the graph above (see also "Define Markers" on page 216). Select a marker with the roll key. One click activates the cursor, the second click captures the selected marker to move it to the desired position. Set the focus back to the diagram with a double click on ESC.

The list below the diagram displays the numerical readout of the marker values.

The x-axis of the measurement diagram is freely scalable in the frequency or power range of the generator, the power range for the y-axis is +100 dBm to -200 dBm. In power versus frequency mode, the frequency range of the x-axis is separately scalable. The available time range for power versus time measurements is -1s to +2s.

It is possible to select single or continuous measurement mode in the "Config…" menu. Single starts a single measurement after the trigger, continuous causes a restart of the measurement after each pass. The measurement is triggered by pushing the "Start" button. In continuous mode, the "Start" button is replaced by a "Stop" button after the trigger which can be used to cancel the measurement. A progress bar indicates the status of the measurement.

In time mode, additional triggering is required which is configured in the trigger dialog.

Changing to trace source "Hold" freezes the current trace indication in the diagram.

Some front panel keys are assigned special functions if the power analysis is active (see overview of features and operation in section Chapter 5.3.6.3, "NRP-Z Power Analysis", on page 184):

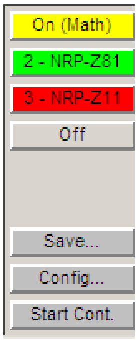
Marker and Pulse Data Indication - Power Analysis

The marker and pulse data value indication below the measurement diagram is only available for certain views of the diagram. The REARR key or the key combination <STR+A> toggles between the different diagram views (see Chapter 5.3.6.3, "NRP-Z Power Analysis", on page 184). The marker indication in the measurement diagram is activated in the marker dialog, see "Define Markers" on page 216.

Tip: In remote-control mode, include the markers of the diagram, their values or the pulse data in the hardcopy file.

Remote command:
:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe] on page 482
:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe] on page 483

Buttons



The dialog comprises at the left side a button bar with the four **trace** buttons for sensor assignment.

The "Save" button enables you to store the measured data. The "Config" button opens the settings dialog for configuring the measurement parameters.

To perform start a measurement, use the "Start/Stop" button at the bottom.

Trace Buttons - Power Analysis

The four buttons in the upper left corner of the measurement diagram indicate the sensor assignment to the respective trace. They open the settings dialogs for the traces, see"Setup Trace" on page 189.

Save… - Power Analysis

Opens the dialog to store a screenshot of the current measurement diagram, see "Save Hardcopy" on page 217.

Config… - Power Analysis

Provides access to the "Configure NRP-Z Analysis" dialog, see "Configure Measurement" on page 193.

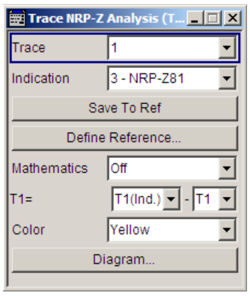
Start - Power Analysis

Triggers the measurements with the R&S NRP-Z power sensors. The measurement results are indicated in the measurement diagram. A progress bar indicates the status of the measurement.

Remote command:
:SENSe[:POWer]:SWEep:INITiate on page 460
*OPC?
:TRACe<ch>[:POWer]:SWEep:DATA:POINts? on page 479
:TRACe<ch>[:POWer]:SWEep:DATA:XVALues? on page 480
:TRACe<ch>[:POWer]:SWEep:DATA:YVALues? on page 480

Setup Trace

The measurement data can be current (sensor trace) or stored trace data, either in a file (reference trace) or in a temporary memory (hold trace). Up to four traces can be indicated at one time. On connection, the sensors are automatically detected and assigned to a trace. By default, connected sensors are assigned to the traces in ascending order, that means sensor 1 to trace 1, sensor 2 to trace 2, etc. If the default trace is already used, the sensor has to be assigned manually in the trace dialog.



With the **reference** and **hold** traces, you can compare traces. Assign a reference curve to one trace and your measured values to a second one, and switch on the display. This feature provides to compare results directly in the graph, or to show deviations in a graph by using the "Mathematics" function.

Example

The current single measurement of sensor 2 which is assigned to trace 2 is used as reference trace.

1. Select "Trace 2" with "Indication 2" = NRP-Zx.
2. Select "Save To Ref".
3. Select "Trace 1" and "Indication Ref.".
4. Select "Diagram".

   The R&S SMA indicates two identical traces.
5. Select "Start single".

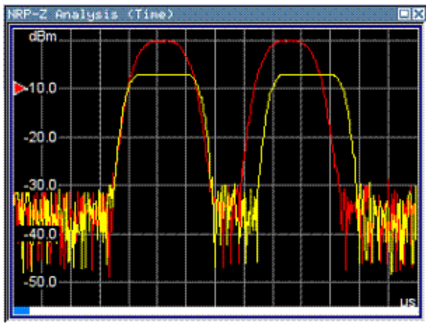
   Triggers a new measurement cycle with sensor 2. You can compare the resulting measurement trace with the former measurement, which is displayed as reference trace.

Trace
Selects the index of the trace. The source for the trace data is selected below. The trace color for each of the four possible traces is preset but can be changed.

Remote command:
n.a.
In remote control, the trace is selected by the suffix of keyword `TRACe`.

Indication - Power Analysis
Selects the source for the trace data.

The selection is indicated on the trace button in the measurement diagram.



Red = reference or hold trace
Yellow = current measurement trace

"Off" No source is selected, the trace is not indicated.

Remote command:
:TRACe<ch>[:POWer]:SWEep:STATe on page 487

"2 - NRP-Zxx" The current measurement results of the selected power sensor are the source for the trace data. The index at the beginning of the sensor name indicates the used connector, for example "2" indicates that the sensor is connected via a USB interface. The data is either continuously updated (continuous measurement) or represents a single measurement cycle (single measurement).

Remote command:
:TRACe<ch>[:POWer]:SWEep:STATe on page 487
:TRACe<ch>[:POWer]:SWEep:FEED on page 481

"Ref" Selects the reference trace. The reference trace is a static trace that was stored in a file and can be recalled.
It is possible to store one reference trace at a time.

Remote command:
:TRACe<ch>[:POWer]:SWEep:COPY on page 479
:TRACe<ch>[:POWer]:SWEep:FEED on page 481
:TRACe<ch>[:POWer]:SWEep:STATe on page 487

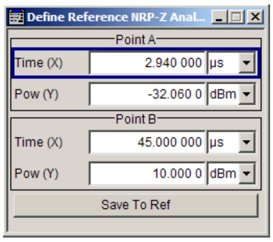
"Hold" Freezes the current trace data. The hold trace is a temporary trace that is available until the NRP power analysis is finished. Freezing the trace of a sensor in one trace and displaying the measurement values of the same sensor in another trace allows fast comparison between measurements.

Remote command:
n.a.

Save to Ref - Trace Power Analysis
Saves the selected trace as reference trace. One reference trace is available at a time.

Remote command:
:TRACe<ch>[:POWer]:SWEep:COPY on page 479

Define Reference - Trace Power Analysis
Opens a dialog for defining a linear reference curve.



To define the reference curve, set the coordinates of "Point A" and "Point B".

The reference curve is determined by two value pairs in the cartesian coordinates of the "NRP-Z Analysis" diagram. Depending on the measurement mode, the following values are required:

- Freq (X) / Pow (Y) in "Frequency" mode
  Determine the parameters of the frequency reference curve.
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues` on page 446
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues` on page 447
- Pow (X) / Pow (Y) in "Power" mode
  Set the x- and y-axis values of the points A and B.
  `:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues` on page 461
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY` on page 470
- Time (X) / Pow (Y) in "Time" mode
  Set the time values for the x-axis and the corresponding y-axis power values.
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues` on page 470
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues` on page 471
- "Save To Ref"
  Saves the selected trace as reference trace. One reference trace is available at a time.
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY` on page 446
  `:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues` on page 462
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY` on page 470

The reference curve consists of a certain number of coordinate points, calculated by the number of steps + 1. The first coordinate point starts at Min, and Max is the last. "Step", "Min" and "Max" are determined in the configuration dialog, see "Configure Measurement" on page 193.

Tip: You can assign the X and Y coordinates of the markers automatically in marker view. By selecting "Fill Point", the function automatically reads the X and Y coordinates from the trace data and derives the intersection point of the selected marker and the trace curve.

Mathematics - Trace Power Analysis
Activates the mathematic function.

The function enables you to determine the deviation of two test series, either of measurement traces, or also of traces that contain math results or stored reference curves. That means you can also assign a math result to an operand for further calculation. Various nested computation steps are possible.

The math operation follows the formula:

T<ch>$_{result}$ = T<ch> $_{Operand1}$ - T<ch>$_{Operand2}$

How to proceed:

Determine T<ch> $_{Operand1}$ in the entry field next to "Tx", and then select T<ch>$_{Operand2}$ in the second entry field right to it.

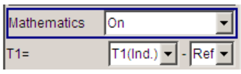
The result ("T<ch>$_{result}$") is assigned to the above selected "Trace". If switched on, the graph shows the resulting curve.

Note:

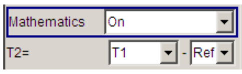
Depending on the type of trace, the instrument automatically sets the appropriate unit on the y-axis:
- "dBm" if it shows only measurement traces.
- "dB" for purely mathematical curves.
- "dB/dBm" ratio scale for mixed display, that means measurements and mathematical curves.

Example:

Example of a nested calculation.
- T1 shows the result of the subtraction of the trace ("Trace 1"), and the reference curve.



- Trace2 subtracts Ref from T1.



That illustrates the nested calculation, since T1 covers already a math operation.
Note: "(Ind.)" denotes the currently selected trace.

Remote command:
`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe` on page 433
`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract` on page 434
`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe` on page 434
`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract` on page 434
`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe` on page 435
`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract` on page 435

Color - Trace Power Analysis
Selects the color of the trace.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:COLor` on page 479

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

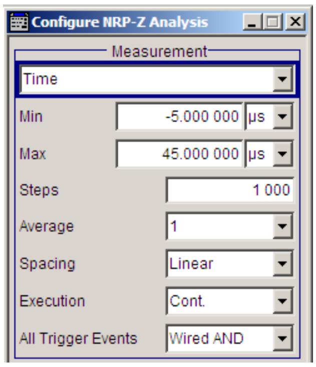
Configure Measurement

The dialog contains the parameters required for configuring the measurement in the frequency, power or time domain.

In the lower section, you can access subdialogs, covering further setting parameters:

- "Configure Diagram" on page 197
- "Configure Gate Mode" on page 200
- "Configure Sensors" on page 203
- "Configure Pulse Data" on page 206
- "Configure Trigger" on page 214
- "Setup Trace" on page 189
- "Define Markers" on page 216

► To access the "Configure NRP-Z Analysis" dialog, select "Config...".



The measurement section provides the parameters for configuring the measurement either in frequency, power or time domain.

Measurement Mode - Power Analysis

Selects the measurement mode.

"Frequency"	Power versus frequency measurement (frequency response).
"Power"	Power versus power measurement (power sweep, AM/AM).
"Time"	Power versus time measurement (envelope power measurement as a function of time, NRP trace mode). The R&S SMA samples power over a time interval and assigns the internal power values that have been determined to a number of points. This mode also provides gated measurement and pulse data analysis, e.g. with a connected R&S NRP-Z81, and the corresponding graphical display "Gate View" and "Pulse Data View".

Remote command:
`:SENSe[:POWer]:SWEep:MODE` on page 461

Min - Power Analysis

Sets the minimum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the generator and the used power sensor.

The range for the start time is -1s to +1s. Value 0 defines the trigger point. By choosing a negative time value, the trace can be shifted in the diagram.

It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, the R&S SMA generates an error message.

If you change this value for a finished single measurement, only the scaling of the x-axis changes. This way, you can zoom the trace. However, for subsequent measurements, the measurement range is changed according to the new setting.

If you change this value during a continuous measurement, only the scaling of the x-axis changes for measurement cycles that have been triggered before the change. For subsequent measurement cycles, the measurement range changes according to the new setting.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:STARt` on page 449
`:SENSe[:POWer]:SWEep:POWer:STARt` on page 466
`:SENSe[:POWer]:SWEep:TIME:STARt` on page 474

Max - Power Analysis
Sets the maximum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the instrument and the used power sensor.

The range for the stop time is 0 s to 2 s. Value 0 defines the trigger point.

It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

If you change this value for a finished single measurement, only the scaling of the x-axis changes. This way, you can zoom the trace. However, for subsequent measurements the measurement range is changed according to the new setting.

If you change this value during a continuous measurement, only the scaling of the x-axis changes for measurement cycles that have been triggered before the change. For subsequent measurement cycles, the measurement range changes according to the new setting.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:STOP` on page 450
`:SENSe[:POWer]:SWEep:POWer:STOP` on page 467
`:SENSe[:POWer]:SWEep:TIME:STOP` on page 474

Steps - Power Analysis
Sets the number of steps for the sweep. The number of measured points is steps + 1. The number of steps is one of the parameters that define the measurement speed. The higher the number of steps, the longer the measurement takes (frequency and power mode).

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:STEPs` on page 450
`:SENSe[:POWer]:SWEep:POWer:STEPs` on page 467
`:SENSe[:POWer]:SWEep:TIME:STEPs` on page 474

Timing - Power Analysis
Frequency and power mode only.

Selects the timing mode of the measurement in frequency and power mode. This parameter is not available in time mode.

"Fast" Fast measurement with an integration time of 2 ms for each measurement step.

"Normal" A longer but more precise measurement (integration time is 20 ms/step).

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE]` on page 450
`:SENSe[:POWer]:SWEep:POWer:TIMing[:MODE]` on page 467

Average - Power Analysis
Time mode only

Selects the averaging factor in time mode. This parameter is not available in frequency and power mode.

The factor determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing. If factor 1 is selected, no averaging is performed.

Remote command:
`:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt]` on page 470

Spacing - Power Analysis
Sets the mode for calculating the sweep steps.

In power versus frequency mode, selection between linear and logarithmic spacing is possible.

"Linear"
- Power versus frequency
  In a linear sweep, the frequency is swept in equidistant steps over the continuous frequency range. The x-axis is a linear frequency axis.
- Power versus power
  The sweeps are performed at constant frequency but with variable generator power that is swept in linear, equidistant steps over a continuous range. The x-axis is a dB-linear power axis.
- Power versus time
  The sweeps are performed at constant frequency and stimulus power. The measurement is repeated over a specified period of time at constant time intervals.

"Logarithmic" Power versus frequency
In a logarithmic sweep, the frequency is swept in equidistant steps on a logarithmic scale. The x-axis is a logarithmic frequency axis.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE]` on page 449
`:SENSe[:POWer]:SWEep:POWer:SPACing[:MODE]` on page 466
`:SENSe[:POWer]:SWEep:TIME:SPACing[:MODE]` on page 473

Execution - Power Analysis

Selects single or continuous mode in power analysis.

The measurement is started in the diagram using the "Start" button. During measurement, the "Start" button is replaced by a "Stop" button which can be used to abort the measurement. The progress bar indicates the status of the measurement.

Note: For time mode, an additional trigger is required (see "Configure Trigger" on page 214).

"Single" Selects single measurement.

"Cont." Selects continuous measurements.

Remote command:
`:SENSe[:POWer]:SWEep:RMODe` on page 469
`:SENSe[:POWer]:SWEep:FREQuency:RMODe` on page 447
`:SENSe[:POWer]:SWEep:POWer:RMODe` on page 462
`:SENSe[:POWer]:SWEep:TIME:RMODe` on page 469

All Trigger Events - Power Analysis

Ddetermines, whether the measurement data processing starts with a trigger event in one of the sensors (Logical OR), or whether all channels have to be triggered (logical AND). Each sensor evaluates a trigger event according to its setting independently.

This function supports the internal or external trigger modes with multi-channel time measurements.

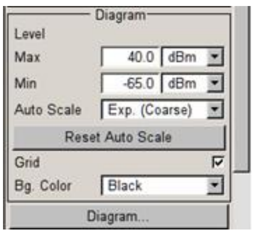
"Wired AND" When all channels are triggered, the measurement starts.

"Wired OR" The measurement starts when a trigger event occurs.

Remote command:
`:SENSe[:POWer]:SWEep:TIME:TEVents` on page 475

Configure Diagram

The "Configure NRP-Z Analysis" dialog is divided into several sections. The diagram area covers the parameters for scaling the y-axis and the appearance of the diagram.



Min - Max y-Axis - Power Analysis

Selects the minimum and maximum value of the y-axis.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum` on page 451
`:SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum` on page 452
`:SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum` on page 468
`:SENSe[:POWer]:SWEep:POWer:YSCale:MINimum` on page 469

`:SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum` on page 476
`:SENSe[:POWer]:SWEep:TIME:YSCale:MINimum` on page 476

Auto Scale - Power Analysis

Activates autoscaling of the y-axis of the diagram. The "Auto Scale" function adjusts the scale divisions so that the entire trace fits into the diagram area.

"Off" Auto scale is deactivated. Switching from activated to deactivated, the scaling is maintained.

"Exp. (Course/Fine)"
Auto scale is activated. Automatically selects the appropriate scaling of the y-axis so that the trace is always visible. The range is expanded when a value is out of the right or the left end-of-scale value. The step width is 5 dB for selection "Exp. (Coarse)" and variable in the range of 0.2 db to 5 dB for selection "Exp. (Fine)".

"Flt. (Coarse/Fine)"
Auto scale is activated, that means this parameter automatically selects the appropriate scaling of the y-axis so that the trace is always visible. The range is either expanded, when a value is out of the right/left end-of-scale value or it is reduced when the trace fits into a smaller scale area. The step width is 5 dB for selection "Flt. (Coarse)" and variable in the range of 0.2 db to 5 dB for selection "Flt. (Fine)".

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO` on page 451
`:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO` on page 467
`:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO` on page 475

Reset Auto Scale - Power Analysis

Resets the scaling of the y-axis to suitable values after the use of auto scaling in the expanding mode. For this mode, the Y scale can get too expanded because of temporary high power values. The reset function resets the diagram again, to indicate smaller power values.

Remote command:
`:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet` on page 451
`:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet` on page 468
`:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet` on page 476

Grid - Power Analysis

Activates/deactivates the indication of a grid in the diagram area.

Remote command:
`:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe` on page 436

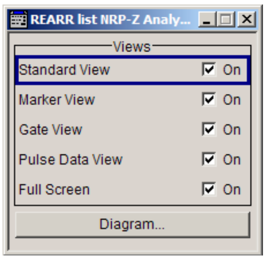
Bg Color - Power Analysis

Selects the background color of the diagram, black or white. The background color is also effective for the hardcopy of the diagram.

Remote command:
`:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor` on page 435

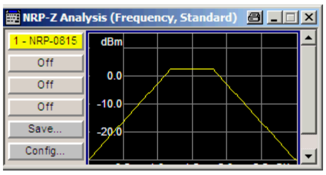
REARR list - Power Analysis

The "REARR list…" button in the middle section opens the dialog for selection of diagram views. This function provides to activate only the required "Views" on the checkboxes to the right. REARR or STRG+<A> switches between all views that are activated in this dialog.

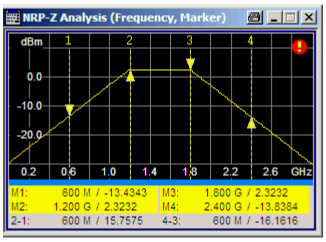


Viewing modes of frequency power and level sweep timing measurements:

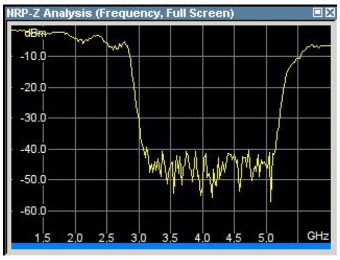
- "Standard View:" shows the graph and the button bar at the left



- "Marker View:" shows the graph and the corresponding marker values at the bottom

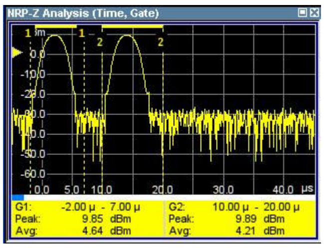


- "Full Screen:" shows the graph in fullscreen, and fades out buttons and list values



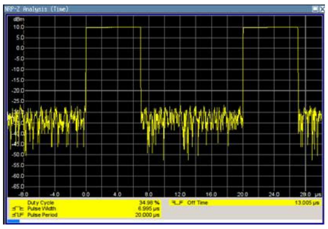
Viewing modes of time trace and pulse data measurements:

- "Gate View:" shows the graph with the corresponding gate data
  Gate view provides indicating time trace measurements, as for example the peak envelope power of the RF signal.



Note: This view is selectable in time mode, since gate measurement is a function of time.

- "Pulse Data View:" shows the graph and the corresponding pulse data
  Pulse data view indicates pulse data measurement results of the R&S NRP-Z8x sensor family.



  Note: This view is selectable in time mode, since pulse data measurement is a function of time.

Note: The toggle function always switches sequentially between the activated views. When you disable a view that is shown, the instrument automatically switches to the next active view.
At least one view must be active, that means the final active view cannot be switched off.

Remote command:
`:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe]` on page 484
`:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe]` on page 482
`:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe]` on page 481
`:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe]` on page 483
`:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe]` on page 481
Pressing the "Diagram..." button returns to the "NRP-Z Analysis" diagram.

Gate Mode… - Power Analysis
Opens the dialog for configuring the settings in gate mode, see "Configure Gate Mode" on page 200. This mode assumes that you are working in measurement mode Measurement Mode - Power Analysis "Time".

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

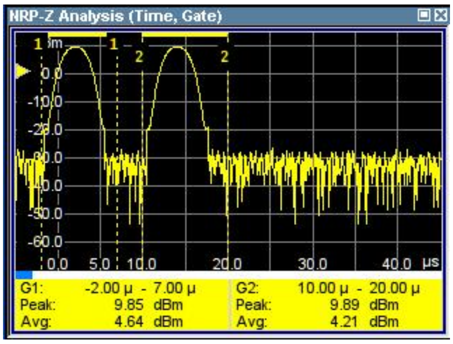
Configure Gate Mode

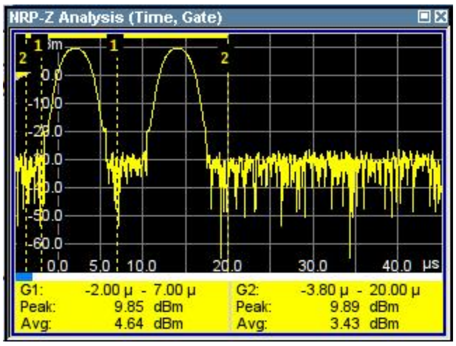
The "Configure NRP-Z Analysis" dialog is divided into several sections. The "Gate Mode…" button in the middle section opens the dialog for time gate settings.

For time measurement mode only.

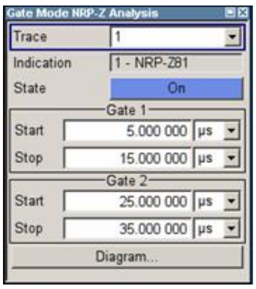
Almost all R&S NRP sensors also support time gated measurements of peak and average power (see the data sheet or operating manual of the respective sensor). Two user-configurable gates can be assigned to one of the traces. Both gates are active at the same time. The values are calculated from the trace data, the time resolution is determined by the resolution of the sensor. An external trigger signal or signal triggering is required for synchronization.

The following graph shows two measurement examples, one with separated gates, and another one with overlapping gates.





The start and stop time of the gates are indicated as gate markers, a bar between the start and stop marker shows the gate length. The indication state of the gate borders and measurement values is only available for certain diagram views which are switched with the "REARR" key. The "REARR list NRP-Z Analysis" dialog provides a selection of views, between which is toggled (see"REARR list - Power Analysis" on page 199).



In the remote control mode, commands for setting the indication state differ from the commands for reading the measurement values.

- **Command that defines the indication state for the diagram and for hardcopy:**
  :TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] on page 481
- **Commands that query the measured values:**
  :CALCulate[:POWer]:SWEep:TIME:GATE<ch>:AVERage? on page 431
  Queries the measured average power.
  :CALCulate[:POWer]:SWEep:TIME:GATE<ch>:MAXimum? on page 432
  Queries the measured peak power.

Trace - Gate
Selects the trace to which the gates are assigned. The sensor assignment to the respective trace is performed in the measurement diagram (trace buttons). The two gates are assigned to the same trace.

Remote command:
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED on page 432

Indication
(time measurement mode only)

Indicates the type of R&S NRP power sensor assigned to the selected trace. This field is automatically updated if the sensor is connected or disconnected. Additionally, this sensor is indicated on the trace button in the measurement diagram.

Remote command:
n.a.

State - Gate
Enables time gated measurement. The measurement is started with the "Start" button in the main measurement diagram. Both gates are active at one time.

The gate borders and the measurement values (average and peak power) are indicated in/below the measurement diagram. The indication is only available for certain diagram views which are switched with the "Rearrange" key.

Remote command:
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe on page 433
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:AVERage? on page 431
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:MAXimum? on page 432
:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] on page 481

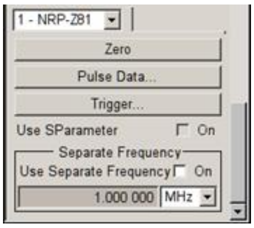
Start / Stop - Gate
Sets the start and the stop times for the respective gate.

Remote command:
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STARt on page 433
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STOP on page 433

Diagram... - Power Analysis
Returns to the "NRP-Z Analysis" diagram.

Configure Sensors

The "Configure NRP-Z Analysis" dialog is divided into several sections. The power sensor area additionally provides specific parameters for the power sensor. This part of the dialog can differ from the following description depending on the sensor used. Refer to the manual of the power sensor in this case.



The "Pulse Data..." button is displayed only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Power Sensor - Power Analysis
Selects the power sensor to be set if more than one sensor is connected to the instrument.

Remote command:
n.a.
In remote control, the sensor is selected via the numeric suffix in the sense key word of the command, for example `SENSe2:POWer:SWEep:...`.

Zero - Power Analysis
Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor. If a Rohde & Schwarz power sensor receives an input power during the zeroing process, it aborts zeroing and generates an error message. Zeroing takes a few seconds, depending on the sensor model. Refer to the documentation of your power sensor for more information.

Tips for zeroing

When to perform zeroing:
- 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 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, but do not disconnect it from the power sensor. This proceeding keeps the thermal equilibrium, and the zeroing process also compensates the noise that superimposes the measured signal (e.g. from a broadband amplifier).

Remote command:
:SENSe<ch>[:POWer]:ZERO on page 477

Pulse Data… - Power Analysis
Opens the dialog for configuring the settings for pulse data analysis, see "Configure Pulse Data" on page 206. This mode assumes that you are working in the time domain analysis (Measurement Mode - Power Analysis "Time") and the sensor supports automatic pulse analysis.

Trigger… - Power Analysis
Opens the dialog for configuring the trigger settings, see "Configure Trigger" on page 214. This mode assumes that you are working in the time domain analysis (Measurement Mode - Power Analysis "Time").

Use S-Parameter - Power Analysis
Activates the use of the s-parameters correction data of the connected power sensor. For sensors with attenuator this checkbox is automatically checked.

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

Remote command:
:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe on page 440

Level Offset State- Power Analysis
Activates a level offset at the sensor input. Set the appropriate value in the entry field on the right, see Level Offset - Power Analysis.

Remote command:
:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet:STATe on page 448
:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet:STATe on page 462
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet:STATe on page 464

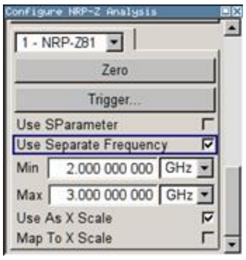
Level Offset - Power Analysis
Sets the level offset at the sensor input. To consider the value, activate the offset with "Level Offset State- Power Analysis" on page 204.

Remote command:
:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet on page 447
:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet on page 462
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet on page 463

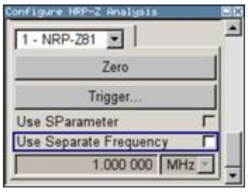
Use Separate Frequency- Power Analysis
This setting is offered for measurements with DUTs that change the measurement frequency (like modulators), thus changing the input frequency of the sensor.

The dialog differs depending on the measurement modes:
- Power versus frequency measurement
  Activates the use of a different frequency range other than the set signal generator frequency range for the measurement. The separate minimum and maximum frequency values are set below.

The x-scale of the diagram can be adjusted to the separate frequency range with functions "Use as X Scale" and "Map to X Scale".



- Power versus power measurement / Power versus time measurement
  Activates the use of a different frequency other than the set signal generator frequency for the measurement. The separate frequency value is set in the entry window below.



Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe]`
on page 448
`:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe`
on page 463
`:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency` on page 463
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe`
on page 471
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency` on page 471

Min Frequency - Power Analysis
Power versus frequency measurement only with active "Use Separate Frequency".

Sets the minimum frequency of the measurement.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt`
on page 448

Max Frequency - Power Analysis
Power versus frequency measurement only with active "Use Separate Frequency" only.

Sets the maximum frequency of the measurement.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP`
on page 449

Use as X Scale - Power Analysis
Measurement Mode Frequency only.

Activates the use of the separate frequency min and max values for the scaling of the x-axis. Thus, the trace for this sensor is visible in the diagram , especially for frequency ranges that differ substantially from the generator settings.

If more than one sensor is active, which use separate frequencies, the option is only available for one sensor. To indicate the traces of the other sensors, use function "Map to X Scale".

Remote command:
n.a.

Map to X Scale - Power Analysis
Mode Frequency and active "Use Separate Frequency" only.

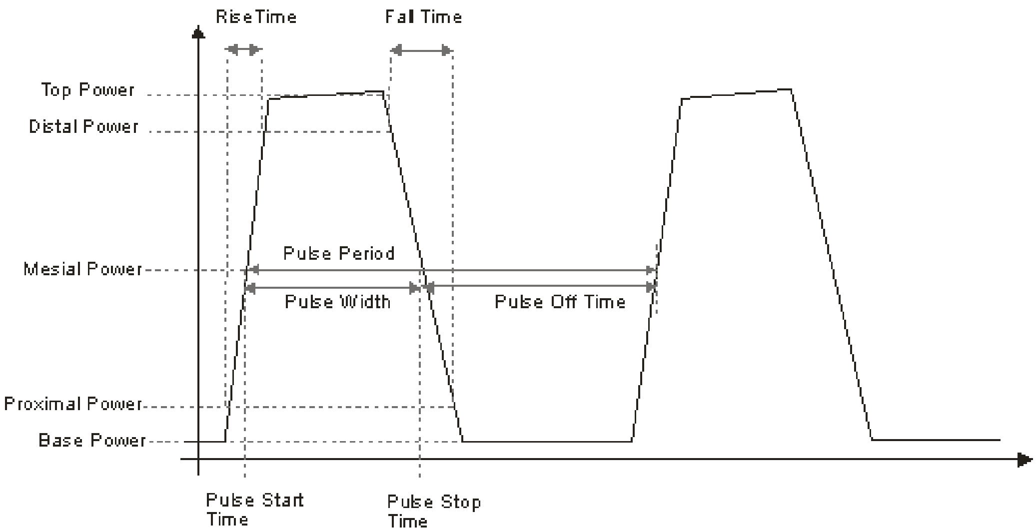
Maps the trace of a sensor that uses separate frequency to the current scaling of the diagram. Usually the scale is determined by the set frequency range of the generator. If more than one sensor is active, which use separate frequencies, the scale can also be determined by the separate frequency range of one of the other sensors.

Remote command:
n.a.

Configure Pulse Data

For R&S NRP-Z power sensors that support time domain analysis and automatic pulse analysis.

The power sensors enable pulse data analysis in measurement mode time. All important pulse parameters are measured after setting the threshold levels. The following graph shows most of these parameters:



The sensor calculates the pulse parameters from each measurement and delivers the results to the R&S SMA.

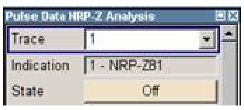
The "Pulse Data" button opens the dialog to configure and enable pulse data analysis:

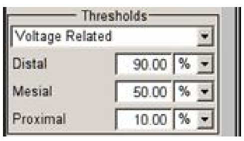
- The "Pulse Data NRP-Z- Analysis" dialog is divided into several sections. The upper section provides the trace and the pulse data analysis. For information on traces and the measurement data on traces, refer to "Setup Trace" on page 189.
- The "Thresholds" section covers the thresholds for detecting time values of a pulsed signal. Thresholds are used to calculate the time parameters. The thresholds can either be related to power or voltage. For information on parameters and terms, refer to "Voltage / Power Related - Pulse Data Analysis" on page 208, "Mesial - Pulse Data Analysis" on page 209 and "Proximal - Pulse Data Analysis" on page 209.
- The "Notifications" section covers the parameters "Duty Cycle", "Pulse Width", "Pulse Period" and "Pulse Off Time", see "Notifications - Pulse Data Analysis" on page 209.
- The "Transition Times" section covers "Rise Time", "Pulse Start Time", "Overshoot" for the rising or falling edges, "Fall Time" and "Pulse Stop Time", see "Transition Times - Pulse Data Analysis" on page 210.
- The "Signal Power" section covers "Minimal Power", "Peak Power" and "Average Power", see "Signal Power - Pulse Data Analysis" on page 212.
- The "Pulse Power" section covers "Top Power" and "Base Power", and "Mesial Power", "Proximal Power" and "Distal Power", see "Pulse Power - Pulse Data Analysis" on page 213.

The indication state of the parameters also affects the hardcopy function. Storing the measurement diagram as hardcopy includes the parameters selected in this dialog. For information on storing measurement data, refer to "Save Hardcopy" on page 217.

A total of six parameters can be indicated at one time. Structured hierarchically, trace 1 features top priority and trace 4 is addressed with the lowest weighting. I.e. only the first six checked parameters are indicated, starting with the settings of trace 1.

The pulse data is only visible for certain zoom levels of the diagram. The REARRANGE key or the key combination <STR+A> on an external keyboard toggles between the different zoom levels.





In the remote control mode, commands for setting the indication state differ from the commands for reading the values of the corresponding pulse data parameters.

In the description of the checkboxes, the different remote control commands are listed as shown in the example below:

- Commands that define the indication state for the diagram and for hardcopy:
  `:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe]` on page 484
  Activates indication of the measured duty cycle.
  `:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:ANNotation[:STATe]` on page 484
  Activates indication the measured top level.
- Commands that query the measured values:
  `:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle?` on page 482
  Queries the measured duty cycle.
  `:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP?` on page 482
  Queries the measured top level.

Trace
Selects the index of the trace. The source for the trace data is selected below. The trace color for each of the four possible traces is preset but can be changed.

Remote command:
n.a.
In remote control, the trace is selected by the suffix of keyword `TRACe`.

Indication
(time measurement mode only)

Indicates the type of R&S NRP power sensor assigned to the selected trace. This field is automatically updated if the sensor is connected or disconnected. Additionally, this sensor is indicated on the trace button in the measurement diagram.

Remote command:
n.a.

State - Pulse Data Analysis
Enables pulse data analysis. The measurement is started with the "Start" button in the main measurement diagram.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe` on page 464

Voltage / Power Related - Pulse Data Analysis
Selects how the threshold parameters are calculated, either voltage related or power related. The voltage-related parameters represent the normal case, as the usual representation when defining the pulse parameters (rise/fall time, pulse width) is U(t). To achieve a display with equivalent power-related values, the voltage-related threshold values must be converted (squared) (see example in table below).

	Distal	Mesial	Proximal
Voltage related:	90%	50%	10%
Power related:	81%	25%	1 %
log. Scale (for example): (approximately, difference between top- base power > 30 dB)	-0.9dB	-6dB	-20dB

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE on page 464
:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE? on page 485

Distal - Pulse Data Analysis
Sets the upper reference level in terms of percentage of the overall pulse level (power or voltage related). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:HREFerence on page 465
:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence on page 486

Mesial - Pulse Data Analysis
Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define the pulse width (τ) and pulse period.

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:REFerence on page 465
:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence on page 486

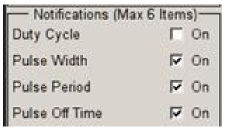
Proximal - Pulse Data Analysis
Sets the lower reference level in terms of percentage of the overall pulse level (power or voltage related).

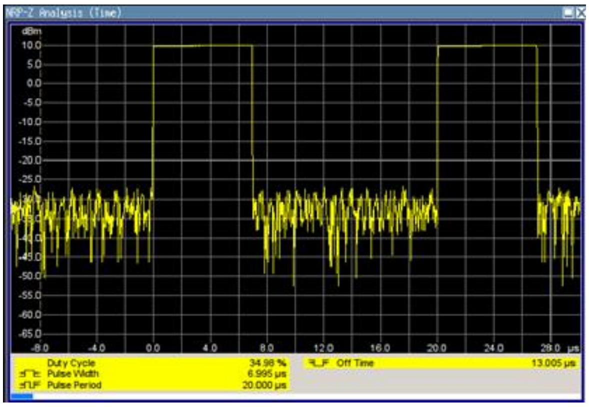
The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:LREFerence on page 466
:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence on page 486

Notifications - Pulse Data Analysis
Selects the pulse parameters to be indicated below the measurement diagram.

Note: The "Rearrange" key or the key combination <STR+A> toggle between the diagram views.





"Duty Cycle" Indicates the ratio between the pulse duration (τ) and the pulse period (T) of the measured pulse signal in per cent:
Duty Cycle = (pulse duration / pulse period) * 100

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe]` on page 484
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle?` on page 482

"Pulse Width" Indicates the pulse duration of the pulse data measurement in seconds.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay:ANNotation[:STATe]` on page 484
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation?` on page 482

"Pulse Period" Indicates the time the pulse signal needs to complete one cycle.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:ANNotation[:STATe]` on page 484
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod?` on page 482

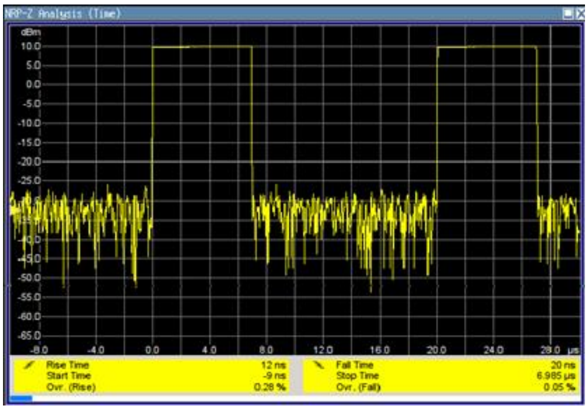
"Pulse Off Time" Determines the time the pulse signal is low, that means as long as the signal level is below the proximal value.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation:DISPlay:ANNotation[:STATe]` on page 484
`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation?` on page 482

Transition Times - Pulse Data Analysis
Selects the transition parameters of the pulse signal to be indicated below the measurement diagram.

The R&S NRP-Z sensor searches for the first rising edge and the first falling edge in the trace.

Note: The "Rearrange" key or the key combination <STR+A> toggle between diagram views.



"Rise Time / Fall Time"

Display the time the signal requires from crossing low reference until it reaches high reference level and vice versa.

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation:DISPlay:ANNotation[:STATe] on page 485
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation? on page 482
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation:DISPlay:ANNotation[:STATe] on page 485
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation? on page 482

"Pulse Start Time / Pulse Stop Time"

Display the time when the pulse signal crosses the medial reference level.

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence:DISPlay:ANNotation[:STATe] on page 485
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence? on page 482
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence:DISPlay:ANNotation[:STATe] on page 485
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence? on page 482

"Overshoot (Rising Edge / Falling Edge)"

Display the maximum value of the pulse signal following a rising transition and the minimum value of the signal after a falling transition, respectively.

Overshoot values are given in per cent of the pulse amplitude as shown below:

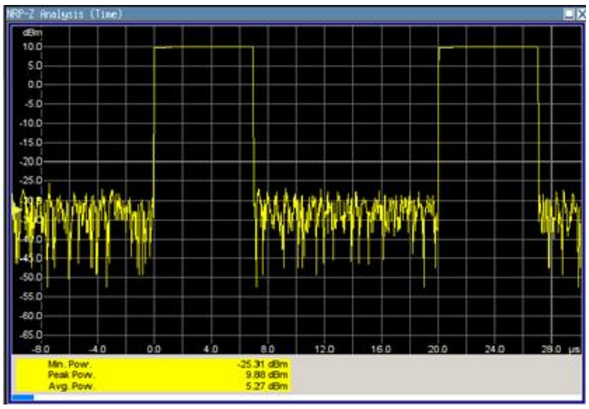
- Overshoot(pos) = 100* (maximum - top level) / (top level - base level)
- Overshoot(neg) = 100* (base level - minimum) / (top level - base level)

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot:DISPlay:ANNotation[:STATe] on page 485
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot? on page 482
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot:DISPlay:ANNotation[:STATe] on page 485
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot? on page 482

Signal Power - Pulse Data Analysis

Selects the power parameters of the pulse signal to be indicated below the measurement diagram.

Note: The REARRANGE key or the key combination <STR+A> toggle between the diagram views.



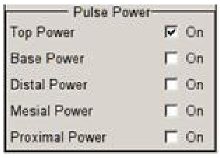
"Minimal / Peak / Average Power" display the minimum, the maximum and the average power of the pulse signal in dBm.

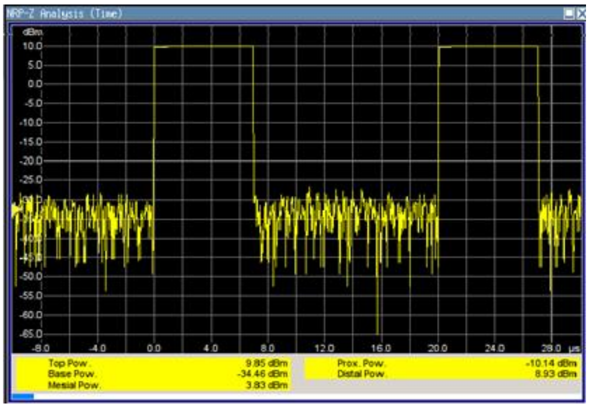
Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay:ANNotation[:STATe] on page 484
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum? on page 482

:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay:
ANNotation[:STATe] on page 484
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum? on page 482
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:
ANNotation[:STATe] on page 484
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage? on page 482

Pulse Power - Pulse Data Analysis
Selects which pulse power parameters are indicated in the diagram (pulse data view only).

Note: The "Rearrange" key or the key combination "<STR+a>" toggles between the diagram views.





"Top / Base Power"
Indicate the pulse top and base level of the analyzed signal in dBm.

Remote command:
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:
ANNotation[:STATe] on page 484
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP? on page 482
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay:
ANNotation[:STATe] on page 484
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE? on page 482

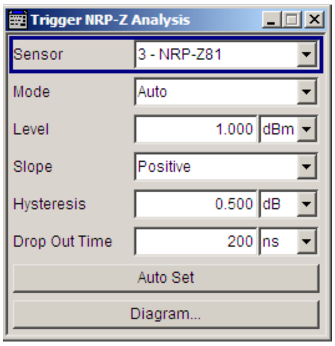
"Distal / Mesial / Proximal Power"
Display the absolute power values of the medial, low and high reference level in dBm.

Remote command:
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay:ANNotation[:STATe]` on page 484
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence?` on page 482
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay:ANNotation[:STATe]` on page 484
`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence?` on page 482

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

Configure Trigger

The "Trigger…" button opens the "Trigger NRP-Z Analysis" dialog. The button is only active for time measurement mode. For this mode, the measurement start has to be known to the sensor as the measurement is controlled by the sensor.



Power Sensor - Power Analysis
Selects the power sensor to be set if more than one sensor is connected to the instrument.

Remote command:
n.a.
In remote control mode, the sensor is selected via the numeric suffix in the sense key word of the command, for example `SENSe2:POWer:SWEep:...`.

Mode - Power Analysis
Selects if the measurement is free running, or starts only after an internal or external trigger event.

Remote command:
`:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce` on page 473

Level - Power Analysis
Sets the trigger threshold. This setting is also possible by means of the trigger marker on the left side of the diagram.

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel on page 472

Slope - Power Analysis
Sets the polarity of the active slope of the trigger signals.

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

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

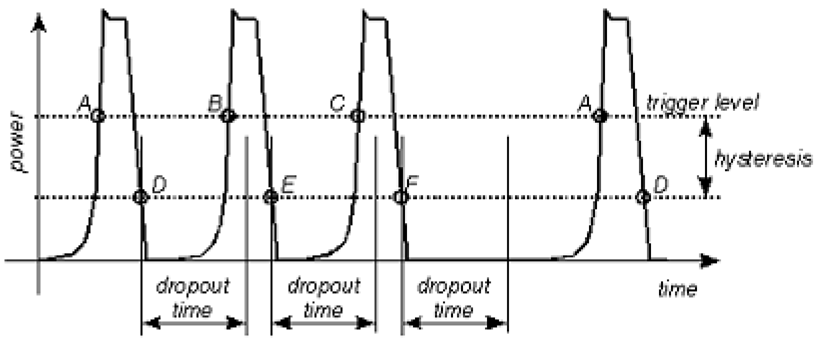
Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SLOPe on page 473

Hysteresis - Power Analysis
Sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis on page 472

Drop out Time - Power Analysis
Determines the minimum time for which the signal must be below (above) the power level defined by "Level" and "Hysteresis" before triggering can occur again. It prevents the trigger system from being activated too early if the trigger threshold is briefly underranged or exceeded.

The dropout time parameter is useful when dealing with, for example, GSM signals with several active slots. When measuring in synchronization with the signal, a trigger event is to be produced at A, but not at B or C. As the RF power between the slots is below the threshold defined by "Level" and "Hysteresis", the trigger hysteresis cannot prevent triggering at B or at C. Select the dropout time parameter greater than the time elapsed between points E and B and between F and C, but less than the time elapsed between G and A. It makes sure that the trigger at A is effective.



As the mechanism associated with the dropout time parameter is reactivated whenever the trigger threshold is crossed, unambiguous triggering can also be obtained for many complex signals. By contrast, all triggering is suppressed during the hold-off time. I.e. in the example, that although stable triggering conditions can be obtained with a suitable hold-off time (regular triggering at the same point), it is not possible to set exclusive triggering at A.

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe on page 472

Auto Set - Power Analysis
Sets the trigger level, the hysteresis and the drop out time to default values.

Remote command:
:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO on page 472

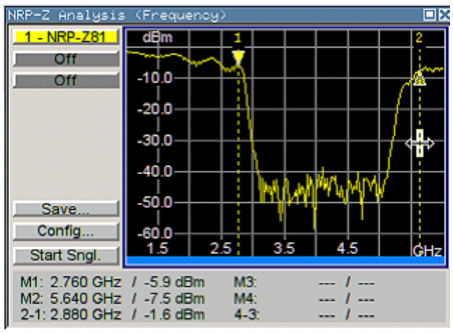
Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

Define Markers

Readout and comparison of particular values of the traces is possible by means of four markers. The markers can be edited either in the diagram or in the "Marker" dialog that is called with the SETUP key in the "NRP-Z Analysis" diagram.

In the "Marker" dialog, you can activate the marker display ("Visible") and assign a marker to a certain trace ("Trace"). In the diagram, the exact position must still be defined.

Markers and the marker list are available in the medium zoom level which is shown in the graph below. To access the markers, activate the "NRP-Z Analysis (Time, Marker)" view with the "Rearrange" key. The markers are moved by means of the cursor and the roll key to the desired trace position. One click activates the marker cursor, the second click attaches the cursor to the selected marker which now can be moved to the desired position. Two clicks on the ESC key set the focus back to the diagram. The positions of the active markers are indicated in the marker list.



Marker - Power Analysis
Selects the marker to be configured.

Remote command:
n.a.

Visible - Power Analysis
Selects if the marker and the marker list are shown in the diagram.

Remote command:
n.a.

Trace - Power Analysis
Selects the trace to which the marker is assigned.

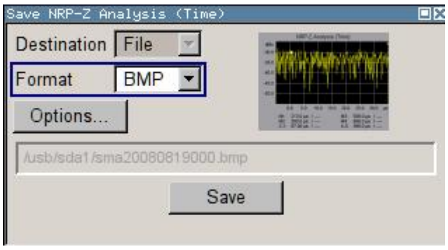
Remote command:
n.a.

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis" diagram.

Remote command:
n.a.

Save Hardcopy

The "Save …" button in the "Power Analysis" diagram opens a dialog to store a screenshot of the current measurement diagram. The current screen shot is stored as indicated, that means with or without marker indication. The different diagram views are toggled with the "Rearrange" key or the key combination <STR+A> on an external keyboard (see overview of features and operation in Chapter 5.3.6.3, "NRP-Z Power Analysis", on page 184.



Destination - Power Analysis
Indicates that the hardcopy is stored in a file.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice` on page 453

Format - Power Analysis
Selects the file format.

Several bitmap graphic formats are offered. In addition, format `*.csv` is available which stores the measurement values as ASCII data. The csv settings are performed in the "Options…" submenu.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage` on page 454

File name - Power Analysis
Indicates the file name.

The file name can be set either manually via the file manager (button "File…") or generated automatically. Automatic naming is activated and configured in the "Options…" subdialog

Remote command:

`:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]` on page 456

`:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe` on page 460

`:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE?` on page 457

Save Hardcopy - Power Analysis

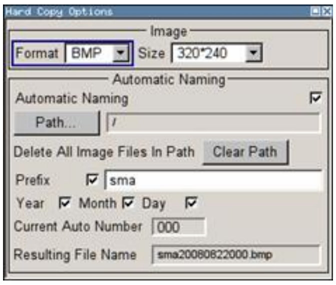
Stores the current measurement diagram as hardcopy in a graphic file format or the trace data in a csv-file, depending on the selected file format.

Remote command:

`:SENSe[:POWer]:SWEep:HCOPy[:EXECute]` on page 456

Save Options - Power Analysis

Opens a submenu to select the screenshot format and size and also to activate and select the automatic naming settings.



"Format" Selects the hardcopy format. In addition to several bitmap formats, format "*.csv" is available which stores the measurement values as ASCII data.

Remote command:

`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage` on page 454

"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.

Remote command:

`:SENSe[:POWer]:SWEep:HCOPy:DEVice:SIZE` on page 455

"Automatic Naming"

Selects that file names are created by rules if checked. The filename includes at least number and optionally additional information which is determined below.

Remote command:

`:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe` on page 460

"Path" Sets the directory for saving the files. The "Clear Path" button deletes all image files with extensions "bmp", "img", "png", "xpm" and "csv" in the directory set for automatic naming.

Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory on page 456
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar
on page 457

"Prefix, Year, Month, Day"
"Prefix, Year, Month, Day" are included in the file name if checked and automatic naming is selected. The "Auto Number" used for file name creation and the resulting file name are indicated below.

Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe
on page 459
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix
on page 459
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe
on page 458
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?
on page 458
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe
on page 458
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?
on page 458
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe
on page 460
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?
on page 459

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

Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?
on page 459

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

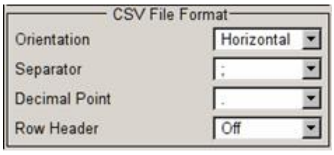
Remote command:
:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE? on page 457

Remote command:
:SENSe[:POWer]:SWEep:HCOPy[:EXECute] on page 456

CSV Options Hardcopy- Power Analysis

If file format *.csv is selected, the trace data is saved as an ASCII file with separated values. Additional settings are available in the hardcopy options submenu.

CSV files can be imported into the program MS Excel and then processed further. Adjust the value separator and the decimal point according to the language version, to import the data correctly.



"Orientation" Defines the orientation of the X/Y value pairs:

- **Horizontal:**
  X/Y values of trace 1 in rows 1 and 2,
  X/Y values of trace 2 in rows 3 and 4,
  X/Y values of trace 3 in rows 5 and 6,
  X/Y values of trace 4 in rows 7 and 8.

  Example:

  Trace1,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace1,Y[dBm]: -20.09; -19.17; -18.19; -15.43; ...

  Trace2,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace2,Y[dBm]: -19.09; -18.17; -17.19; -14.43; ...

  Trace3,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace3,Y[dBm]: -21.09; -20.17; -19.19; -16.43; ...

  Trace4,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace4,Y[dBm]: -22.07; -20.14; -21.56; -17.67; ...

- **Vertical:**
  X/Y values of trace 1 in column 1 and 2,
  X/Y values of trace 2 in column 3 and 4,
  X/Y values of trace 3 in column 5 and 6,
  X/Y values of trace 4 in column 7 and 8.

  Example:

  Trace1,X[Hz]; Trace1,Y[dBm]; Trace2,X[Hz]; Trace2,Y[dBm]; Trace3,X[Hz]; Trace3,Y[dBm]; Trace4,X[Hz]; Trace4,Y[dBm];

  10000.0;-20.09;10000.0; -19.09;10000.0;21.09;10000.0;22.07;

  10010.0;-19.17;10010.0;-18.17;10010.0; -20.17;10010.0; -20.14;

  10020.0;-18.19;10020.0;-17.19;10020.0;-19.19;10020.0;-21.56;

  10030.0; -15.43;10030.0; -14.43;10030.0;-16.43;10030.0;-17.67;...

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation`
on page 455

"Separator" Defines the character to be used to separate the values: tabulator, semicolon, comma or blank.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator` on page 455

"Decimal Point"
Defines the character to be used as the decimal point of the values: dot or comma.

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint` on page 454

"Row Header" Defines a header for each row or column, depending on the orientation. A header contains information on the trace, e.g. the trace index, or frequency, power or time values.

Example:

Trace=2;Source=detecting..;X[Hz]";"Trace=2;Source=detecting..;Y[dBm]"

Remote command:
`:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer` on page 454

5.3.7 RF Sweep and List Mode

5.3.7.1 Overview

The R&S SMA 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.
- Activating a sweep mode immediately disables NRP-Z Level Control.
  Vice versa, a running sweep mode blocks "NRP-Z Level Control". It can not be activated.
- Signal generation in list mode does not work when the narrow PLL bandwidth is set
- If you want to remain at a specific frequency or level value during a sweep, enter the value directly in the status bar. The sweep stops immediately.
- A phase continuous frequency sweep can be generated after activating the phase continuous mode, see "Setting a Phase Continuous Frequency Sweep" on page 148.

Setting a sweep

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

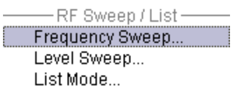
The LF sweep is activated and configured in the "Mod Gen" block.

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 display update for optimum sweep performance especially with short dwell times (see Chapter 5.2.3.8, "Display Update", on page 103).

5.3.7.2 RF Frequency Sweep

The dialog enables you to activate and configure a sweep for the RF frequency.



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

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

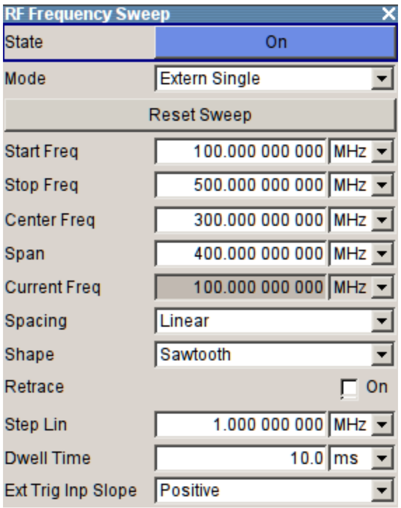
The buttons are used to reset the RF sweep (all sweep modes) or to execute the RF sweep ("Single" mode).

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

You can configure the sweep range of the RF sweep in two ways, either by entering the "Start" and "Stop" values or by entering the "Center" frequency and the "Span".

The two sets of parameters correlate as follows:

- "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

► To access the sweep dialog, select "RF > configure > Sweep/List > RF Frequency Sweep".

In these dialogs you can configure the corresponding sweep signal.

State - Frequency Sweep

Activates RF sweep mode.

Note:

Activating a sweep mode automatically deactivates other sweeps and the list mode.

Remote command:

`[:SOURce<hw>]:FREQuency:MODE` on page 543

Mode - RF Frequency Sweep

Selects the RF frequency sweep mode.

If you change the sweep mode during the execution, the signal generator stops the sweep and starts with the next trigger event at the initial value.

The "Reset Sweep" button sets the sweep to the start value.

"Auto" Generates a continuously repeating sweep signal immediately after activating the sweep mode.
The sweep steps are performed atomatically, controlled by the dwell time, see "Dwell Time - Frequency Sweep" on page 228.

Example:

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

"Single" Generates a single sweep cycle after a trigger event.
The sweep steps within the cycle are performed automatically, controlled by the dwell time. If one cycle is completed, the instrument waits for the next trigger event.
To trigger the sweep, use "Execute Single Sweep" button, or the corresponding remote control commands, for example `*TRG`.

Example:

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

"Step" Generates the sweep signal step-by-step, manually triggered.
To perform the sweep steps, enter the frequency value under Current Freq - Frequency Sweep. You can directly enter the value, but also use the UP and DOWN navigation keys or the ROTARY KNOB.
You can determine the step width below in the entry field "Step Lin" or "Step Log", see Step Lin/Log - Frequency Sweep.
If a step is out of the sweep range ("Start Freq" or "Stop Freq"), it is ignored.

Note: To step through the sweep frequencies in remote control mode, use the `FREQ:MAN` command with the `UP` or `DOWN` parameter.

Example:

```
SOUR:FREQ:CENT 300MHz
SOUR:FREQ:SPAN 400MHz
SOUR:SWE:FREQ:SPAC LIN
SOUR:SWE:FREQ:STEP:LIN 100MHz
SOUR:FREQ:MODE MAN
```

set sweep mode "Step".

```
SOUR:FREQ:MODE SWE
```

activate sweep mode, the frequency is set to "Start Freq".

```
SOUR:FREQ:MAN UP
```

set the frequency to the next higher sweep frequency.

```
SOUR:FREQ:MAN DOWN
```

set the frequency to the next lower sweep frequency.

"Extern Single" Generates a single sweep cycle when an a external trigger event occurs.
The sweep steps within the cycle are performed automatically, controlled by the dwell time. If one cycle is completed, the instrument waits for the next trigger event.
To trigger the sweep, apply an external trigger signal.
Refer to the description of the rear panel for information on the connectors for external trigger signal input (see Chapter 2.2, "Rear Panel Tour", on page 23).

Example:

`SOUR:SWE:FREQ:MODE AUTO`

`TRIG:FSW:SOUR EXT`

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

"Extern Step" Generates the sweep signal step-by-step, manually triggered.
To trigger a sweep step, apply an external trigger signal. The step width corresponds to the step width set for the rotary knob.

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"
Generates a continuously repeating sweep signal that is started, stopped and restarted by subseqeunt external trigger events. The sweep steps are performed automatically, controlled by the dwell time.
Refer to the description of the rear panel for information on the connectors for external trigger signal input (see Chapter 2.2, "Rear Panel Tour", on page 23).

Example:

`SOUR:SWE:FREQ:MODE AUTO`

`TRIG:FSW:SOUR EAUT`

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

Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MODE` on page 640
`:TRIGger<hw>:FSWeep:SOURce` on page 680
`[:SOURce<hw>]:FREQuency:MODE` on page 543

Execute Single Sweep - Frequency Sweep
Starts a sweep manually. This trigger button is displayed in "Single" mode.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute on page 639
:TRIGger<hw>:FSWeep[:IMMediate] on page 681
:TRIGger<hw>[:SWEep][:IMMediate] on page 685

Reset Sweep - Frequency Sweep
Resets the sweep.

With the next trigger event, the sweep starts with at the initial value.

Remote command:
[:SOURce<hw>]:SWEep:RESet[:ALL] on page 648

Start Freq - Frequency Sweep
Sets the start frequency.

Remote command:
[:SOURce<hw>]:FREQuency:STARt on page 547

Stop Freq - Frequency Sweep
Sets the stop frequency.

Remote command:
[:SOURce<hw>]:FREQuency:STOP on page 548

Center Freq - Frequency Sweep
Sets the center frequency.

Remote command:
[:SOURce<hw>]:FREQuency:CENTer on page 540

Span - Frequency Sweep
Sets the span.

Remote command:
[:SOURce<hw>]:FREQuency:SPAN on page 547

Current Freq - Frequency Sweep
Displays the current frequency.

In sweep "Step" mode, the parameter is editable and you can enter frequency for the next step.

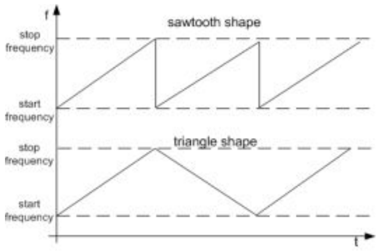
Remote command:
[:SOURce<hw>]:FREQuency:MANual on page 542

Spacing - Frequency Sweep
Selects the mode for the calculation of the frequency sweep intervals.

"Linear"	Takes the frequency value entered as an absolute value in Hz.
"Logarithmic"	Takes the value entered as a lograithmic value, that means as a constant fraction of teh current frequency in %.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 642

Shape - RF Frequency Sweep
Selects the waveform shape of the sweep signal.



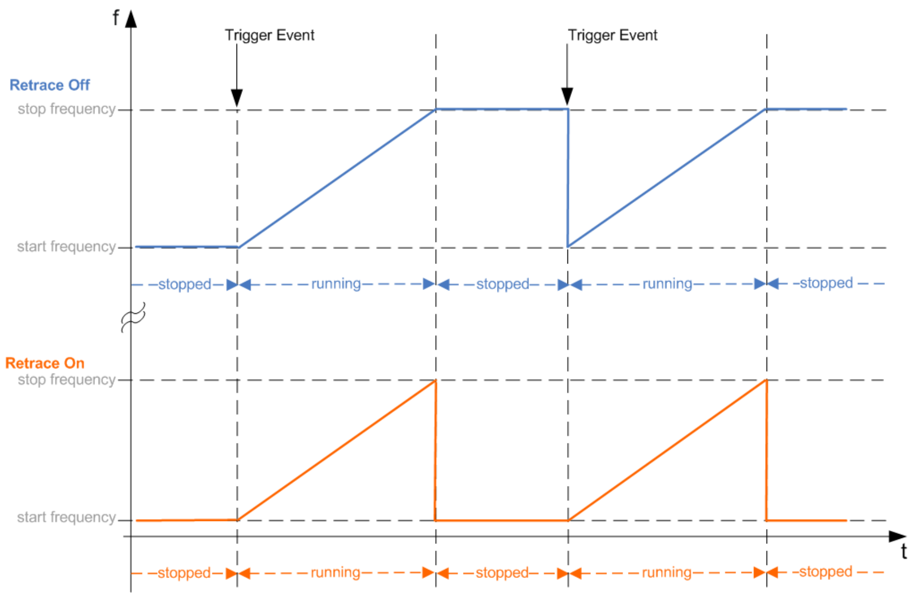
"Sawtooth" One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, that means the shape of the sweep sequence resembles a sawtooth.

"Triangle" The sweep runs from the start to the stop frequency and back, that means the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe on page 641

Retrace - RF Frequency Sweep
Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single", see Mode - RF Frequency Sweep.



Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:RETRace on page 641

Step Lin/Log - Frequency Sweep
Sets the step width for the individual frequency sweep steps.

At each step this value is added to the current frequency.

Depending on the Spacing - Frequency Sweep mode you have set, the corresponding parameter is displayed.

"Step Lin" The step width is a constant value in Hz.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] on page 642

"Step Log" The step width is determined logarithmically in %, that means as a constant fraction of the current frequency.
Successive frequencies are calculated as follows:

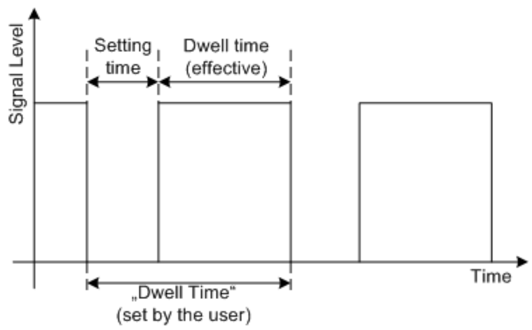
- **start_f < stop_f**
  f2 = f1 * (1 + step_log / 100)
  If f2 > stop_f: f2 is set to stop_f.
- **start_f > stop_f**
  f2 = f1 / (1 + step_log / 100)
  If f2 < stop_f: f2 is set to stop_f.

When the shape "Triangle" is set, the frequency values on the slope from **stop_f back to start_f** are the same as on the slope from **start_f to stop_f**.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic on page 643

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 display update for optimum sweep performance especially with short dwell times (see Chapter 5.2.3.8, "Display Update", on page 103).

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:DWELl on page 639

Ext. Trigger Input Slope

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

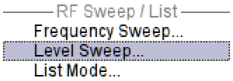
This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive" activates the rising edge of the trigger signal.

"Negative" activates the falling edge of the trigger signal.

Remote command:
[:SOURce]:INPut:TRIGger:SLOPe on page 566

5.3.7.3 RF Level Sweep



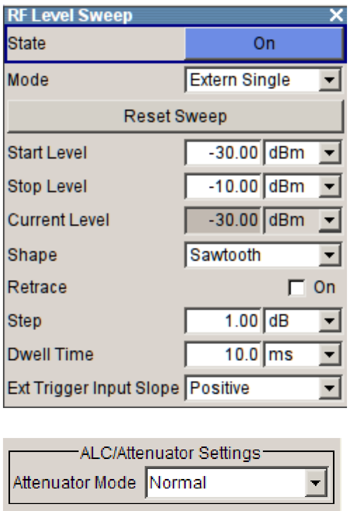
To open the "Level Sweep" menu, select "RF > Configure > Level Sweep" or use the MENU key under "RF".

RF Level Sweep Settings

The "RF Level Sweep" dialog is used to activate and configure a sweep for the RF level.

In the top section, the RF 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 a sweep mode automatically deactivates other sweeps and the list mode.

Remote command:
[:SOURce<hw>]:POWer:MODE on page 613

Mode - Level Sweep
Selects the level sweep instrument operating mode and the sweep mode.

If you change the sweep mode during the execution, the signal generator stops the sweep and starts with the next trigger event at the initial value.

The "Reset Sweep" button sets the sweep to the start value.

"Auto" Sets an automatically repeated sweep cycle.

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, or by means remote trigger commands, e.g. `*TRG`.

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.

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.
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 23).

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.

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).
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 23).

Example:

`SOUR:SWE:POW:MODE AUTO`

`TRIG:PSW:SOUR EAUT`

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

Remote command:
`[:SOURce<hw>]:SWEep:POWer:MODE` on page 645
`:TRIGger<hw>:PSWeep:SOURce` on page 683.
`[:SOURce<hw>]:POWer:MODE` on page 613

Reset Sweep - Level Sweep

Resets the sweep. The start level is set and the next sweep starts from there.

Remote command:
`[:SOURce<hw>]:SWEep:RESet[:ALL]` on page 648

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
```

Remote command:
`[:SOURce<hw>]:SWEep:POWer:EXECute` on page 645
`:TRIGger<hw>:PSWeep[:IMMediate]` on page 683
`:TRIGger<hw>[:SWEep][:IMMediate]` on page 685

Start Level - Level Sweep
Sets the start level.

Remote command:
`[:SOURce<hw>]:POWer:STARt` on page 616

Stop Level - Level Sweep
Sets the stop level.

Remote command:
`[:SOURce<hw>]:POWer:STOP` on page 617

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.

Remote command:
`[:SOURce<hw>]:POWer:MANual` on page 612

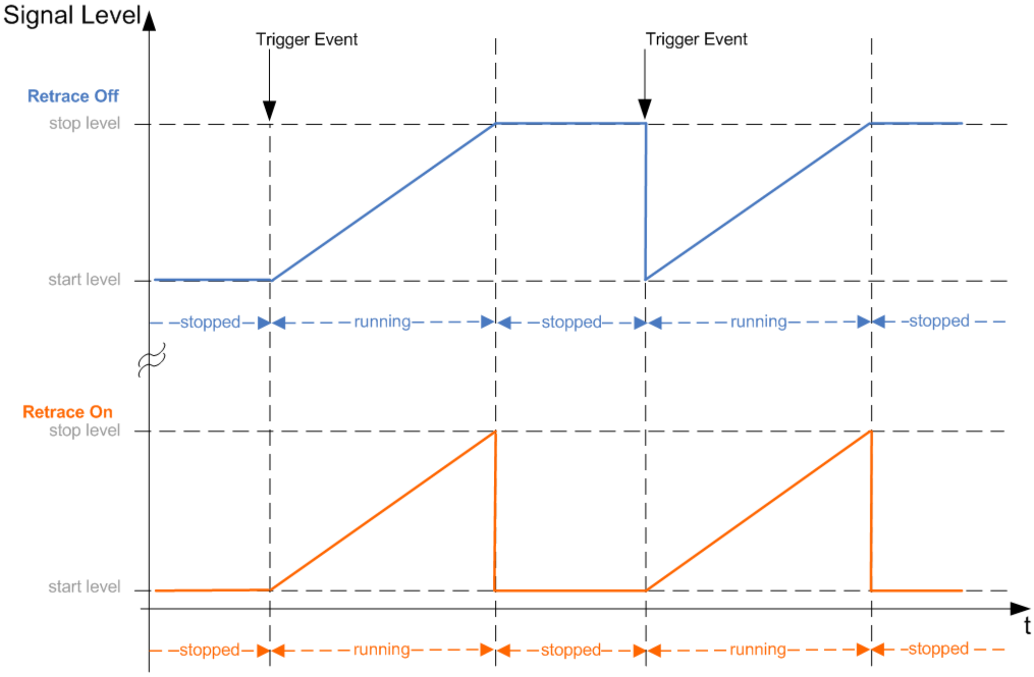
Shape - RF Level Sweep
Selects the cycle mode for a sweep sequence (shape).

"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.

Remote command:
`[:SOURce<hw>]:SWEep:POWer:SHAPe` on page 647

Retrace - RF Level Sweep
Activates that the signal changes to the start level value while it is waiting for the next trigger event. It allows you to shift down the power during the waiting period.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single", see Mode - Level Sweep.



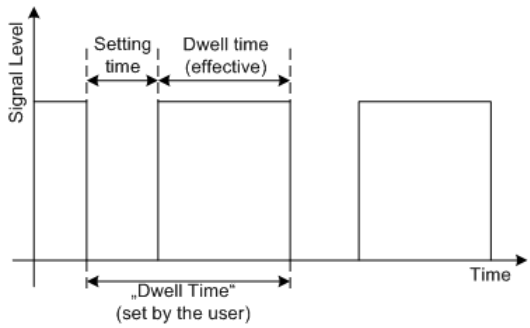
Remote command:
[:SOURce<hw>]:SWEep:POWer:RETRace on page 646

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.

Remote command:
[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] on page 647

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 display update for optimum sweep performance especially with short dwell times (see Chapter 5.2.3.8, "Display Update", on page 103).

Remote command:
`[:SOURce<hw>]:SWEep:POWer:DWELl` on page 644

Ext. Trigger Input Slope
Sets the polarity of the active slope of an externally applied instrument trigger.

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive" activates the rising edge of the trigger signal.

"Negative" activates the falling edge of the trigger signal.

Remote command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 566

Attenuator Mode - Level Sweep with High Power Option
(High Power Option only)

Sets the ranges of level settings for the level sweep. The sweep is either performed in the low level (electronically switching attenuator) or in the high level (relay-switched high-power-bypass) ranges.

Note: An error message is generated and the best possible level is set if the level setting for the current sweep step is outside the selected range.

"Normal " The level settings for the level sweep are made in the area of the electronically switching attenuator. The high level ranges are not available.

"High Power " The level settings for the level sweep are made in the area of the option. Only the high level range is available.

Remote command:
`[:SOURce<hw>]:SWEep:POWer:AMODe` on page 644

5.3.7.4 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.

Interactions between List mode and other operating modes or settings

- List mode and sweeps can not be activated simultaneously, they deactivate each other.
- Activating the list mode instantly disables NRP-Z Level Control.
  A running list mode blocks "NRP-Z Level Control". It can not be activated
- Regarding the PLL bandwidth: Note that the normal PLL bandwidth mode is set, since the frequency settling time in narrow mode impacts the fast frequency changes in list mode, see "Main Pll Bandwidth" on page 143. Signal generation in list mode does not work with the narrow PLL bandwidth.

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

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

The list is either processed from the beginning to the end of the list (modes "Auto", ("External") "Single", ("External") "Step") or by hopping from one freely selectable list index (frequency/level pair) to the next (modes "Extern Hop", "Extern Hop Direct").

List Mode Extern Hop

The Extern Hop control signals (clock, strobe and data) are supplied via the serial FHOP bus on the "AUX I/O" interface at the rear of the instrument.

Data transmission starts with the MSB (most significant bit). A strobe marks the LSB (least significant bit) and thus the end of a valid data sequence (40 bits). The data bits determine the RF path, the Extern Hop mode (direct or not) and the processed list index. The timing of the control signals is illustrated in the following figure.

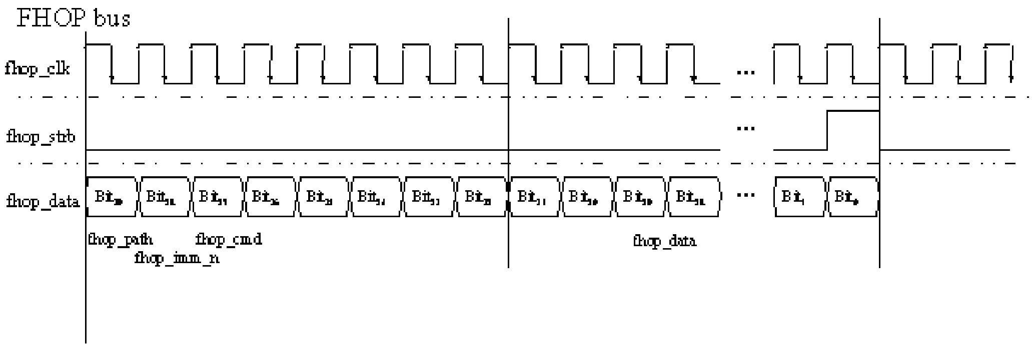


Figure 5-11: Input control signals for List Modes Fast Hop and Fast Hop Direct on the serial FHOP bus

Table 5-1: Function of data bits of FHOP bus (fhop_data line) and their function for controlling fast frequency hopping

Data bit name (bit number)	Function
path (39)	Bit 39 must be set to 0
imm_n (38)	Selects Fast Hop mode: ● 0 = Fast Hop Direct the selected settings are performed at once after data transfer of a complete sequence (40 bits) without additional triggering ● 1 = Fast Hop the selected settings are performed after an instrument trigger
cmd (37 to 32)	Selects function for fast hop mode. Bit 32 must be set to 1 (= List Mode) Bit 37 to 33 must be set to 0 (= reserved for future extensions)
data (31 to 0)	Data bits Determine the list index (frequency/level setting) to be processed for List Mode

Example:

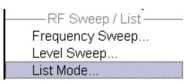
The bit sequence 0100-0010-0000-0000-0000-0000-0000-0000-0000-1010 on data line "fhop_data" selects the list index 10 of the currently loaded list on Path A. The frequency and level setting associated with this index are performed after the next instrument trigger.

Preconditions:

List Mode "Extern Hop" is selected in the "List" menu and a list with at least 10 entries is loaded.

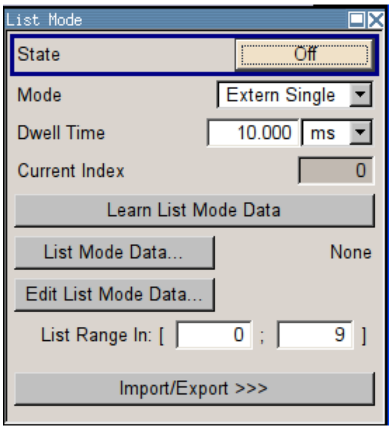
An external trigger is provided at the INST TRIG connector.

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.

Remote command:
`[:SOURce<hw>]:FREQuency:MODE` on page 543

Attenuator Mode – List Mode with High Power Option

(High Power Option only)

Sets the ranges of level settings for the level sweep. The sweep is either performed in the low level (electronically switching attenuator) or in the high level (relay-switched high-power-bypass) ranges.

Note: An error message is generated and the best possible level is set if the level setting for the current sweep step is outside the selected range.

"Normal " The level settings for the level sweep are made in the area of the electronically switching attenuator. The high level ranges are not available.

"High Power " The level settings for the level sweep are made in the area of the option. Only the high level range is available.

Remote command:
`[:SOURce<hw>]:LIST:POWer:AMODe` on page 589

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.

"Extern Hop" Index-by-index cycle.
The processed list index is determined by the external control signals provided via the serial FHOP bus on the AUX I/O interface at the rear of the instrument (see "List Mode Extern Hop" on page 235).
The external trigger signal is used. Each trigger event starts the processing of the frequency and level settings associated with selected index (trigger source as described under "Extern Single"). The duration of a list step is determined by the time between two trigger events. Note that the fhop_imm_n bit has to be disabled on the fhop_data line (=1).

"Extern Hop Direct" Index-by-index cycle. The processed list index is determined by the external control signals provided via the serial FHOP bus.
Processing of the frequency and level settings associated with selected index is automatically started at the end of data transmission. Note that the fhop_imm_n bit has to be enabled on the fhop_data line (= 0).

Remote command:
[:SOURce<hw>]:LIST:MODE on page 588
[:SOURce<hw>]:LIST:TRIGger:SOURce on page 591

Execute Single - List Mode
Triggers the list manually. This button is available only if mode "Single" is selected.

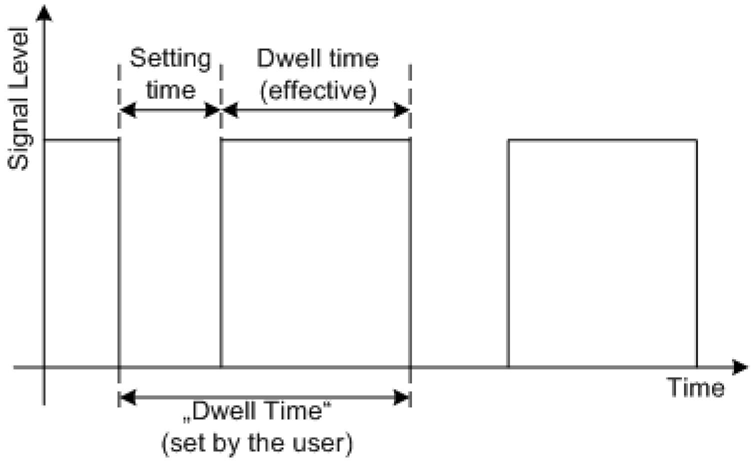
Remote command:
[:SOURce<hw>]:LIST:TRIGger:EXECute on page 591

Reset - List Mode
Resets the list to the starting point.

Remote command:
[:SOURce<hw>]:LIST:RESet on page 590

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.

Remote command:
[:SOURce<hw>]:LIST:DWELl on page 585

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

Remote command:
[:SOURce<hw>]:LIST:INDex on page 587

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.

Remote command:
[:SOURce<hw>]:LIST:LEARn on page 588

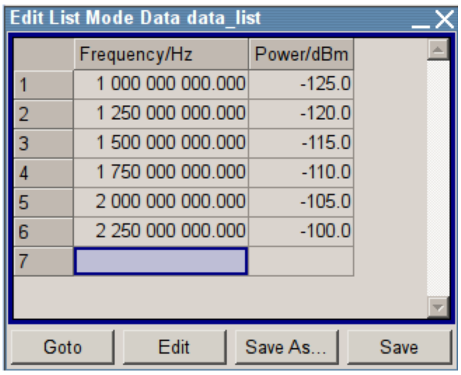
List Mode Data... - List Mode

Calls the "File Select" menu for selecting and creating a list or the "File Manager".

Remote command:
[:SOURce<hw>]:LIST:SELect on page 590
[:SOURce<hw>]:LIST:DELete on page 581
[:SOURce<hw>]:LIST:DELete:ALL on page 581

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.

Remote command:
[:SOURce<hw>]:LIST:FREQuency on page 586

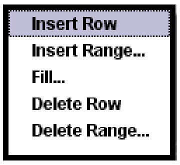
"Power /dBm" Enter the level of the frequency/power value pair.

Remote command:
[:SOURce<hw>]:LIST:POWer on page 589

"Goto" Selects row for editing.

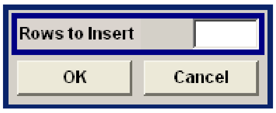
If "Goto row" is selected, a window opens for entering the requested row.

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



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

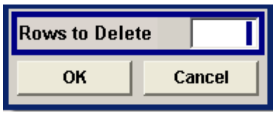
"Insert Range" Inserts new rows before the marked row. The number of rows to be inserted can be defined in an entry window.



"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 243).

"Delete Row" Deletes the marked row.

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



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

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

List Range In - List Mode

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

Remote command:
`[:SOURce<hw>]:LIST:INDex:STARt` on page 587
`[:SOURce<hw>]:LIST:INDex:STOP` on page 588

Ext. Trigger Input Slope

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

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive" activates the rising edge of the trigger signal.

"Negative" activates the falling edge of the trigger signal.

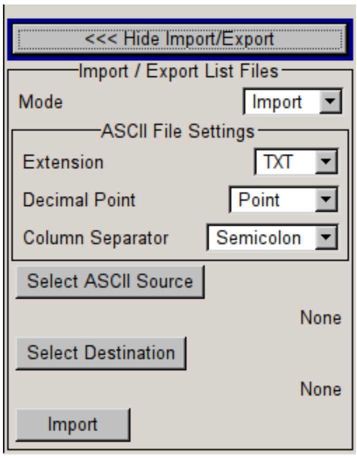
Remote command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 566

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.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:MODE` on page 585

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.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension` on page 582

Decimal Point - List Mode

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

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal` on page 584

Column Separator- List Mode

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

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn` on page 583

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.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect` on page 583

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.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:SELect` on page 585

Import / Export - List Mode

Starts the export or import of the selected file.

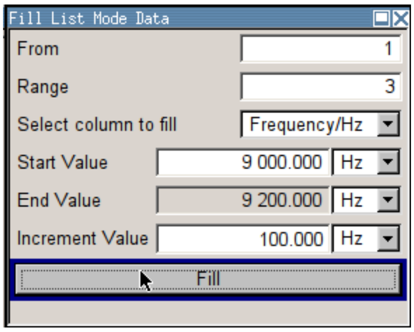
When import is selected, the ASCII file is imported as list mode list.

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

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:EXECute` on page 584

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.

Remote command:
n.a.

Range
Sets the range for filling the table.

Remote command:
n.a.

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

Remote command:
n.a.

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

Remote command:
n.a.

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

Remote command:
n.a.

Increment value
Sets the increment for the frequency or the level entries.

Remote command:
n.a.

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

Remote command:
n.a.

5.4 Modulation

5.4.1 Overview of Modulation

Analog modulation is a method used to transmit information of an LF (Low Frequency) signal in accordance with a second signal, typically one of a higher frequency. This is done by varying one or more properties of a high frequency waveform, called the modulation or carrier signal, with the modulating signal that contains the information to be transmitted.

The three key parameters of the modulation signal are the amplitude, phase and frequency. These parameters are modified in accordance with the low frequency signal to obtain the modulated RF signal.

The R&S SMA provides all the various types of modulation, such as:

- AM (Amplitude Modulation)
- FM (Frequency Modulation, analog and digital)
- PhiM (Phase Modulation, analog and digital)
- PULM (Pulse Modulation)
- Chip Modulation

The RF signal can be modulated with a wide variety of internally generated modulations waveforms, for example sine waves, triangle/rectangular/trapeze signals, and noise. The basic unit basic unit (R&S SMA + frequency option R&S SMA-B10x) provides analog amplitude and pulse modulation without additional equipment options. A standard LF generator and a pulse generator are provided for generating the internal modulation signal. Further available options are:

- R&S SMA-B20 (FM/PhiM Modulator) for performing Frequency modulation (FM) and phase modulation (PhiM)
  R&S SMA-B22 (Enhanced Phase Noise Performance andFM/PhiM Modulator)
  Chirp modulation is available with one of these options and an interface board with part number 1400.0530.02.
- R&S SMA-K23 High Performance Pulse Generator features extended pulse modulation
- R&S SMA-K24 Multifunction Generator provides a second LF Generator and a Noise generator
  The LF Generator can be used as a second modulation source with extended frequency range and selectable signal shapes. The noise source provides white noise with selectable bandwidth and level distribution as additional modulation source.
- R&S SMA-K25 VOR/ILS Modulation for generating test signals for avionic systems (VOR (VHF Omnidirectional Range), ILS-GS (Instrument Landing System - Glide Slope), ILS-LOC (Instrument Landing System - Localizer) and Marker Beacon).
- R&S SMA-K26 DME Modulation
- R&S SMA-K27 Pulse Train enables generation of pulse trains

Settings for the modulation are made in separate modulation menus. These menus can be accessed in the block diagram by way of the "Modulation" function block, or by means of the menu with the same name which is opened using the MENU key.

5.4.1.1 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.

Remote command:
`[:SOURce<hw>]:MODulation[:ALL][:STATe]` on page 599

5.4.1.2 Modulation Sources

The following modulations use internal and external modulation sources:

- Amplitude modulation
- Pulse modulation
- Frequency modulation
- Phase modulation
- VOR/ILS modulation

Marker Beacon modulation only uses the internal modulation sources. For external digital FM and PhiM only external modulation sources can be used.

Internal Modulation Sources

Two LF generators, a noise generator and a pulse generator are available as internal modulation sources for a fully equipped instrument.

The first LF generator supplies sinusoidal signals. The second LF generator supplies signals with selectable shapes. The frequency range is extended. The pulse generator provides single and double pulse modulation with selectable pulse widths and periods or a user-definable pulse train. The LF generator is also used for the generation of the VOR/ILS signals.

The noise generator supplies white noise with selectable bandwidth and level distribution.

See also Chapter 5.5.1, "Overview of LF Generator", on page 322.

External Modulation Sources

The modulation inputs AM EXT, FM/PM 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 signal for digital FM/PM modulation is fed in via the AUX I/O interface. The AM EXT connector can be used to feed in external VOR/ILS signal in addition.

The external modulation signal for AM, FM and PM 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 V, otherwise modulation distortions might occur.

The PULSE EXT connector at the rear of the instrument controls the external pulse modulation. The input shows some hysteresis with threshold levels of 0.7 V/0.9 V. The voltage must not exceed 10 V.

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	dig FM	PhiM	dig PhiM	Pulse	VOR	ILS	MB	ADF	DME
Amplitude modulation (AM)	/	+	+	+	+	-	-	-	-	-	-
Frequency modulation (FM)	+	/	-	-	-	+	+	+	+	+	+
Digital Frequency modulation (FM)	+	-	/	-	+	+	+	+	+	+	+
Phase modulation (PhiM)	+	-	-	/	+	+	+	+	+	+	+
Digital Phase modulation (PhiM)	+	-	-	-	/	-	-	-	-	-	-
Pulse modulation	-	+	+	+	+	/	-	-	-	-	-
VOR modulation	-	+	+	-	+	-	/	-	-	-	-
ILS modulation	-	+	+	-	+	-	-	/	-	-	-
Marker Beacon modulation (MB)	-	+	+	-	+	-	-	-	/	-	-
ADF modulation	-	+	+	-	+	-	-	-	-	/	-
DME modulation	-	+	+	-	+	-	-	-	-	-	/

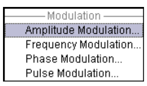
5.4.2 Amplitude Modulation (AM)

An internal and/or external source can be selected for amplitude modulation. Two LF modulation generators and a noise generator are available as the internal source for a fully equipped instrument. Two-tone AM is possible by simultaneously switching on the external and internal or both internal sources.

The AM 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 Settings



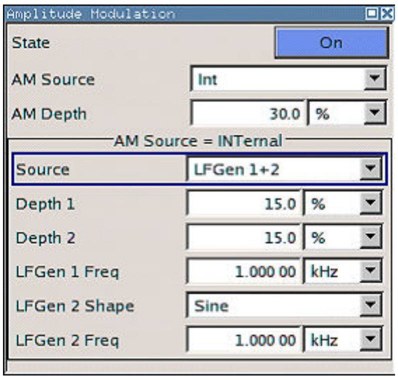
To open the "Amplitude Modulation" dialog, select "Modulation > Configure > Amplitude Modulation" or use the MENU key under "Modulation".

In the upper section of the dialog, 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 dialog or in the "LF Output" dialog (internal source only).

These settings affect all modulations which use the same modulation source.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.



If an avionic modulation (VOR/ILS) is activated this modulation is deactivated and an error message indicated in the info line.

State

Activates amplitude modulation.

Remote command:

[:SOURce<hw>]:AM:STATe on page 496

AM Source

Selects the source for the AM modulation signal.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.

"Internal" Uses the internal LF generator as modulation signal source for AM.

"External" Uses an externally applied modulation signal.
The external signal is input via the AM EXT connector.

"Intern + Extern"
Uses both, the internal and externally applied modulation signal, for example to perform two-tone AM.

Remote command:

[:SOURce<hw>]:AM:SOURce on page 495

AM Depth

Sets the modulation depth in percent.

Note: With two-tone modulation, observe that the set modulation depth applies to 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).

Remote command:
`[:SOURce<hw>]:AM[:DEPTh]` on page 494

Internal Source
Source Internal only

Selects which internal modulation source is used. The available selection depends on the options fitted.

"None"	Switches off all internal modulation sources.
"LFGen1 / LFGen2"	Selects one of the internal LF generators as the source for AM modulation.
"LFGen1+2"	Selects both internal LF generators as the source for AM modulation. LF frequency and modulation depth can be set separately. The added modulation depths of the two modulation generators must not exceed the overall modulation depth. This selection enables two-tone AM modulation.
"Noise"	Selects noise signal. The modulation signal is white noise either with Gaussian distribution or equal distribution. This setting affects all analog modulations which use the noise generator as the internal modulation source. See also Chapter 5.5.3.2, "Noise Settings", on page 332.
"LFGen1+Noise / LFGen2+Noise"	Selects one LF generator as the source for AM modulation and the noise signal. In addition to the AM modulation signal, white noise is used as modulation signal.

Remote command:
`[:SOURce<hw>]:AM:INTernal:SOURce` on page 495

Depth 1/Depth 2
Source Internal, LFGen1+2 only

Selects the modulation depth for the two LF generators. The sum of the two values must not exceed the overall modulation depth set in the upper part of the dialog.

Remote command:
`[:SOURce<hw>]:AM:INTernal<ch>:DEPTh` on page 494

LF Gen 1/2 Freq
Source Internal, LFGen1+2 only

Sets the frequency of the two LF generators.

Remote command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 567

LF Gen 2 Shape
Source Internal, LFGen2 only

Selects the shape of the second LF generator signal. In case of selection Trapeze, additional settings concerning the duration of the single trapeze elements can be made (see Chapter 5.5.3.1, "LF Output Dialog", on page 329).

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe` on page 577

AM Sensitivity
Displays the input sensitivity of the externally applied modulation signal at the AM EXT input in %/V.

The modulation depth entered under AM Depth is achieved with 1 Volt modulation of the input.

Remote command:
`[:SOURce<hw>]:AM:SENSitivity?` on page 495

AM External Coupling
Selects the coupling mode (AC or DC) for external feed.

Note: Coupling for external feed via input AM EXT can be set independently for all modulations using the external modulation signal.

"AC"	Disconnects the DC voltage component and uses only the AC component of the modulation signal.
"DC"	Uses the modulation signal with both components, AC and DC.

Remote command:
`[:SOURce<hw>]:AM:EXTernal:COUPling` on page 494

5.4.2.2 Noise Settings

In case of internal modulation source, the settings for the noise source are offered in the "Noise" section. This setting affects all analog modulations which use the noise generator as the internal modulation source. The settings are described in Chapter 5.5.3.2, "Noise Settings", on page 332.

5.4.3 Frequency Modulation (FM)

Frequency modulation requires option R&S SMA-B20 (FM/PhiM Modulator) or option R&S SMA-B22 (Enhanced Noise Performance and FM/PhiM Modulator).

An internal and/or external source can be selected for frequency modulation. Two LF modulation generators and a noise generator are available as internal sources for a fully equipped instrument. Two-tone FM is possible by simultaneously switching on the external and internal source.

The FM/PM 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 input impedance (50 Ohm or high) can be selected.

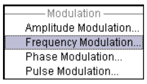
The digital FM signal is fed in via the AUX I/O interface.

Selection between Low Noise mode (with better signal/noise ratio, but reduced setting range for modulation bandwidth and deviation, see data sheet) and standard mode is possible (option R&S SMA-B22 only).

It is not possible to use analog frequency modulation simultaneously with digital frequency modulation or with analog or digital phase modulation.

See "Simultaneous Operation of Several Modulations or Other Operating Modes" on page 247 for an overview in detail.

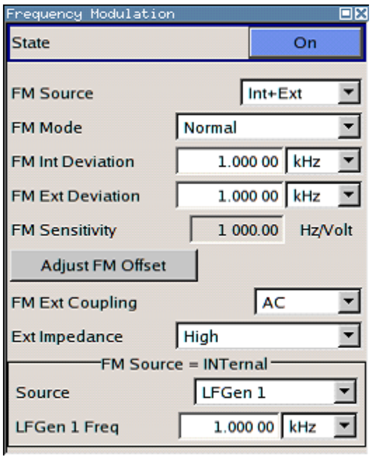
5.4.3.1 Frequency Modulation Settings



To access the "Frequency Modulation" dialog, select "Modulation > Configure > Frequency Modulation" or use the MENU key under "Modulation".

In the upper section of the dialog, you can select the modulation source and activate modulation. The modulation source can be selected independently for the different modulation types and the LF output.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.



State

Activates frequency modulation.

Activation of FM deactivates phase modulation.

Remote command:

[:SOURce<hw>]:FM:STATe on page 540

FM Source

Selects the source for the FM signal.

"Internal" Uses the internal LF generator as modulation signal source for FM.

"External" Uses an externally applied modulation signal.
The external signal is input via the FM/PM EXT connector.

"Internal + External"
Uses both, the internal and externally applied modulation signal, for example to perform two-tone FM.

"Ext digital" uses an externally applied digital modulation signal. The signal is input via the AUX I/O connector.
This mode is provided for fast frequency hopping. The FM-Data bus is directly connected to the DDS of the synthesizer module. Thus, very fast frequency hopping (settling times of <=10 us) is possible for frequency bandwidth up to 40/80 MHz, depending on the RF frequency. The accuracy of the set frequency deviation is limited to 50ppm.
The binary format of the external digital data can be selected (see "Binary Format " on page 254).

Remote command:
`[:SOURce<hw>]:FM:SOURce` on page 539

FM Mode

Selects the mode for the frequency modulation.

"Normal" The maximum range for modulation bandwidth and FM deviation is available.

"Low Noise" (requires option R&S SMA-B22)
Frequency modulation with phase noise and spurious characteristics close to CW mode. The ranges of modulation bandwidth and FM deviation are reduced (see data sheet).
If your instrument is equipped with the SynEx Assembly (part number 1413.1800.02), you can reduce the phase noise even more by setting the PLL bandwidth to "Narrow". See "Main Pll Bandwidth" on page 143 and Chapter 5.3.2.7, "The Configurable Main PLL Bandwidth", on page 144 for details.

Remote command:
`[:SOURce<hw>]:FM:MODE` on page 538

FM Deviation

Sets the modulation deviation in Hz.

The deviation is given as the absolute deviation in relation to the set center frequency, for example a deviation 5 MHz at a center frequency of 1 GHz leads to a frequency modulation between 995 MHz and 1005 MHz.

The maximum 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 maximum 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".

Remote command:
`[:SOURce<hw>]:FM[:DEViation]` on page 536
`[:SOURce<hw>]:FM:EXTernal:DEViation` on page 537

Internal Source

Selects the internal signal source to be used for frequency modulation. The available LF generators provided in the list depend on the installed options.

"None" Deactivates all internal modulation sources.

"LFGen1 / LFGen2"
Uses a signal generated by one of the internal LF generators as modulation signal.

"LFGen1+2" Uses the signals of both internal LF generators for frequency modulation.
You can set the LF frequency and modulation deviation separately for each generator. The sum of the deviations of the two modulation generators must not exceed the total value set with FM Deviation.
With this setting, you can perform two-tone FM modulation.

"Noise" Uses the noise signal for phase modulation, that is white noise either with Gaussian distribution or equal distribution.
This setting affects all analog modulations which use the noise generator as the internal modulation source.
See also Chapter 5.5.3.2, "Noise Settings", on page 332.

"LFGen1+Noise / LFGen2+Noise"
Uses a signal generated by an internal LF generator and overlaid with white noise for phase modulation.

Remote command:
`[:SOURce<hw>]:FM:INTernal:SOURce` on page 538

Deviation 1/Deviation 2

Source Internal, LFGen1+2 only

Selects the deviation for the two frequency modulation signals. The sum of the two values must not exceed the overall modulation deviation set in the upper part of the menu.

Remote command:
`[:SOURce<hw>]:FM:INTernal<ch>:DEViation` on page 537

LF Gen 1/2 Freq

Source Internal, LFGen1+2 only

Sets the frequency of the two LF generators.

Remote command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 567

LF Gen 2 Shape

Source Internal, LFGen2 only

Selects the shape of the second LF generator signal. In case of selection Trapeze, additional settings concerning the duration of the single trapeze elements can be made (see Chapter 5.5.3.1, "LF Output Dialog", on page 329).

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe` on page 577

FM Sensitivity
Displays the input sensitivity of the externally applied modulation signal at the FM/PM EXT input in Hz/V.

The modulation deviation entered with FM Deviation is achieved 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.

Remote command:
`[:SOURce<hw>]:FM:SENSitivity?` on page 538

Adjust FM Offset
Starts the adjustment for the FM/PhiM modulator. The option is adjusted with respect to DC-offset.

Remote command:
`:CALibration<hw>:FMOFfset[:MEASure]?` on page 399

FM External Coupling
(Source External only)

Selects the coupling mode (AC or DC) for the externally applied frequence modulation signal.

Note: Coupling for external feed via input FM/PM EXT can be set independently for all modulations using the external modulation signal.

"AC"	Disconnects the DC voltage component and uses only the AC component of the modulation signal.
"DC"	Uses the modulation signal with both components, AC and DC.

Remote command:
`[:SOURce<hw>]:FM:EXTernal:COUPling` on page 536

Ext. Impedance
(Source External only)

Sets the impedance for an externally applied modulation signal. Use the AM EXT connector for amplitude modulation signals, and the FM/PM EXT frequency of phase modulation signals.

You can select 50 Ohm or high (>100 kOhm).

This setting affects all analog modulations which use the external modulation signal.

Remote command:
`[:SOURce<hw>]:INPut:MODext:IMPedance` on page 565

Binary Format
Source External only

Selects the binary format for external digital frequency modulation (see Table 5-2). The data is input via the AUX I/O interface.

NOTICE! Risk of instrument damage!. The maximum possible input voltage is 3.3 V DC.

Table 5-2: Binary data formats

Scale	Example for set frequency deviation = 10 MHz	Offset Binary	Two's Complement
+ full scale	10 MHz	1111….1111	0111….1111
+0.75 full scale	7.5 MHz	1110….0000	0110….0000
+0.5 full scale	5 MHz	1100….0000	0100….0000
+0.25 full scale	2.5 MHz	1010….0000	0010….0000
0	0 MHz	1000….0000	0000….0000
-0.25 full scale	-2.5 MHz	0110….0000	1110….0000
-0.5 full scale	- 5 MHz	0100….0000	1100….0000
- 0.75full scale	-7.5 MHz	0010….0000	1010….0000
- full scale + 1LSB	- 9.999695 MHz	0000….0001	1000….0001
- full scale	- 10 MHz	0000….0000	1000….0000

Table 5-3: Pin connection for input of digital FM data via AUX I/O connector

Connection	Parallel data input with 16-bit word width for digital FM modulation data.
11 - FM_DAT	FM_DATA 15 (MSB)
12 - FM_DAT	FM_DATA 14
13 - FM_DAT	FM_DATA 13
14 - FM_DAT	FM_DATA 12
15 - FM_DAT	FM_DATA 11
16 - FM_DAT	FM_DATA 10
17 - FM_DAT	FM_DATA 9
18 - FM_DAT	FM_DATA 8
19 - FM_DAT	FM_DATA 7
20 - FM_DAT	FM_DATA 6
21 - FM_DAT	FM_DATA 5
22 - FM_DAT	FM_DATA 4
23 - FM_DAT	FM_DATA 3
24 - FM_DAT	FM_DATA 2
25 - FM_DAT	FM_DATA 1
26 - FM_DAT	FM_DATA 0 (LSB)

"Offset Binary" Offset Binary code is selected. This code represents analog values between full scale and minus full scale.

"Two's Complement"
Two's Complement code is selected.

Remote command:
`[:SOURce<hw>]:FM:EXTernal:DIGital:BFORmat` on page 537

5.4.3.2 Noise Settings

In case of internal modulation source, the settings for the noise source are offered in the "Noise" section. This setting affects all analog modulations which use the noise generator as the internal modulation source. The settings are described in Chapter 5.5.3.2, "Noise Settings", on page 332.

5.4.4 Phase Modulation (PhiM)

Phase modulation requires option R&S SMA-B20 (FM/ϕM Modulator) or option R&S SMA-B22 (Enhanced Noise Performance and FM/ϕM Modulator).

It is not possible to use analog phase modulation simultaneously with digital phase modulation or with analog or digital frequency modulation.

See "Simultaneous Operation of Several Modulations or Other Operating Modes" on page 247 for an overview in detail.

An internal and/or external source can be selected for phase modulation. Two LF modulation generators and a noise source are available as internal sources in a fully equipped instrument.

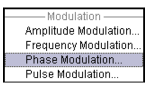
The FM/PM EXT input connector for external feed of analog modulation signals is at the front of the instrument. The coupling mode of the input (AC or DC) and the input impedance (50 Ohm or high) can be selected.

The digital PM signal is fed in via the AUX I/O interface.

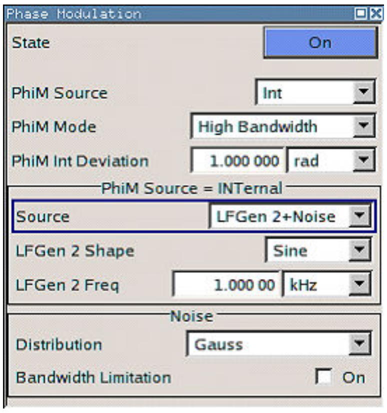
Selection between the following modulation modes is possible:

- "High Bandwidth" mode with full setting range for modulation bandwidth and limited ϕM deviation.
- "High Deviation" mode with full setting range for ϕM deviation and a reduced setting range for modulation bandwidth. Phase noise is reduced in the lower modulation frequency range compared to the default mode.
- "Low Noise" mode with better signal/noise ratio, but reduced setting range for modulation bandwidth and deviation (see data sheet)

5.4.4.1 Phase Modulation Dialog



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



In the upper section of the dialog, 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 dialog (internal source only).

These settings affect all modulations which use the same modulation sources.

For a fully equipped instrument, two LF generators and a noise generator are available as internal sources.

State

Activates ϕM modulation.

Activation of ϕM deactivates frequency modulation.

Remote command:
[:SOURce<hw>]:PM:STATe on page 607

ϕM Source

Selects the source for the ϕM signal.

For a fully equipped instrument, two LF generators and a noise generator are available as internal sources.

"Internal" Uses the internal LF generator as the modulation signal source for ϕM.

"External" Uses an externally applied modulation signal.
The external signal is input via the FM/PM EXT connector.

"Internal + External"
Uses both, the internal and externally applied modulation signal.

"Ext digital" Uses an externally applied digital modulation signal. The external signal is input via the AUX I/O connector.

Remote command:
[:SOURce<hw>]:PM:SOURce on page 606

ϕM Mode

Selects the mode for the phase modulation.

"High Bandwidth"
The maximum range for modulation bandwidth is available. However, phase noise is increased for low modulation frequencies. The range for ϕM deviation is limited.
This mode is recommended for high modulation frequencies.

"High Deviation"
The maximum range for ϕM deviation is available. Phase noise is improved for low frequencies compared to the default mode. The range of modulation frequency is limited (see data sheet).
This mode is recommended for low modulation frequencies and/or high ϕM deviation.

"Low Noise" (with option R&S SMA-B22 only)
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).
If your instrument is equipped with the SynEx Assembly (part number 1413.1800.02), you can reduce the phase noise even more by setting the PLL bandwidth to "Narrow". See "Main Pll Bandwidth" on page 143 and Chapter 5.3.2.7, "The Configurable Main PLL Bandwidth", on page 144 for details.

Remote command:
`[:SOURce<hw>]:PM:MODE` on page 605

ϕM Deviation

Sets the modulation deviation in RAD.

The maximum deviation depends on the set RF frequency and the selected modulation mode (see data sheet).

If the entered deviation is too high for the set RF frequency, the instrument provides the maximum value and displays an error message. The same applies, if the RF frequency is set to a value, at which the deviation cannot be determined.

The deviation of the internal source must not exceed the deviation of the external source in case of modulation source "Int+Ext".

Remote command:
`[:SOURce<hw>]:PM[:DEViation]` on page 603
`[:SOURce<hw>]:PM:EXTernal:DEViation` on page 604

Internal Source

Selects the internal signal source to be used for phase modulation. The available LF generators provided in the list depend on the installed options.

"None" Deactivates all internal modulation sources.

"LFGen1 / LFGen2"
Uses a signal generated by one of the internal LF generators as modulation signal.

"LFGen1+2" Uses the signals of both internal LF generators for phase modulation. You can set the LF frequency and modulation deviation separately for each generator. The sum of the deviations of the two modulation generators must not exceed the total value set with ϕM Deviation.

"Noise" Uses the noise signal for phase modulation, that is white noise either with Gaussian distribution or equal distribution.
This setting affects all analog modulations which use the noise generator as the internal modulation source.
See also Chapter 5.5.3.2, "Noise Settings", on page 332.

"LFGen1+Noise / LFGen2+Noise"
Uses a signal generated by an internal LF generator and overlaid with white noise for phase modulation.

Remote command:
`[:SOURce<hw>]:PM:INTernal:SOURce` on page 605

Deviation 1/Deviation 2
Source Internal, LFGen1+2 only

Selects the deviation for the two frequency modulation signals. The sum of the two values must not exceed the overall modulation deviation set in the upper part of the menu.

Remote command:
`[:SOURce<hw>]:PM:INTernal<ch>:DEViation` on page 604

LF Gen 1/2 Freq
Source Internal, LFGen1+2 only

Sets the frequency of the two LF generators.

Remote command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 567

LF Gen 2 Shape
Source Internal, LFGen2 only

Selects the shape of the second LF generator signal. In case of selection Trapeze, additional settings concerning the duration of the single trapeze elements can be made (see Chapter 5.5.3.1, "LF Output Dialog", on page 329).

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe` on page 577

ϕM Sensitivity
Displays the input sensitivity of the externally applied modulation signal at the FM/PM EXT input in RAD/V.

The modulation deviation entered with ϕM Deviation"ϕM Deviation" is achieved with 1 Volt (=U_{peak}) of the input signal.

Note: The input voltage must not exceed 1.1 V_p otherwise modulation distortions occur.

Remote command:
`[:SOURce<hw>]:PM:SENSitivity?` on page 606

PhiM Ext Coupling
Selects the coupling mode ("AC" or "DC") for the external modulation signal.

Note: Coupling for external feed via input FM/PM EXT can be set independently for all modulations using the external modulation signal.

"AC" Disconnects the DC voltage component and uses only the AC component of the modulation signal.

"DC" Uses the modulation signal with both components, AC and DC.

Remote command:
`[:SOURce<hw>]:PM:EXTernal:COUPling` on page 603

Ext. Impedance
(Source External only)

Sets the impedance for an externally applied modulation signal. Use the AM EXT connector for amplitude modulation signals, and the FM/PM EXT frequency of phase modulation signals.

You can select 50 Ohm or high (>100 kOhm).

This setting affects all analog modulations which use the external modulation signal.

Remote command:
`[:SOURce<hw>]:INPut:MODext:IMPedance` on page 565

Ext ϕM Binary Format
Source External only

Selects the binary format for external digital frequency modulation (see Table 5-4). The data is input via the AUX I/O interface.

NOTICE! Risk of instrument damage. The maximum input voltage is 3.3 V dc.

Table 5-4: Binary data formats

Scale	Example for set phase deviation = 120 DEG	Offset Binary	Two's Complement
+ full scale	120 DEG	1111….1111	0111….1111
+0.75 full scale	90 DEG	1110….0000	0110….0000
+0.5 full scale	60 DEG	1100….0000	0100….0000
+0.25 full scale	30 DEG	1010….0000	0010….0000
+ 0	0 DEG	1000….0000	0000….0000
-0.25 full scale	-30 DEG	0110….0000	1110….0000
-0.5 full scale	- 60 DEG	0100….0000	1100….0000
- 0.75full scale	- 90 DEG	0010….0000	1010….0000
- full scale + 1LSB		0000….0001	1000….0001
- full scale	- 120 DEG	0000….0000	1000….0000

Table 5-5: Pin connection for input of digital PM data via AUX I/O connector

Connection	Parallel data input with 16-bit word width for digital PM modulation data.
11 - FM_DAT	FM_DATA 15 (MSB)
12 - FM_DAT	FM_DATA 14

Connection	Parallel data input with 16-bit word width for digital PM modulation data.
13 - FM_DAT	FM_DATA 13
14 - FM_DAT	FM_DATA 12
15 - FM_DAT	FM_DATA 11
16 - FM_DAT	FM_DATA 10
17 - FM_DAT	FM_DATA 9
18 - FM_DAT	FM_DATA 8
19 - FM_DAT	FM_DATA 7
20 - FM_DAT	FM_DATA 6
21 - FM_DAT	FM_DATA 5
22 - FM_DAT	FM_DATA 4
23 - FM_DAT	FM_DATA 3
24 - FM_DAT	FM_DATA 2
25 - FM_DAT	FM_DATA 1
26 - FM_DAT	FM_DATA 0 (LSB)

5.4.4.2 Noise Settings

In case of internal modulation source, the settings for the noise source are offered in the "Noise" section. This setting affects all analog modulations which use the noise generator as the internal modulation source. The settings are described in Chapter 5.5.3.2, "Noise Settings", on page 332.

5.4.5 Pulse Modulation (PM)

Pulse modulation is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) without additional equipment options.

A standard pulse generator is available for internal modulation. Internal Pulse Modulation with extended features, for example generation of double pulse, requires option R&S SMA-K23, Pulse Generator. Option R&S SMA-K27, Pulse Train, enables generation of pulse trains.

As modulation signal, you can either use the signal of the internal pulse generator or an externally supplied signal. 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 R&S SMA deactivates ALC automatically ("ALC OFF", i.e. switches to "Sample & Hold" state).

The "Sample&Hold" state opens the ALC loop, and disables the automatic control of the output level. The level modulator is set directly.

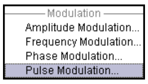
However, to correct the output level, the R&S SMA executes a "Sample & Hold" measurement after each change of frequency or level settings.

The nominal level is ON for typically 3 ms to 5 ms after level or frequency setting, if:

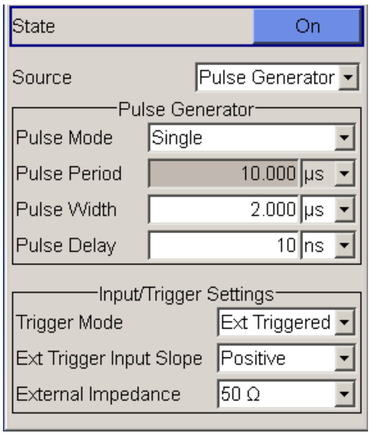
- No attenuator is fitted (frequency option R&S SMA-B103L/B106L)
- "High Power" mode is enabled
- "Auto" mode is enabled, and if the level is in the range of the high power, i.e. the mechanical relay bypass is switched.

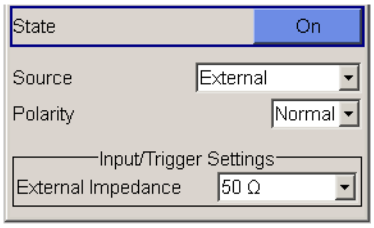
The level is decreased by 30 dB during "Sample & Hold" measurement.

5.4.5.1 Pulse Modulation Settings



► To access the "Pulse Modulation" settings, select "Modulation > config... > Pulse Modulation".





The dialog contains all parameters for configuring a pulse modulation signal, comprising the signal source, pulse generator and trigger settings.

Depending on the selected modulation source, the provided parameters vary:

- "Source Pulse Generator"
  Displays the parameters for configuring the pulse generator signal, which in turn vary according to the selected "Mode > Single / Double ...".
  Note: Extended features as the generation of double pulse signals or selectable trigger mode require option R&S SMA-K23.
- "External"
  Enables you to configure the polarity of an externally supplied pulse modulation signal.

Note: The pulse generator settings in this dialog are mirrored from the actual "Pulse Generator" dialog of the "Mod Gen" block. Therefore find the description on the access and the corresponding parameters under in Chapter 5.5.4.1, "Pulse Generator Settings", on page 333.

Option R&S SMA-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 339.

State

Activates pulse modulation.

Activation of pulse modulation deactivates ALC and power ramping.

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 333).

Remote command:
`[:SOURce<hw>]:PULM:STATe` on page 624

Source

Selects the modulation signal source for pulse modulation.

"Pulse Generator"

Uses the pulse generator as modulation signal source.
The settings for the pulse characteristics and the trigger are offered in the "Pulse Generator" section of the "Pulse Modulation" menu.
The internal pulse generator signal is provided at the PULSE VIDEO output, the sync signal at the PULSE SYNC output.

- Without option R&S SMA-K23:
  The internally generated rectangular signal is used for the pulse modulation. The frequency of the internal signal can be set in the LF Output menu.
- With option R&S SMA-K23:
  If option R&S SMA-K23 is installed, the characteristics of the generated pulse can be set in a wide range, and double pulse generation is possible. The settings are made in the "Pulse Generator" section of the menu.

"External" Uses an externally applied modulation signal.
The external modulation signal is input via the PULSE EXT connector.
The external modulation is provided at the PULSE VIDEO output.

Remote command:
`[:SOURce<hw>]:PULM:SOURce` on page 623

Polarity

(External Source only)

Selects the polarity of the modulation signal.

"Normal" The RF signal is **On** while the level is high at the modulation input.

"Inverted" The RF signal is **Off** while the level is high at the modulation input.

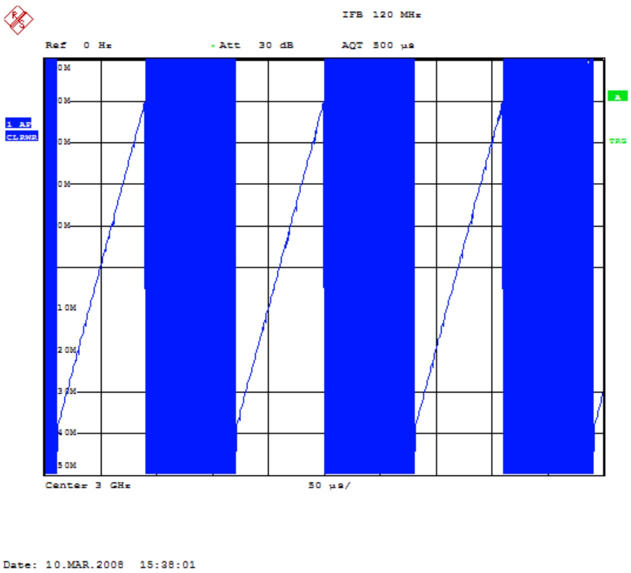
Remote command:
[:SOURce<hw>]:PULM:POLarity on page 623

5.4.6 Chirp Modulation

Chirp modulation is used in radar technique to achieve pulse compression. Pulse compression increases the sensitivity and resolution of radar systems by modifying transmitted pulses to improve their auto-correlation properties. To chirp the radar signal is one way of accomplishing pulse compression. A chirp is a signal with increasing or decreasing frequency over time.

The R&S SMA always couples the chirp modulation with the pulse modulation. It generates the modulation signals for FM and pulse modulator, and synchronizes the signals internally. The internal pulse generator signal is the modulation source for the pulse modulator, and the internal LF generator signal is the signal source for the frequency modulation. Normal FM mode is used. Using external modulation signals is not possible for chirp modulation.

The following graph shows the FM demodulated signal of chirped pulses with a chirp bandwidth of 80 MHz and a pulse width of 80 µs. Chirp direction is up.



Chirp modulation is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-B20 or B22 and interface board with part number 1400.0530.02 or 1400.0552.02.

Chirp Modulation with extended ranges for resolution, pulse width and period require option R&S SMA-K23, Pulse Generator.

The PULSE EXT connector at the rear of the instrument can be used as external trigger or gate signal input.

The polarity and input impedance of the connector can be selected.

The pulse signal is output at the PULSE VIDEO connector at the rear of the instrument, the sync signal at the PULSE SYNC output.

The FM modulation signal can be output at the LF connector.

All other analog modulations are deactivated during chirp modulation

When chirp modulation is activated, any active analog modulation is automatically switched off.

Automatic Level Control (ALC) is deactivated with chirp modulation

When pulse modulation is activated, the R&S SMA deactivates ALC automatically ("ALC OFF", i.e. switches to "Sample & Hold" state).

The "Sample&Hold" state opens the ALC loop, and disables the automatic control of the output level. The level modulator is set directly.

However, to correct the output level, the R&S SMA executes a "Sample & Hold" measurement after each change of frequency or level settings.

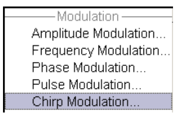
The nominal level is ON for typically 3 ms to 5 ms after level or frequency setting, if:

- No attenuator is fitted (frequency option R&S SMA-B103L/B106L)
- "High Power" mode is enabled
- "Auto" mode is enabled, and if the level is in the range of the high power, i.e. the mechanical relay bypass is switched.

The level is decreased by 30 dB during "Sample & Hold" measurement.

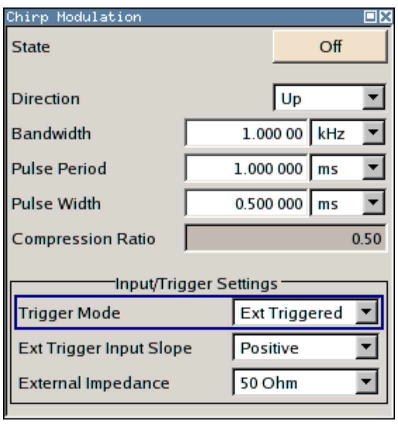
The Sample&Hold measurement for the ALC is performed at the chirp center frequency. Therefore, the frequency response of the RF path can result in level errors for the FM modulated carrier especially with high chirp bandwidths.

5.4.6.1 Chirp Modulation Settings



Access:

► Select "Modulation > config... > Chirp Modulation".



The "Chirp Modulation" dialog contains the parameters for configuring the modulation and trigger settings.

State - Chirp Modulation
Activates/deactivates chirp modulation

Note: Any active modulation is automatically switched off when chirp modulation is activated.

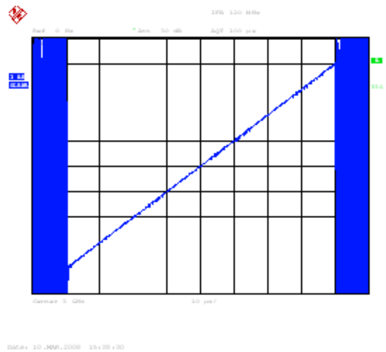
The pulse generator signal is provided at the PULSE VIDEO output, the sync signal at the PULSE SYNC output.

These outputs are automatically switched on/off according to the chirp modulation state. The FM modulation signal can be output at the LF connector.

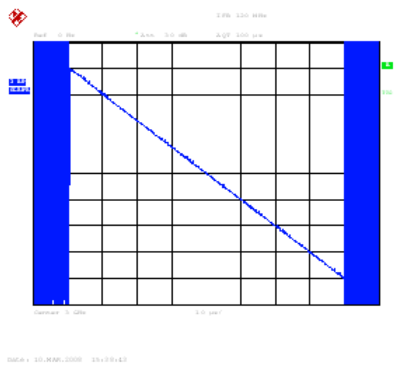
Remote command:
`[:SOURce<hw>]:CHIRp:STATe` on page 498

Direction - Chirp Modulation
Selects the direction of the chirp modulation.

"Up" The chirp starts with the lower frequency.



"Down" The chirp starts with the higher frequency.



Remote command:
`[:SOURce<hw>]:CHIRp:DIRection` on page 497

Bandwidth - Chirp Modulation
Sets the modulation bandwidth in Hz.

The bandwidth denotes the difference between the maximum and minimum frequency. E.g. a bandwidth of 10 MHz at a center frequency of 1 GHz leads to a frequency modulation between 995 MHz and 1005 MHz.

The maximum bandwidth depends on the current RF frequency (see data sheet) . If the bandwidth is too high for the RF frequency, or the frequency is out of the bandwidth range, the R&S SMA sets the maximum bandwidth and generates an error message

Remote command:
`[:SOURce<hw>]:CHIRp:BANDwidth` on page 497

Pulse Period - Chirp Modulation
Sets the period of the generated chirp. Option R&S SMA-K23 provides a resolution of 20 ns.

Remote command:
`[:SOURce<hw>]:CHIRp:PULSe:PERiod` on page 498

Pulse Width - Chirp Modulation
Sets the width of the generated chirp. The pulse width must be at least 1 us less than the set pulse period. Option R&S SMA-K23 provides a resolution of 20 ns.

Remote command:
`[:SOURce<hw>]:CHIRp:PULSe:WIDTh` on page 498

Compression Ratio - Chirp Modulation
Indicates the pulse compression ratio, i.e. the product of the pulse width in (s) and the bandwidth (Hz). Pulse compression increases the range resolution as well as the signal to noise ratio of pulsed signals.

Remote command:
`[:SOURce<hw>]:CHIRp:COMPression:RATio?` on page 497

Trigger Mode - Chirp Modulation
Selects the trigger mode for chirp modulation signals.

Note: An external trigger signal is supplied via the PULSE EXT connector.

"Auto" The chirp modulation signals are generated continuously.

"Ext Triggered"
The chirp modulation signals are triggered by an external trigger event.

"Ext Gated" The chirp modulation signals are gated by an external gate signal.

Remote command:
`[:SOURce<hw>]:CHIRp:TRIGger:MODE` on page 500

External Trigger Input Slope - Chirp Modulation
("Ext. Triggered" only)

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

Note: An external trigger signal is supplied via the PULSE EXT connector.

"Positive" The chirp modulation signals are triggered on the positive slope of the external trigger signal.

"Negative"	The chirp modulation signals are triggered on the negative slope of the external trigger signal.

Remote command:
[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:SLOPe on page 499

Gate Input Polarity - Chirp Modulation
(External Gate only).

Selects the polarity of the Gate signal.

Note: An external gate signal is supplied via the PULSE EXT connector.

"Normal"	The chirp modulation signals are generated while the gate signal is high.
"Inverse"	The chirp modulation signals are generated while the gate signal is low.

Remote command:
[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:GATE:POLarity on page 499

External Impedance - Chirp Modulation
(External trigger or gate only)

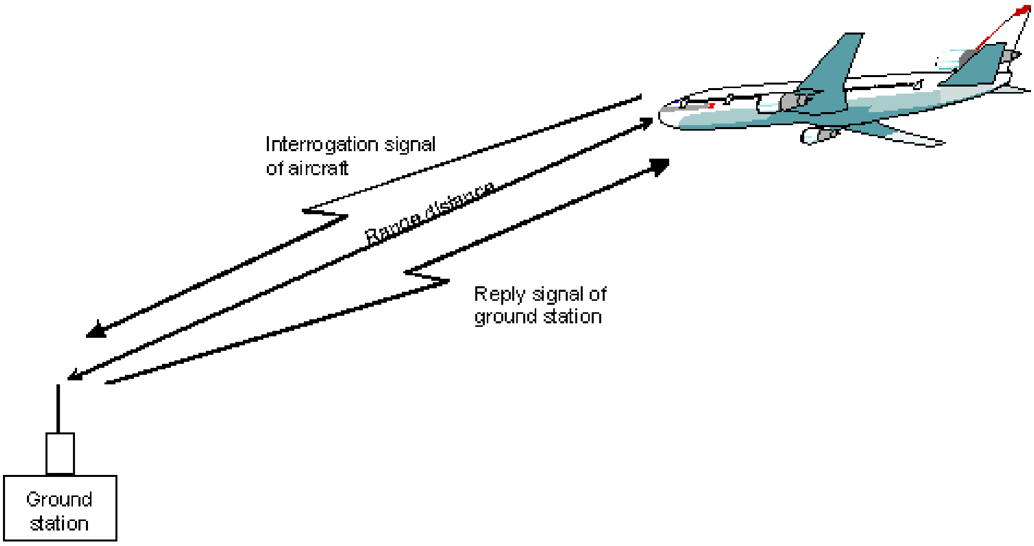
Selects the input impedance for the external trigger and gate signal input (10 kOhm or 50 Ohms).

Remote command:
[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:IMPedance on page 499

5.4.7 DME Modulation

Option R&S SMA-K26 enables DME modulation on the R&S SMA.

Distance Measurement Equipment (DME) is a radar system which determines the slant distance between the aircraft and the ground station. On the aircraft, the time is measured which the radio signal takes to travel from the aircraft to the ground station and back. The aircraft is equipped with an interrogator and the ground station with a transponder.



The DME channels are paired with the VOR frequencies, in the range between 1025 MHz to 1150 MHz for the interrogator, and 962 MHz and 1213 MHz for the transponder. The spacing for all channels is 1 MHz. X and Y channels differ in the spacing between the two pulses of the pulse pair and in the delay for the reply pulse.

The interrogator transmits a stream of pulse pairs with fixed duration and spacing. The ground-based transponder receives the pulse train and retransmits them after a defined delay on a frequency which is +/-63 MHz from the interrogation frequency. The airborne interrogator identifies its own stream of pulses and measures the time between the start of interrogation and response from the ground transponder to evaluate the slant distance. The distance is given in nautic miles (nm). 1 nm is 1852.01 meters and corresponds to a run time of 12.359 µs.

Two different modes are offered for the DME test signal:

- DME interrogation
  Pulse stream from the interrogator, X or Y channel (simulation of aircraft interrogator)
- DME reply
  Reply pulses from the transponder + optional ID signal, X or Y channel (simulation of ground station)

In addition, a single test pulse can be generated.

The following graph shows the timing of the pulse pairs (slant range distance = 0 nm).

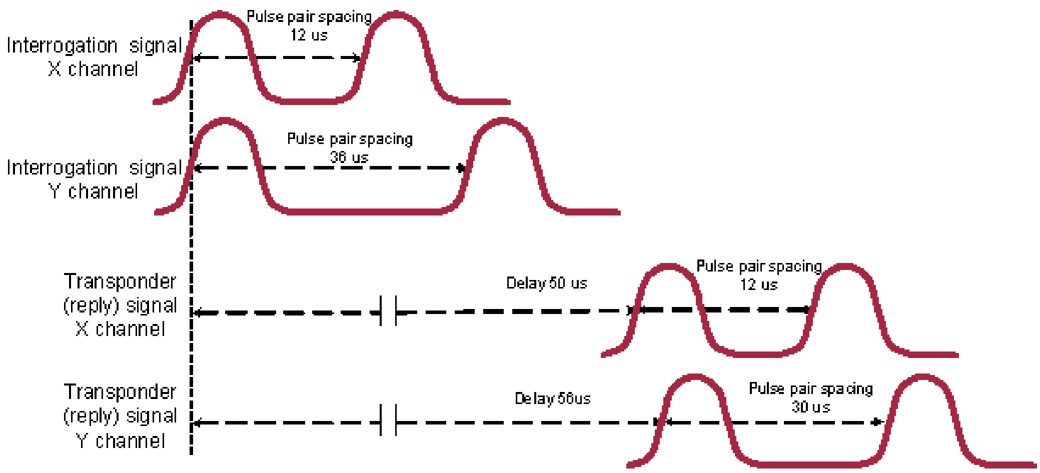
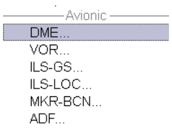


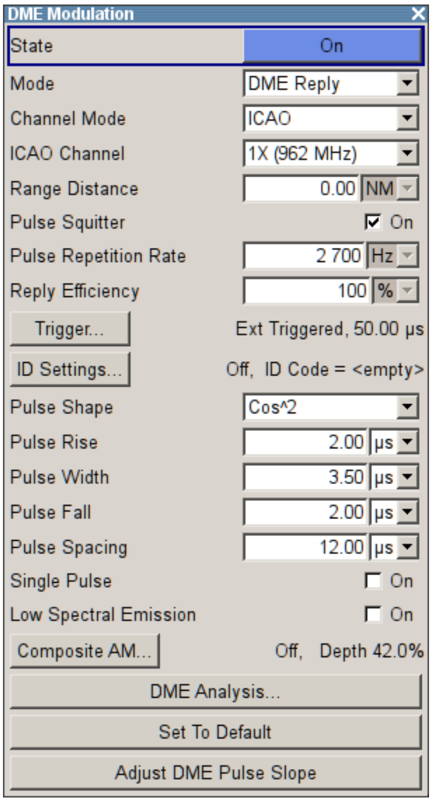
Figure 5-12: Timing of the pulse pairs (slant range distance = 0 nm)

5.4.7.1 DME Modulation Settings



Access:

► Select "Modulation > config... > DME".



The "DME Modulation" dialog contains the channel, pulse pair and trigger parameters, and the parameters for setting the modulation. To measure the "Reply response", use an R&S NRP-Z81 Wideband Power Sensor.

The remote commands required to define the DME modulation settings are described in Chapter 7.14.5, "SOURce:DME Subsystem", on page 509.

State - DME Modulation

Activates the DME modulation

Note: Modulations PULSE, VOR, ILS-GS, ILS-LOC, MKR-BCN, ADF, AM, and internal FM/PhiM are automatically switched off when DME modulation is activated. Also, the pulse generator is automatically deactivated.

The DME modulation signal can be output at the LF connector.

Remote command:
`[:SOURce]:DME:STATe` on page 530

Mode - DME Modulation

Selects the DME modulation mode. The mode determines the signal type that is simulated. The exact timing of the signal for each mode is determined by the selected channel (X or Y, see below).

The timing and shape of the pulses can be freely selected. By default these values are set according to the standard.

"DME Interrogation CH X/Y"

The interrogation signal of the airborne transmitter is simulated.
The following graph shows the interrogation signal of channel X.

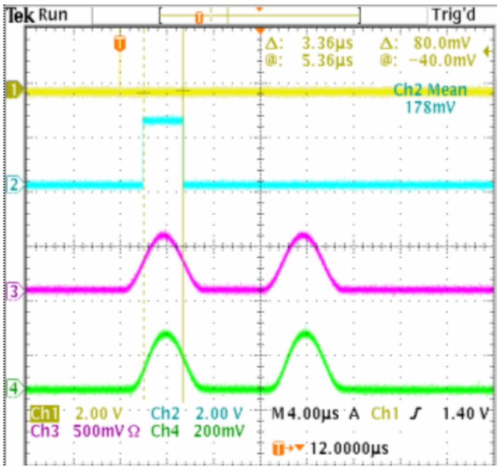


Figure 5-13: DME interrogation CH X (Trigger = Auto)

1 = SYNC signal (pulse width 50 ns)
2 = VIDEO signal (active with 50 % pulse width of first DME pulse)
3 = LF Output signal (DME modulation signal)
4 = RF Output signal (measured with external detector)

"DME Reply CH X/Y"

The reply signal of the ground-based transponder is simulated. The trigger is automatically set to external and the default trigger delay either to 50 µs (channel X) or 56 µs (channel Y) depending on the selected channel. The trigger signal is input via the PULSE EXT connector.

The interval between the pulse pairs can be set to a fixed value (repetition rate) or to random generation (pulse squitter).

The following graph shows the reply signal of channel X (Trigger = External). In case of a trigger event, the reply pulse pair is generated after the set trigger delay.

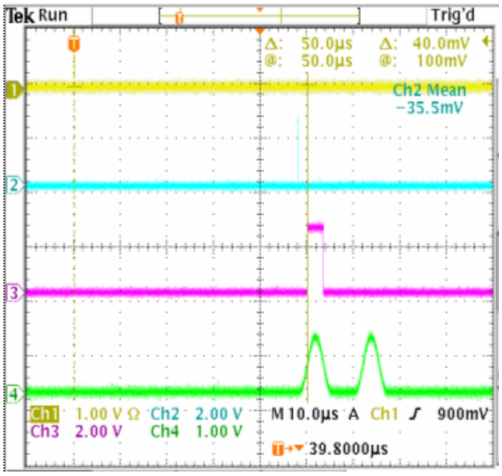


Figure 5-14: DME reply CH X (Trigger = External)

1 = external TRIGGER signal (T: pulse width 50 ns)
2 = SYNC signal (pulse width 50 ns)
3 = VIDEO signal with a delay of 50 µs between external trigger and video signal (= range distance of 0 nm) (active with 50 % pulse width of first DME pulse)
4 = LF Output signal (DME modulation signal)

Remote command:
[:SOURce]:DME:MODE on page 526

Channel Mode - DME Modulation

Selects the channel that is simulated.

Standard compliant X and Y channels differ in the spacing between the two pulses of the pulse pair and the delay of the ground station (see table below). ICAO indicates the ICAO channel parameter below for selecting the ICAO channel.

Channel	Pulse spacing interrogation mode	Pulse spacing reply mode	Reply delay 1st pulse	Reply delay 2nd pulse
X	12 us	12 us	50 us	50 us
Y	36 us	30 us	56 us	50 us

Remote command:
[:SOURce]:DME:CSUFfix on page 517

ICAO Channel - DME Modulation
Selects the ICAO channel, i.e., the DME transmitting frequency. The RF frequency is set to the value selected here.

The individual values in the table are:
- Ch. No. = ICAO channel number
- VOR freq. = VOR interrogation frequency (MHz)
- DME interrog. freq. = DME interrogation frequency (MHz)
- DME reply freq. = DME reply frequency (MHz)

Table 5-6: Standardized DME transmitting frequencies (MHz) and the associated ICAO channels for interrogation and reply

Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.	Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.	Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.
1X		1025	962	43X	110.60	1067	1004	85X	113.80	1109	1172
1Y		1025	1088	43Y	110.65	1067	1130	85Y	113.85	1109	1046
2X		1026	963	44X	110.70	1068	1005	86X	113.90	1110	1173
2Y		1026	1089	44Y	110.75	1068	1131	86Y	113.95	1110	1047
3X		1027	964	45X	110.80	1069	1106	87X	114.00	1111	1174
3Y		1027	1090	45Y	110.85	1069	1132	87Y	114.05	1111	1048
4X		1028	965	46X	110.90	1070	1007	88X	114.10	1112	1175
4Y		1028	1091	46Y	110.95	1070	1133	88Y	114.15	1112	1049
5X		1029	966	47X	111.00	1071	1008	89X	114.20	1113	1176
5Y		1029	1092	47Y	111.05	1071	1134	89Y	114.25	1113	1050
6X		1030	967	48X	111.10	1072	1009	90X	114.30	1114	1177
6Y		1030	1093	48Y	111.15	1072	1135	90Y	114.35	1114	1051
7X		1031	968	49X	111.20	1073	1010	91X	114.40	1115	1178
7Y		1031	1094	49Y	111.25	1073	1136	91Y	114.45	1115	1052
8X		1032	969	50X	111.30	1074	1011	92X	114.50	1116	1179
8Y		1032	1095	50Y	111.35	1074	1137	92Y	114.55	1116	1053
9X		1033	970	51X	111.40	1075	1012	93X	114.60	1117	1180
9Y		1033	1096	51Y	111.45	1075	1138	93Y	114.65	1117	1054
10X		1034	971	52X	111.50	1076	1013	94X	114.70	1118	1181
10Y		1034	1097	52Y	111.55	1076	1139	94Y	114.75	1118	1055
11X		1035	972	53X	111.60	1077	1014	95X	114.80	1119	1182
11Y		1035	1098	53Y	111.65	1077	1140	95Y	114.85	1119	1056
12X		1036	973	54X	111.70	1078	1015	96X	114.90	1120	1183
12Y		1036	1099	54Y	111.75	1078	1141	96Y	114.95	1120	1057
13X		1037	974	55X	111.80	1079	1016	97X	115.00	1121	1184
13Y		1037	1100	55Y	111.85	1079	1142	97Y	115.05	1121	1058
14X		1038	975	56X	111.90	1080	1017	98X	115.10	1122	1185
14Y		1038	1101	56Y	111.95	1080	1143	98Y	115.15	1122	1059

Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.	Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.	Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.
15X		1039	976	57X	112.00	1081	1018	99X	115.20	1123	1186
15Y		1039	1102	57Y	112.05	1081	1144	99Y	115.25	1123	1060
16X		1040	977	58X	112.10	1082	1019	100X	115.30	1124	1187
16Y		1040	1103	58Y	112.15	1082	1145	100Y	115.35	1124	1061
17X	108.00	1041	978	59X	112.20	1083	1020	101X	115.40	1125	1188
17Y	108.05	1041	1104	59Y	112.25	1083	1146	101Y	115.45	1125	1062
18X	108.10	1042	979	60X		1084	1021	102X	115.50	1126	1189
18Y	108.15	1042	1105	60Y		1084	1147	102Y	115.55	1126	1063
19X	108.20	1043	980	61X		1085	1022	103X	115.60	1127	1190
19Y	108.25	1043	1106	61Y		1085	1148	103Y	115.65	1127	1064
20X	108.30	1044	981	62X		1086	1023	104X	115.70	1128	1191
20Y	108.35	1044	1107	62Y		1086	1149	104Y	115.75	1128	1065
21X	108.40	1045	982	63X		1087	1024	105X	115.80	1129	1192
21Y	108.45	1045	1108	63Y		1087	1150	105Y	115.85	1129	1066
22X	108.50	1046	983	64X		1088	1151	106X	115.90	1130	1193
22Y	108.55	1046	1109	64Y		1088	1025	106Y	115.95	1130	1067
23X	108.60	1047	984	65X		1089	1152	107X	116.00	1131	1194
23Y	108.65	1047	1110	65Y		1089	1026	107Y	116.05	1131	1068
24X	108.70	1048	985	66X		1090	1153	108X	116.10	1132	1195
24Y	108.75	1048	1111	66Y		1090	1027	108Y	116.15	1132	1069
25X	108.80	1049	986	67X		1091	1154	109X	116.20	1133	1196
25Y	108.85	1049	1112	67Y		1091	1028	109Y	116.25	1133	1070
26X	108.90	1050	987	68X		1092	1155	110X	116.30	1134	1197
26Y	108.95	1050	1113	68Y		1092	1029	110Y	116.35	1134	1071
27X	109.00	1051	988	69X		1093	1156	111X	116.40	1135	1198
27Y	109.05	1051	1114	69Y		1093	1030	111Y	116.45	1135	1072
28X	109.10	1052	989	70X	112.30	1094	1157	112X	116.50	1136	1199
28Y	109.15	1052	1115	70Y	112.35	1094	1031	112Y	116.55	1136	1073
29X	109.20	1053	990	71X	112.40	1095	1158	113X	116.60	1137	1200
29Y	109.25	1053	1116	71Y	112.45	1095	1032	113Y	116.65	1137	1074
30X	109.30	1054	991	72X	112.50	1096	1159	114X	116.70	1138	1201
30Y	109.35	1054	1117	72Y	112.55	1096	1033	114Y	116.75	1138	1075
31X	109.40	1055	992	73X	112.60	1097	1160	115X	116.80	1139	1202
31Y	109.45	1055	1118	73Y	112.65	1097	1034	115Y	116.85	1139	1076
32X	109.50	1056	993	74X	112.70	1098	1161	116X	116.90	1140	1203
32Y	109.55	1056	1119	74Y	112.75	1098	1035	116Y	116.95	1140	1077

Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.	Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.	Ch. No.	VOR freq.	DME interrog. freq.	DME reply freq.
33X	109.60	1057	994	75X	112.80	1099	1162	117X	117.00	1141	1204
33Y	109.65	1057	1120	75Y	112.85	1099	1036	117Y	117.05	1141	1078
34X	109.70	1058	995	76X	112.90	1100	1163	118X	117.10	1142	1205
34Y	109.75	1058	1121	76Y	112.95	1100	1037	118Y	117.15	1142	1079
35X	109.80	1059	996	77X	113.00	1101	1164	119X	117.20	1143	1206
35Y	109.85	1059	1122	77Y	113.05	1101	1038	119Y	117.25	1143	1080
36X	109.90	1060	997	78X	113.10	1102	1165	120X	117.30	1144	1207
36Y	109.95	1060	1123	78Y	113.15	1102	1039	120Y	117.35	1144	1081
37X	110.00	1061	998	79X	113.20	1103	1166	121X	117.40	1145	1208
37Y	110.05	1061	1124	79Y	113.25	1103	1040	121Y	117.45	1145	1082
38X	110.10	1062	999	80X	113.30	1104	1167	122X	117.50	1146	1209
38Y	110.15	1062	1125	80Y	113.35	1104	1041	122Y	117.55	1146	1083
39X	110.20	1063	1000	81X	113.40	1105	1168	123X	117.60	1147	1210
39Y	110.25	1063	1126	81Y	113.45	1105	1042	123Y	117.65	1147	1084
40X	110.30	1064	1001	82X	113.50	1106	1169	124X	117.70	1148	1211
40Y	110.35	1064	1127	82Y	113.55	1106	1043	124Y	117.75	1148	1085
41X	110.40	1065	1002	83X	113.60	1107	1170	125X	117.80	1149	1212
41Y	110.45	1065	1128	83Y	113.65	1107	1044	125Y	117.85	1149	1086
42X	110.50	1066	1003	84X	113.70	1108	1171	126X	117.90	1150	1213
42Y	110.55	1066	1129	84Y	113.75	1108	1045	126Y	117.95	1150	1087

Remote command:
`[:SOURce]:DME:ICAO:CHANnel` on page 518

Range Distance - DME Modulation
("Reply Mode" only)

Sets the simulated distance between interrogator and transponder for reply mode. The distance is given in nautic miles (nm). 1 nm is 1852.01 meters and corresponds to a run time of 12.359 µs.

The range distance and the external trigger delay are interdependent according to:

"Range Distance" = ("Trigger Delay" – X/Y mode delay) / 12.359 µs/nm,

where:

X mode delay = 50 µs, Y mode delay = 56 µs

Changing one value automatically changes the other value.

Remote command:
`[:SOURce]:DME:RDIStance` on page 528

Pulse Squitter - DME Modulation
The average repetition rate is 2700 pp/s. The pulse spacing is distributed randomly in the range of 60 µs to about 1500 µs according to EUROCAE EN-54 6.2.12.

The squitter pulses are constantly sent by the ground station in order to ensure proper operation and in order to ease synchronization of the aircraft interrogator to the ground station.

Remote command:
`[:SOURce]:DME:SQUitter` on page 529

Pulse Repetition Rate - DME Modulation
- In "Interrogation mode"
  Sets the pulse repetition rate for trigger setting "Auto" or "Ext Gated".
- In "Reply Mode"
  Indicates the mean pulse repetition rate in squitter mode.

Remote command:
`[:SOURce]:DME:RATE` on page 527

Reply Efficiency - DME Modulation
("Reply Mode" only)

Sets the relation between reply pulse pairs and received trigger signals. E.g. with a set efficiency of 50 % only every second trigger event leads to the generation of a reply pulse pair.

Remote command:
`[:SOURce]:DME:EFFiciency` on page 520

Trigger - DME Modulation
Accesses the dialog for setting the trigger parameters (see Chapter 5.4.7.2, "Trigger Settings for DME", on page 278).

ID Settings - DME Modulation
("Reply Mode" only)

Accesses the dialog for setting the DME ID signal parameters (see Chapter 5.4.7.3, "ID Settings for DME Reply Mode", on page 281).

Pulse Shape - DME Modulation
Selects the pulse shape.

"Cos^2"	The falling and the rising edge of the pulse are cos^2 shaped.
"Cos Cos^2"	The rising edge is cos shaped and the falling edge is cos^2 shaped.
"Linear"	The falling and the rising edge of the pulse are shaped linear.

Remote command:
`[:SOURce]:DME:SHAPe` on page 528

Pulse Rise - DME Modulation
Sets the rise time of the pulse (10 % to 90 % of peak voltage).

Remote command:
`[:SOURce]:DME:RISE` on page 528

Pulse Width - DME Modulation
Sets the pulse width (50 % to 50 % of peak voltage).

Remote command:
[:SOURce]:DME:WIDTh on page 535

Pulse Fall - DME Modulation
Sets the fall time of the pulse (90 % to 10 % of peak voltage).

Remote command:
[:SOURce]:DME:FALL on page 520

Pulse Spacing - DME Modulation
Sets the spacing between the first and second pulse of a pulse pair. I.e. the time between half-voltage points on the leading edge of each pulse.

Remote command:
[:SOURce]:DME:PPS on page 526

Single Pulse - DME Modulation
Activates generation of a single test pulse.

Remote command:
[:SOURce]:DME:SINGle on page 529

Echo Pulse - DME Modulation
("Pulse Squitter > Off" only)

Activates an echo pulse pair. The echo pulses have the same shape and timing as the original pulses.

You can determine the delay and attenuation of the echo pulses, see Echo Delay, and Echo Attenuation - DME ModulationEcho Attenuation.

Remote command:
[:SOURce]:DME:ECHO on page 519

Echo Delay - DME Modulation
("Echo Pulse > On" only)

Sets the delay from the first original pulse to the first echo pulse.

Remote command:
[:SOURce]:DME:ECHO:DELay on page 519

Echo Attenuation - DME Modulation
("Echo Pulse > On" only)

Sets the attenuation of the echo pulses compared to the original pulses. A positive attenuation leads to echo pulses with reduced amplitude compared to the original pulses. A negative attenuation leads to echo pulses with increased amplitude compared to the original pulses.

Remote command:
[:SOURce]:DME:ECHO:ATTenuation on page 519

Low Spectral Emission - DME Modulation
Activates the generation of a DME signal with higher spectral purity but less dynamic compared to the default mode. The ON/OFF ratio of the pulses is reduced from >100 dB to 35 dB typically.

Remote command:
`[:SOURce]:DME:LOWemission` on page 526

Composite AM... - DME Modulation
("Reply Mode" only)

Accesses the dialog for defining the two-tone signals that can be additionally superimposed on the pulses (see Chapter 5.4.7.4, "DME Composite AM Settings", on page 284).

DME Analysis - DME Modulation
(Only if an R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector)

Accesses the dialog for setting the "DME Analysis" (see Chapter 5.4.7.5, "DME Analysis", on page 286).

Set To Default - DME Modulation
Sets a default DME signal (interrogation mode channel X).

Selects the default settings for the pulse parameters according to standard (EUROCAE ED57/ED54 and ICAO ANNEX 10 to the convention of international civil aviation).

This button does not impact the modulation state.

Remote command:
`[:SOURce]:DME:PRESet` on page 527

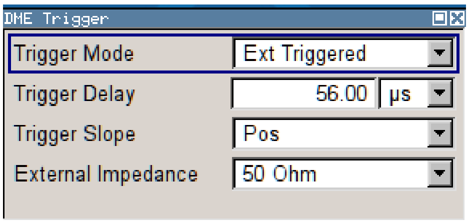
Adjust DME Pulse Slope
Activates internal adjustment of the DME pulse slope for best linearity.

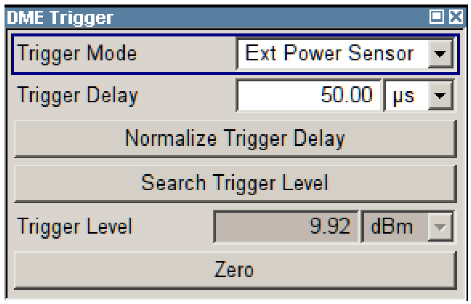
Remote command:
`:CALibration:DME[:MEASure]?` on page 399

5.4.7.2 Trigger Settings for DME

Access:

► Select "Modulation > config... > DME > Trigger".





The "DME Trigger" dialog contains the parameters for configuring the trigger mode. If a connected R&S NRP-Z81 power sensor triggers the setup, the R&S SMA provides additional parameters for synchronizing with the sensor.

Trigger Mode - DME Modulation

Selects the trigger mode for DME modulation signals. In "Reply Mode", you can only work with an external trigger signal.

"Auto" The DME modulation signals are generated continuously.

"Ext Triggered" The DME modulation signals are triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

"Ext Gated" The DME modulation signals are gated by an external gate signal. The signal is supplied via the PULSE EXT connector.

"Ext Power Sensor"
Sensor R&S NRP-Z81 provides the trigger signal.
An external DME interrogation signal is feed into a sensor. The 50 % voltage point of this signal is used by the power sensor to generate the trigger for the R&S SMA. The R&S SMA simulates the ground station ("Reply Mode") and sends the reply signal after the set trigger delay.

Remote command:
`[:SOURce]:DME:TRIGger` on page 532

Trigger Delay - DME Modulation

("Ext Triggered" and "Ext Power Sensor" only)

Sets the delay between the external trigger and the first DME output pulse (50 % voltage point of first pulse). In "DME Reply" mode, this parameter simulates the defined delay of the DME transponder and twice the run time of the signal (from interrogator to transponder and back). The delay is a measure of the range distance. Thus, the two values are interdependent according to:

Delay = X/Y mode delay + range distance * 12.359 nm/µs,

where:

X mode delay = 50 µs, Y mode delay = 56 µs

Changing one value automatically changes the other value.

Remote command:
`[:SOURce]:DME:TRIGger:DELay` on page 533

Trigger Slope - DME Modulation
("Ext" trigger only)

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

"Positive" The DME modulation signals are triggered on the positive slope of the external trigger signal.

"Negative" The DME modulation signals are triggered on the negative slope of the external trigger signal.

Remote command:
`[:SOURce]:DME:TRIGger:SLOPe` on page 534

Gate Input Polarity - DME Modulation
("Ext Gate" only)

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

"Normal" The DME modulation signal is generated while the gate signal is high.

"Inverse" The DME modulation signal is generated while the gate signal is low.

Remote command:
`[:SOURce]:DME:TRIGger:GPOLarity` on page 534

External Impedance - DME Modulation
("Ext Trigger" or "Ext Gate" only)

Selects the input impedance for the external trigger and gate signal input (10 kOhm or 50 Ohms).

Remote command:
`[:SOURce]:DME:TRIGger:IMPedance` on page 534

Normalize Trigger Delay - DME Modulation
("Ext Power Sensor" only)

Performs a normalization of the test setup. The function measures the delay due to the R&S NRP-Z81 sensor is and subsequently considers the value in the trigger delay.

For normalization, connect the sensor directly to the RF output of the R&S SMA. "Normalize Trigger Delay" determines the delay between RF input and trigger output of the sensor. This value is sensor specific and is stored on the R&S SMA. The value is valid as long as the same sensor is used.

Remote command:
`[:SOURce]:DME:TRIGger:DELay:NORMalize?` on page 533

Search Trigger Level - DME Modulation
("Ext Power Sensor" only)

Determines the trigger level = 50 % voltage point of first pulse of the external DME interrogation signal.

After connecting the R&S NRP-Z81 sensor to the external interrogation signal source, "Search Trigger Level" determines the trigger point.

Execute the search function at each change of the level of the external DME signal.

Remote command:
[:SOURce]:DME:ANALysis:TRIGger:SEARch? on page 517

Trigger Level - DME Modulation
("Ext Power Sensor" only)

Indicates the trigger level, e.g. 9.92 dBm for an external signal with a peak level of 15.94 dBm.

Remote command:
n.a.

Zero - Power Sensors
("Ext Power Sensor" only)

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. If a Rohde & Schwarz power sensor receives an input power during the zeroing process, it aborts zeroing and generates an error message. Zeroing takes a few seconds, depending on the sensor model. Refer to the documentation of your power sensor for more information.

Tips for zeroing

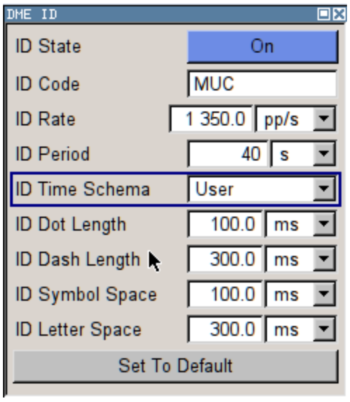
When to perform zeroing:
- During warm up after switching on or connecting the instrument
- After a substantial change of the ambient temperature
- After fastening the power sensor module to an RF connector at high temperature
- After several hours of operation
- When low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
- Switch off the RF power source for zeroing, but do not disconnect it from the power sensor. This proceeding keeps the thermal equilibrium, and the zeroing process also compensates the noise that superimposes the measured signal (e.g. from a broadband amplifier).

Remote command:
:SENSe<ch>[:POWer]:ZERO on page 477

5.4.7.3 ID Settings for DME Reply Mode

Access:

► Select "Modulation > config... > DME > ID Settings".



The "DME ID" dialog contains the parameters for configuring the identification sequence for the reply signal. Each airport identifies itself with a three letter code, for example 'MUC' for the Munich airport. This information is transmitted in Morse code. The transmission of the identification sequence can be suppressed.

ID State - DME Modulation
("Reply Mode" only)

Switches on/off the generation of the identification sequence (ID signal) of the ground station. The ID signal consists of a series of pulse pairs transmitted at a rate of 1350 Hz.

The transmission of the ground signal is interrupted every 40 s (ID period) and one ID sequence is transmitted instead. The "key down time" of the ground signal corresponds to the period of transmission for a dot or dash in the Morse code ID sequence (e.g. 100 ms for a dot). During the key down times reply pulses are not transmitted, however, they are transmitted between the key down times.

Remote command:
`[:SOURce]:DME:ID[:STATe]` on page 524

ID Code - DME Modulation
("Reply Mode" only)

Sets the coding of the ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (ID signal).

The ID tone is sent according to the selected code (see Table 5-7). The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

Table 5-7: Morse code

Letter	Morse code	Letter	Morse code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -

Letter	Morse code	Letter	Morse code
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:
The following values are default values:
- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300 ms
- The time between two tones is 100 ms
- The time between two letters is 300 ms

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100
= 3100 ms

Remote command:
`[:SOURce]:DME:ID:CODE` on page 521

ID Rate - DME Modulation
("Reply Mode" only)

Sets the pulse repetition rate of the ID sequence.

Remote command:
`[:SOURce]:DME:ID:RATE` on page 524

ID Period - DME Modulation
("Reply Mode" only)

Sets the period of the ID sequence in seconds.

Remote command:
`[:SOURce]:DME:ID:PERiod` on page 523

ID Time Schema - DME Modulation
("Reply Mode" only)

Selects the mode to define the length parameters of the ID signal.

"Standard"	The set dot length determines the dash length (= three times the dot length).
"User"	Allows you to define all length parameters independently.

Remote command:
[:SOURce]:DME:ID:TSCHema on page 525

ID Dot Length - DME Modulation
("Reply Mode" only)

Sets the length of a Morse dot in seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if standard time scheme is selected.

Remote command:
[:SOURce]:DME:ID:DOT on page 522

ID Dash Length - DME Modulation
("Reply Mode" and "User Time Scheme" only)

Sets the length of a Morse dash in seconds.

Remote command:
[:SOURce]:DME:ID:DASH on page 521

ID Symbol Space - DME Modulation
(Reply mode and user time schema only)

Sets the length of a symbol space in seconds.

Remote command:
[:SOURce]:DME:ID:SYMBol on page 524

ID Letter Space - DME Modulation
("Reply Mode" and "User Time Scheme" only)

Sets the length of a letter space in seconds.

Remote command:
[:SOURce]:DME:ID:LETTer on page 522

Set To Default ID - DME Modulation
Selects the default settings for the ID signal.

Remote command:
[:SOURce]:DME:ID:PRESet on page 523

5.4.7.4 DME Composite AM Settings

DME defines frequency and depth of the two-tone signal that is superimposed to the pulse signal with amplitude modulation.

The following example shows a DME signal with a superimposed two-tone signal:

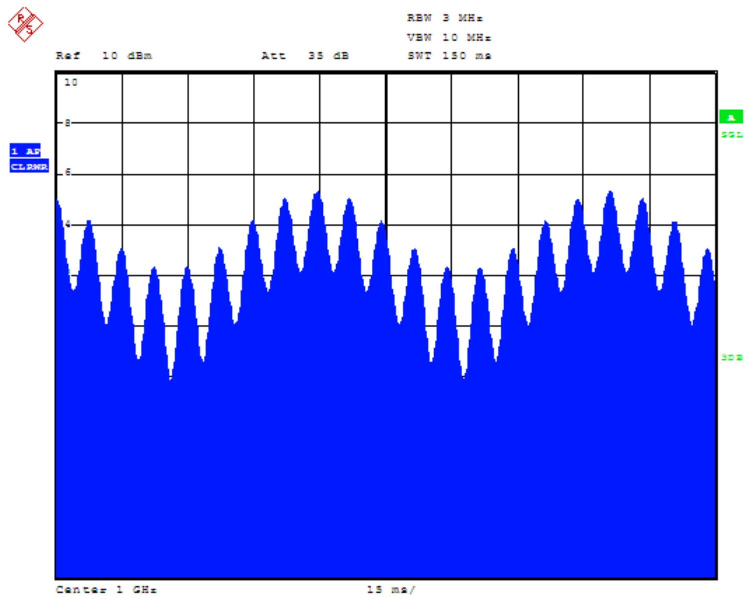
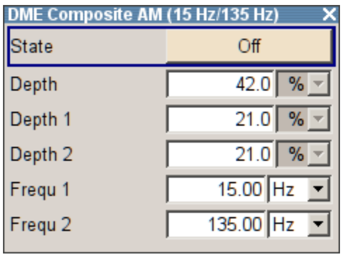


Figure 5-15: Measurement of RF envelope with DME interrogations at 6000 pp/s

Access:

► Select "Modulation > config... > DME > Composite AM".



The "DME Composite AM" dialog provides the settings for a two-tone signal that can be superimposed on the DME pulses with amplitude modulation. This feature enables you to simulate the variation of the DME pulse amplitude for DME receiver testing.

Composite AM State - DME Modulation

Activates the two-tone signal.

Remote command:
`[:SOURce]:DME:TACan:STATe` on page 532

Composite AM Depth - DME Modulation

Sets the modulation depth in %.

Note: Observe that this value is valid for both signals, and that the sum modulation depth is determined by doubling the set modulation depth. If the maximum value for the modulation depth is exceeded (see data sheet), overmodulation occurs.

Remote command:
`[:SOURce]:DME:TACan:DEPTh` on page 530

Composite AM Depth 1/2 - DME Modulation
Determines the modulation depth in % for one component of the two-tone signal.

Remote command:
[:SOURce]:DME:TACan:INTernal<ch>:DEPTh on page 530

Composite AM Frequency 1/2 - DME Modulation
Sets the individual frequencies of the two-tone signal.

Remote command:
[:SOURce]:DME:TACan<ch>:FREQuency on page 531

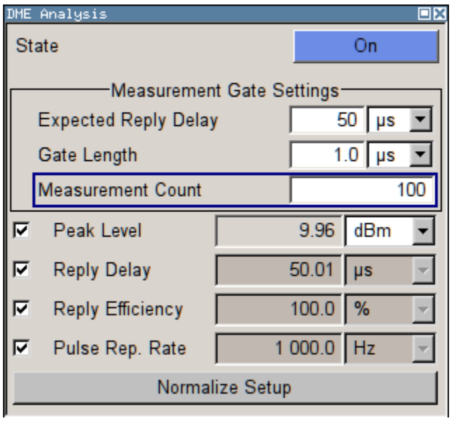
5.4.7.5 DME Analysis

The DME analysis uses a R&S NRP-Z81 Power Sensor to measure the reply delay, the average peak power, the efficiency and the pulse repetition rate of the ground station transponder. The interrogation signal is simulated by the R&S SMA and transmitted to the transponder. The reply signal of the transponder is measured using the power sensor and is analyzed by internal software routines to determine these parameters. The measurement values are indicated in the DME dialog.

DME Analysis Settings

Access:

► Select "Modulation > config... > DME > DME Analysis".



The "DME Analyisis" dialog provides the settings to configure the parameters of the reply signal of the ground station transponder. You can use this feature when an R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

DME Analysis State - DME Modulation
Activates the DME analysis. The R&S SMA generates interrogation pulse pairs and starts an internal counter for time measurement.

Remote command:
[:SOURce]:DME:ANALysis:STATe on page 515

Expected Reply Delay - DME Modulation
Sets the expected reply delay.

Remote command:
`[:SOURce]:DME:ANALysis:GATE:EDELay` on page 512

Gate Length - DME Modulation
Sets the gate length for the measurement window.

Remote command:
`[:SOURce]:DME:ANALysis:GATE[:LENGth]` on page 512

Measurement Count - DME Modulation
Sets the number of pulse pairs which are sent from the R&S SMA (= interrogator) to the ground station in one measurement cycle.

Remote command:
`[:SOURce]:DME:ANALysis:GATE:COUNt` on page 511

Peak Level State - DME Modulation
Activates the measurement of the average peak level of all valid pulse pairs in a measurement cycle.

Remote command:
`[:SOURce]:DME:ANALysis:POWer:STATe` on page 514

Peak Level - DME Modulation
Indicates the measured average peak level of all pulse pairs in a measurement cycle.

Remote command:
`[:SOURce]:DME:ANALysis:POWer?` on page 513

Reply Delay Status- DME Modulation
Activates the measurement of the average reply delay of all valid pulse pairs in a measurement cycle.

Remote command:
`[:SOURce]:DME:ANALysis:TIME:STATe` on page 517

Reply Delay - DME Modulation
Indicates the measured average reply delay of all valid pulse pairs in a measurement cycle. If there are no valid measurements available in the set measurement window "invalid" is indicated.

Remote command:
`[:SOURce]:DME:ANALysis:TIME?` on page 516
`[:SOURce]:DME:ANALysis:TIME:OK?` on page 516

Reply Efficiency State- DME Modulation
Activates the measurement of the reply efficiency in %. The measurement is the ratio of the number of measured valid reply pulse pairs to transmitted pulse pairs in a measurement cycle.

Remote command:
`[:SOURce]:DME:ANALysis:EFFiciency:STATe` on page 511

Reply Efficiency - DME Modulation
Indicates the measured reply efficiency in %. The measurement is the ratio of the number of measured valid reply pulse pairs to the transmitted pulse pairs in a measurement cycle. If there are no valid measurements available in the set measurement window "invalid" is indicated.

Remote command:
[:SOURce]:DME:ANALysis:EFFiciency? on page 510
[:SOURce]:DME:ANALysis:EFFiciency:OK? on page 510

Pulse Repetition Frequency State - DME Modulation
Activates the measurement of the mean pulse repetition rate of the DME ground station. For this measurement, all received pulses of the DME ground station are considered. The typical measurement time for this parameter is approx. 1 s.

This measurement and the measurement of the delay, reply efficiency and average peak power are performed alternately. Therefore, the speed of the pulse repetition measurement increases when all other measurements are deactivated.

Remote command:
[:SOURce]:DME:ANALysis:PRRate:STATe on page 515

Pulse Repetition Frequency - DME Modulation
Indicates the measured mean pulse repetition rate of the DME ground station.

If there are no valid measurements available in the set measurement window "invalid" is indicated.

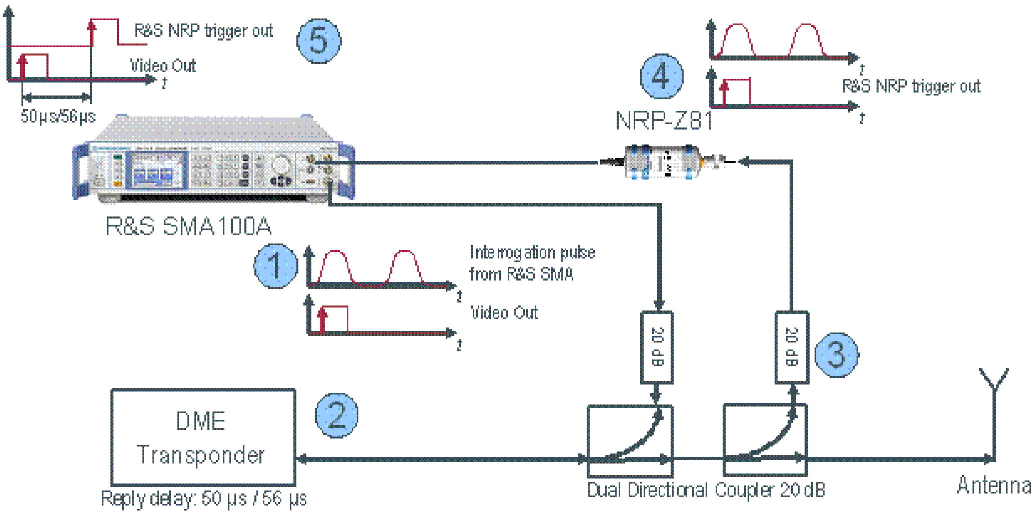
Remote command:
[:SOURce]:DME:ANALysis:PRRate? on page 514
[:SOURce]:DME:ANALysis:PRRate:OK? on page 515

Normalize Setup - DME Modulation
Performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the reply measurements.

Remote command:
[:SOURce]:DME:ANALysis:NORMalize? on page 513

Test Setup for DME Analysis

For additional information, refer to the application note 1GP74: Test of DME/TACAN Transponders, available at the download area of the Rohde & Schwarz internet site.



NOTICE

Possible damage to the power sensor

High output power of the DME transponder (up to 1 kW) might destroy the power sensor.

Therefore, the attenuator at the power sensor input must be selected in such a way, that the power applied to the power sensor is in the allowed range of the R&S NRP-Z81 before connecting the power sensor to the coupler.

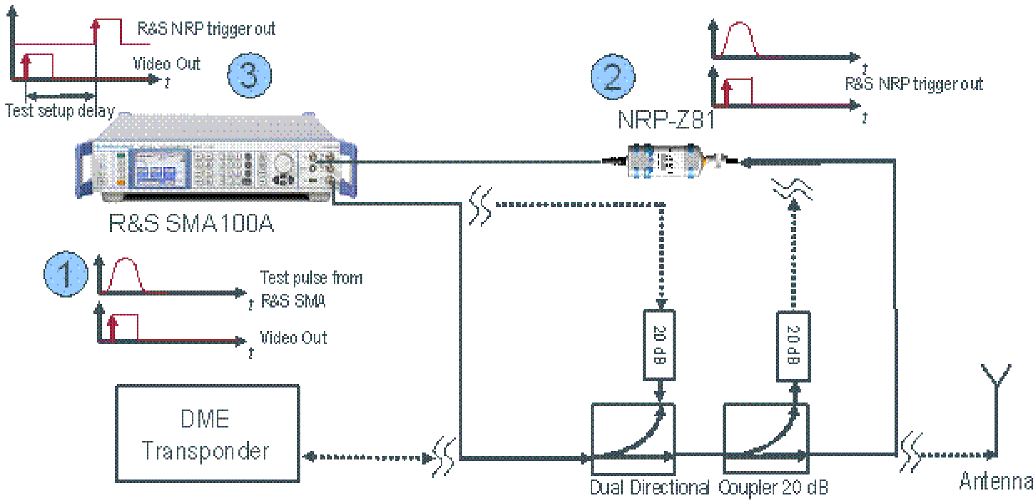
Procedure for DME Reply Delay measurement

1. The R&S SMA generates interrogation pulse pairs and starts an internal counter for the time measurement.
2. The DME transponder receives an interrogation pulse pair, and replies after a 50 µs to 56 µs delay with a reply pulse pair, depending on the channel.
3. The transmitted power is coupled to the power sensor input.
4. The R&S NRP-Z81 receives the transmitted reply pulse pair, and triggers the R&S SMA to stop the time measurement. It also measures the peak pulse power and transmits the readings to the R&S SMA.
5. The R&S SMA displays the peak pulse power of the reflected reply pulse pair, and the reply delay of the DME transponder (ideally 50 µs or 56 µs). In addition, it shows the DME transponder efficiency, i.e. the number of response pulse pairs as a percentage of the interrogation pulse pairs.
   The reply delay value, caused by the cable between the coupler and the antenna, must be corrected by adding twice the signal delay. This correction compensates both, the delay of the received signal and the delay of the transmitted signal. The following equation provides a typical value for the twofold signal delay due to cable length:

$$\Delta t = \frac{2 \times l \times \sqrt{\varepsilon_r}}{c}$$

l = cable length in meters
ε_r = relative dielectric (e.g. 2.1 for teflon, 2.25 for polyethylene)
c = 3 x 10^8 m/s

Optional normalization of the test setup removes additional delays that are due to the test setup.



Procedure for Test Setup Normalization

1. The R&S SMA generates a test pulse for normalization and starts the counter for time measurement.
   The dual directional coupler transmits the test pulse to the R&S NRP-Z81 power sensor. The connections to the DME transponder and the antenna are interrupted.
2. The R&S NRP-Z81 receives the test pulse, and triggers the R&S SMA to stop the time measurement.
3. The R&S SMA evaluates the test setup delay and considers the value in a subsequent DME analysis measurement. The R&S SMA stores the correction value on the internal flash disk, to provide it also after a restart of the signal generator.

5.4.8 VOR Modulation

VOR modulation(**V**HF **O**mnidirectional **R**ange) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

VOR systems provide directional information for air planes in flight. The VOR stations transmit a carrier which is modulated with two separate 30 Hz modulations. One of the 30 Hz signals (Reference signal) remains in the same phase at all reception positions around the VOR station. The other 30 Hz signal received (Variable signal) differs in phase by exactly the angular displacement of the receiver around the VOR from the

Zero radial. The aircraft receiver demodulates the two 30 Hz signals and compares their phase difference.

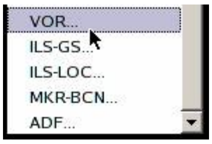
Four different modes are offered for the VOR test signal:

- Norm
  VOR modulation + optional COM/ID tone
- VAR
  Amplitude modulation of the output signal with the 30 Hz signal content of the VOR signal.
- Subcarrier
  Amplitude modulation of the output signal with the unmodulated 9960 Hz FM carrier of the VOR signal
- Subcarrier + FM
  Amplitude modulation of the output signal with the frequency-modulated 9960 Hz FM carrier of the VOR signal

An external signal can be added to the internal signal (EXT AM = EXT (MOD AM)). The external signal is input via the AM EXT connector.

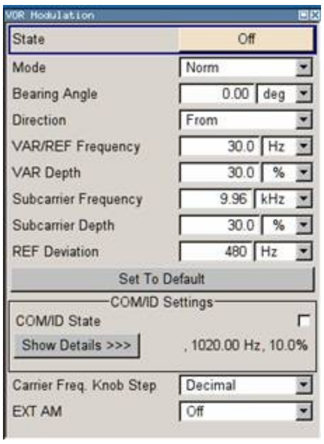
The VOR signal is output at the LF OUT connector at the front of the instrument.

5.4.8.1 VOR Modulation Settings



The "VOR Modulation" dialog is opened in the "Mod" function block or using the MENU key under "Mod".

In the upper section, 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 dialog.

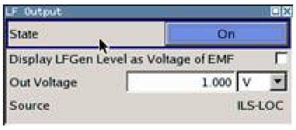


State - VOR Modulation

Activates VOR modulation.

Activation of VOR modulation deactivates AM, ILS, Marker Beacon and ADF modulation.

Source selection is disabled in the "LF Output" menu:



Remote command:
[:SOURce]:VOR:STATe on page 656

Mode - VOR Modulation
Selects the operating mode for the VOR modulation signal.

"Norm" VOR modulation is active.

"VAR" Amplitude modulation of the output signal with the VAR signal component (30 Hz signal content) of the VOR signal. The modulation depth of the 30 Hz signal corresponds to the value set under "Var Depth".

"Subcarrier" Amplitude modulation of the output signal with the unmodulated FM carrier (9960Hz) of the VOR signal. The modulation depth corresponds to the value set under "Subcarrier Depth".

"Subcarrier + FM"
Amplitude modulation of the output signal with the frequency-modulated FM carrier (9960 Hz) of the VOR signal. The frequency deviation corresponds to the value set under "Ref Deviation", the modulation depth corresponds to the value set under "Subcarrier Depth".

Remote command:
[:SOURce]:VOR:MODE on page 654

Bearing Angle - VOR Modulation
Enters the phase angle between the 30 Hz VAR signal and the 30 Hz reference signal. The orientation of the angle depends on the selected direction.

Remote command:
[:SOURce]:VOR[:BANGle] on page 658

Direction - VOR Modulation
Enters the reference position of the phase information.

"From" Selection of the beacon as a reference position. The angle set under "Bearing Angle" corresponds to the angle between the geographic north and the connection line from beacon to airplane.

"To" Selection of the airplane position as a reference position. The angle set under "Bearing Angle" corresponds to the angle between the geographic north and the connection line from airplane to beacon.

Remote command:
[:SOURce]:VOR[:BANGle]:DIRection on page 658

VAR/REF Frequency - VOR Modulation
Enters the frequency of the VAR signal and the REF signal. As the two signals must have the same frequency, the setting is valid for both signals.

Remote command:
[:SOURce]:VOR:VAR:FREQuency on page 657

VAR Depth - VOR Modulation
Enters the AM modulation depth of the 30 Hz VAR signal. The sum of subcarrier depth, VAR depth and COM/ID and must be smaller than 100 PCT.

Remote command:
[:SOURce]:VOR:VAR[:DEPTh] on page 657

Subcarrier Frequency - VOR Modulation
Enters the frequency of the FM carrier.

Remote command:
[:SOURce]:VOR:SUBCarrier[:FREQuency] on page 657

Subcarrier Depth - VOR Modulation
Enters the AM modulation depth of the FM carrier. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

Remote command:
[:SOURce]:VOR:SUBCarrier:DEPTh on page 656

REF Deviation - VOR Modulation
Enters the frequency deviation of the REF signal on the FM carrier.

Remote command:
[:SOURce]:VOR:REFerence[:DEViation] on page 655

Set to Default - VOR Modulation
Activates the VOR default setting.

Parameter	Value
State	Off
Mode	Norm
Source	Internal
Bearing Angle	0 deg
Direction	From
VAR / REF Frequency	30 Hz
VAR Depth	30 Percent
Subcarrier Frequency	9960 kHz
Subcarrier Depth	30 Percent
REF Deviation	480 Hz
COM/ID State	Off
COM/ID Frequency	1020 kHz

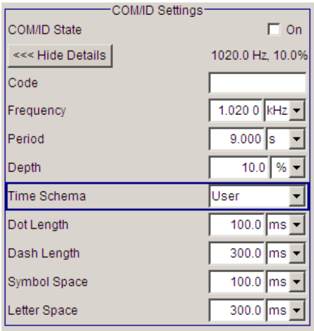
Parameter	Value
COM/ID Period	9 s
COM/ID Depth	10 percent

Remote command:
[:SOURce]:VOR:PRESet on page 655

COM/ID State - VOR Modulation
Switches on/off an additional communication/identification signal (COM/ID signal).

Remote command:
[:SOURce]:VOR:COMid[:STATe] on page 653

Show Details - VOR Modulation
Reveals the detailed setting options for the COM/ID signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this function to hide the detailed setting options display again. (COM/ID signal).



Remote command:
n.a.

COM/ID Code - VOR Modulation
Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below).The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-8: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -

Letter	Morse Code	Letter	Morse Code
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:
The following values are default values:
- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300 ms
- The time between two tones is 100 ms
- The time between two letters is 300ms

After each word, a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms, the word space between the words varies accordingly.

Example:

ID code = MUC

The word length = 300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 = 3100 ms

Remote command:
`[:SOURce]:VOR:COMid:CODE` on page 649

COM/ID Frequency - VOR Modulation
Enters the frequency of the COM/ID signals.

Remote command:
`[:SOURce]:VOR:COMid:FREQuency` on page 651

COM/ID Period - VOR Modulation
Enters the period of the COM/ID signal in seconds.

Remote command:
`[:SOURce]:VOR:COMid:PERiod` on page 652

COM/ID Depth - VOR Modulation
Enters the AM modulation depth of the COM/ID signal. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

Remote command:
[:SOURce]:VOR:COMid:DEPTh on page 650

COM/ID Time Schema - VOR Modulation
Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

Remote command:
[:SOURce]:VOR:COMid:TSCHema on page 652

COM/ID Dot Length - VOR Modulation
Enters the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

Remote command:
[:SOURce]:VOR:COMid:DOT on page 650

COM/ID Dash Length - VOR Modulation
(user time schema only)

Enters the length of a Morse dash by means of seconds.

Remote command:
[:SOURce]:VOR:COMid:DASH on page 649

COM/ID Symbol Space - VOR Modulation
(user time schema only)

Enters the length of a symbol space by means of seconds.

Remote command:
[:SOURce]:VOR:COMid:SYMBol on page 652

COM/ID Letter Space - VOR Modulation
(user time schema only)

Enters the length of a letter space by means of seconds.

Remote command:
[:SOURce]:VOR:COMid:LETTer on page 651

Carrier Freq. Knob Step - VOR Modulation
Selects the variation of the carrier frequency via the rotary knob.

"Decimal" Decimal variation according to the current cursor position.

"Defined" Variation in predefined steps according to the standardized VOR transmitting frequencies in MHz (see table Table 5-9).

Remote command:
[:SOURce]:VOR:FREQuency:STEP on page 653

ICAO Channel - VOR Modulation
Selects the ICAO channel, if "Carrier Freq. Knob Step > Defined" is selected.

The individual values in the table cells are:

- **Ch. No.** = ICAO channel number
- **VOR Freq.** = VOR Interrogation frequency (MHz)

Table 5-9: Standardized VOR transmitting frequencies (MHz) and the associated ICAO channels

Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.
17X	108.00	45X	110.80	75X	112.80	89X	114.20	103X	115.60	117X	117.00
17Y	108.05	45Y	110.85	75Y	112.85	89Y	114.25	103Y	115.65	117Y	117.05
19X	108.20	47X	111.00	76X	112.90	90X	114.30	104X	115.70	118X	117.10
19Y	108.25	47Y	111.05	76Y	112.95	90Y	114.35	104Y	115.75	118Y	117.15
21X	108.40	49X	111.20	77X	113.00	91X	114.40	105X	115.80	119X	117.20
21Y	108.45	49Y	111.25	77Y	113.05	91Y	114.45	105Y	115.85	119Y	117.25
23X	108.60	51X	111.40	78X	113.10	92X	114.50	106X	115.90	120X	117.30
23Y	108.65	51Y	111.45	78Y	113.15	92Y	114.55	106Y	115.95	120Y	117.35
25X	108.80	53X	111.60	79X	113.20	93X	114.60	107X	116.00	121X	117.40
25Y	108.85	53Y	111.65	79Y	113.25	93Y	114.65	107Y	116.05	121Y	117.45
27X	109.00	55X	111.80	80X	113.30	94X	114.70	108X	116.10	122X	117.50
27Y	109.05	55Y	111.85	80Y	113.35	94Y	114.75	108Y	116.15	122Y	117.55
29X	109.20	57X	112.00	81X	113.40	95X	114.80	109X	116.20	123X	117.60
29Y	109.25	57Y	112.05	81Y	113.45	95Y	114.85	109Y	116.25	123Y	117.65
31X	109.40	58X	112.10	82X	113.50	96X	114.90	110X	116.30	124X	117.70
31Y	109.45	58Y	112.15	82Y	113.55	96Y	114.95	110Y	116.35	124Y	117.75
33X	109.60	59X	112.20	83X	113.60	97X	115.00	111X	116.40	125X	117.80
33Y	109.65	59Y	112.25	83Y	113.65	97Y	115.05	111Y	116.45	125Y	117.85
35X	109.80	70X	112.30	84X	113.70	98X	115.10	112X	116.50	126X	117.90
35Y	109.85	70Y	112.35	84Y	113.75	98Y	115.15	112Y	116.55	126Y	117.95
37X	110.00	71X	112.40	85X	113.80	99X	115.20	113X	116.60		
37Y	110.05	71Y	112.45	85Y	113.85	99Y	115.25	113Y	116.65		
39X	110.20	72X	112.50	86X	113.90	100X	115.30	114X	116.75		
39Y	110.25	72Y	112.55	86Y	113.95	100Y	115.35	114Y	116.75		
41X	110.40	73X	112.60	87Y	114.00	101X	115.40	115X	116.80		
41Y	110.45	73Y	112.65	87Y	114.05	101Y	115.45	115Y	116.85		
43X	110.60	74X	112.70	88X	114.10	102X	115.50	116X	116.90		
43Y	110.65	74Y	112.75	88Y	114.15	102Y	115.55	116Y	116.95		

Remote command:
[:SOURce]:VOR:ICAO:CHANnel on page 653

EXT AM - VOR Modulation

Switching on/off an external modulation. The external signal is input via the AM EXT connector.

"Off" Selects the internal modulation source for VOR modulation.

"EXT (MOD AM)" Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the AM EXT connector. The sensitivity is 10 mV per percent modulation depth.

Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated. To avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining VOR signal components.

Remote command:
`[:SOURce]:VOR:SOURce` on page 656

5.4.9 ILS-GS Modulation

ILS-GS modulation (**I**nstrument **L**anding **S**ystem - **G**lide **S**lope) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

ILS systems provide information relating to the position of the air plane relative to the runway during landing. The ILS-GS system indicates if the air plane is above, below or on the glide path. The carrier is modulated by a 90 Hz and a 150 Hz tone and sent to a separate directional antenna system. The antenna array is arranged so that the 90 Hz signal is stronger above of the glide path, and the 150 Hz signal is stronger below the glide path. The information on position is provided after demodulation of the signals by evaluating the difference in depth of modulation (DDM).

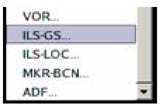
Three different modes are offered for the ILS-GS test signal:

- Norm
  Standard localizer/glideslope signal
- 90 Hz
  Suppression of the 150 Hz modulation tone
- 150 Hz
  Suppression of the 90 Hz modulation tone

An external signal can be added to the internal signal (EXT AM = EXT (MOD AM)). The external signal is input via the AM EXT connector.

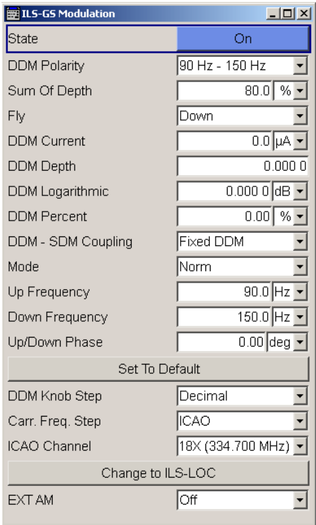
The ILS-GS signal is output at the LF OUT connector at the front of the instrument.

5.4.9.1 ILS-GS Modulation Settings



The "ILS-GS Modulation" dialog is opened in the "Mod" function block or using the MENU key under "Mod".

In the upper section, 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 dialog.

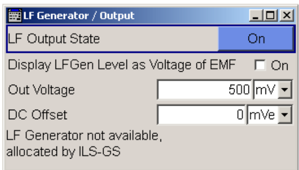


State - ILS-GS Modulation

Activates ILS-GS modulation.

Activation of ILS-GS modulation deactivates AM, VOR, ILS-LOC, Marker Beacon and ADF modulation.

Source selection and the associated parameters are disabled in the "LF Generator / Output" dialog:



Remote command:
`[:SOURce]:ILS:GS|GSLope:STATe` on page 564

DDM Polarity - ILS-GS Modulation

Defines the polarity for DDM calculation (see DDM Depth).

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:DDM:POLarity` on page 558

Sum of Depth - ILS-GS Modulation

Enters the arithmetic sum of the modulation depths of the upper lobe (90Hz) and lower lobe (150Hz) ILS-GS signal contents. The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones. The sum of Sum of Depth and COM/ID depth must be smaller than 100 PCT.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:SDM` on page 563

Fly - ILS-GS Modulation

Selects the simulation mode for the ILS-GS modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Up" The 150-Hz modulation signal is predominant, the DDM value is negative(the airplane is too low, it must climb).

"Down" The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too high, it must descend).

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:DDM:DIRection` on page 556

DDM Current - ILS-GS Modulation

Enters the current of the ILS indicating instrument corresponding to the DDM value. the instrument current is calculated according to:

DDM uA = DDM × 857,125 uA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:DDM:CURRent` on page 555

DDM Depth - ILS-GS Modulation

Enters the difference in depth of modulation between the upper lobe (90Hz) and the lower lobe (150Hz) tone of the ILS-GS modulation signal.

The DDM value is calculated to formula:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)] / 100%

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:DDM[:DEPTh]` on page 556

DDM Logarithmic - ILS-GS Modulation

Enters the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:DDM:LOGarithmic` on page 557

DDM Percent - ILS-GS Modulation

Enters the difference in depth of modulation between the upper lobe (90Hz) and the lower lobe (150Hz) tone of the ILS-GS modulation signal.

The DDM value in percent is calculated to formula:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)]
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)]

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:DDM:PCT` on page 557

DDM - SDM Coupling - ILS-GS Modulation

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed" The absolute DDM values stays constant when the SDM is changed.

"SDM" The absolute DDM values changes when the SDM is changed. The DDM value expressed in dB stays constant.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:DDM:COUPling` on page 555

Mode - ILS-GS Modulation

Selects the operating mode for the ILS-GS modulation signal.

"Norm" ILS-GS modulation is active.

"90 Hz" Amplitude modulation of the output signal with the upper lobe signal component (90Hz signal content) of the ILS-GS signal.

The modulation depth of the 90-Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

- "Direction Down"
  AM(90 Hz) = 0.5 × (SDM + DDM × 100%)
- "Direction Up"
  AM(90 Hz) = 0.5 × (SDM - DDM × 100%)

"150 Hz" Amplitude modulation of the output signal with the lower lobe signal component (150-Hzsignal content) of the ILS-GS signal.

The modulation depth of the 150-Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

- "Direction Down"
  AM (150 Hz) = 0,5 × (SDM + DDM × 100%)
- "Direction Up"
  AM (150 Hz) = 0,5 × (SDM - DDM × 100%)

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:MODE` on page 560

Up Frequency - ILS-GS Modulation

Enters the modulation frequency of the upper antenna lobe.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:ULOBe[:FREQuency]` on page 565

Down Frequency - ILS-GS Modulation

Enters the modulation frequency of the lower antenna lobe .

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:LLOBe[:FREQuency]` on page 559

Up/Down Phase - ILS-GS Modulation
Enters the phase between the modulation signals of the upper and lower antenna lobe. The zero crossing of the lower lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the lower antenna lobe.

Remote command:
[:SOURce]:ILS[:GS|GSLope]:PHASe on page 562

Set to Default - ILS-GS Modulation
Activates the ILS-GS default setting.

Parameter	Value
State	Off
Sum of Depth	80 Percent
Fly	Up
DDM	0
Mode	Norm
Up Frequency	90 Hz
Down Frequency	150 Hz
Up/Down Phase	0 deg
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Depth	10 percent

Remote command:
[:SOURce]:ILS[:GS|GSLope]:PRESet on page 563

DDM Knob Step - ILS-GS Modulation
Selects the variation of the DDM values via the rotary knob.

"Decimal" Decimal variation according to the current cursor position.

"Defined" Variation in predefined steps according to the standardized DDM values:
- -0.4000
- -0.1750 (Glide Sector)
- -0.0910, 0,0450
- 0.0000 (Glide Path)
- +0.0450, +0,0910
- +0.1750 (Glide Sector)
- +0.4000

Remote command:
n.a.

Carrier Frequency Step - ILS-GS Modulation
Selects the variation of the carrier frequency via the rotary knob.

"Decimal" Decimal variation according to the current cursor position.

"ICAO" Activates variation in predefined steps according to the standardized ILS-GS transmitting frequencies (see table, values in MHz). The start value can be selected in the field "ICAO Channel" below.
The selection of the ICAO channel is effective on both ILS modulations. A change to modulation ILS-LOC automatically causes the RF frequency to be adapted to the localizer value which is coupled to the glide slope setting (see table).

The individual values in the table are:

- **Ch. No.** = ICAO channel number
- **LOC Freq.** = ILS Localizer transmitting frequency (MHz)
- **GS Freq.** = ILS GS frequency (MHz)

Table 5-10: Standardized ILS-GS and ILS-LOC transmitting frequencies (MHz) and the associated ICAO channels

Ch. No.	LOC Freq.	GS Freq.	Ch. No.	LOC Freq.	GS Freq.	Ch. No.	LOC Freq.	GS Freq.
18X	108.10	334.70	32X	109.50	332.60	46X	110.90	330.80
18Y	108.15	334.55	32Y	109.55	332.45	46Y	110.95	330.65
20X	108.30	334.10	34X	109.70	333.20	48X	111.10	331.70
20Y	108.35	333.95	34Y	109.75	333.05	48Y	111.15	331.55
22X	108.50	329.90	36X	109.90	333.80	50X	111.30	332.30
22X	108.55	329.75	36Y	109.95	333.65	50Y	111.35	332.15
24X	108.70	330.50	38X	110.10	334.40	52X	111.50	332.90
24Y	108.75	330.35	38Y	110.15	334.25	52Y	111.55	332.75
26X	108.90	329.30	40X	110.30	335.00	54X	111.70	333.50
26Y	108.95	329.15	40Y	110.35	334.85	54Y	111.75	333.35
28X	109.10	331.40	42X	110.50	329.60	56X	111.90	331.10
28Y	109.15	331.25	42Y	110.55	329.45	56Y	111.95	330.95
30X	109.30	332.00	44X	110.70	330.20			
30Y	109.35	331.85	44Y	110.75	330.05			

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:FREQuency:STEP` on page 558

ICAO Channel - ILS-GS Modulation

Selects the ICAO channel, i.e., the ILS-GS transmitting frequency. The RF-frequency is set to the value selected here. A variation of the carrier frequency by the rotary knob is performed in predefined steps according to the standardized ILS-GS transmitting frequencies (see table). The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:ICAO:CHANnel` on page 559

Change to ILS-LOC - ILS-GS Modulation
Changes to ILS-LOC modulation and opens the menu. The current state of the ILS GS modulation (On or Off) is also set for ILS-LOC. The RF frequency setting automatically changes to the transmitting frequency associated with the set ICAO channel for ILS-LOC if the state is on. .

Remote command:
n.a.

EXT AM - ILS-GS Modulation
Switching on/off an external modulation. The external signal is input via the AM EXT connector.

"Off" Selects the internal modulation source for ILS-GS modulation.

"EXT (MOD AM)" Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the AM EXT connector. The sensitivity is 10 mV per percent modulation depth.

Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated.In order to avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining ILS signal components.

Remote command:
`[:SOURce]:ILS[:GS|GSLope]:SOURce` on page 564

5.4.10 ILS-LOC Modulation

ILS-LOC modulation (Instrument Landing System - Localizer) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

ILS systems provide information relating to the position of the air plane relative to the runway during landing. The ILS-LOC system indicates if the air plane is to the left, right or on the glide path. The carrier is modulated by a 90 Hz and a 150 Hz tone and sent to a separate directional antenna system. The antenna array is arranged so that the 90 Hz signal is stronger on the left side of the glide path, and the 150 kHz signal is stronger on the right side of the glide path. The information on position is provided after demodulation of the signals by evaluating the difference in depth of modulation (DDM).

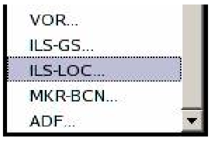
Three different modes are offered for the ILS-LOC test signal:

- Normal
  Standard localizer/glideslope signal + optional COM/ID tone (can be switched on)
- 90 Hz
  Suppression of 150 Hz modulation tone
- 150 Hz
  Suppression of 90 Hz modulation tone

An external signal can be added to the internal signal (EXT AM = EXT (MOD AM)). The external signal is input via the AM EXT connector at the rear of the instrument.

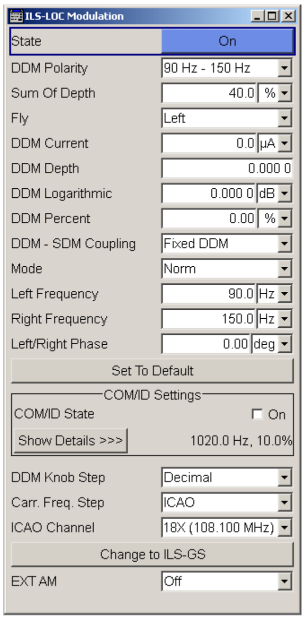
The ILS-LOC signal is output at the LF OUT connector at the front of the instrument.

5.4.10.1 ILS-Localizer Modulation Settings



The "ILS-LOC Modulation" dialog is opened in the "Mod" function block or using the MENU key under "Mod".

In the upper section, 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 dialog.

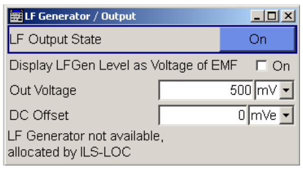


State - ILS-LOC Modulation

Activates ILS-LOC modulation.

Activation of ILS-LOC modulation deactivates AM, VOR, ILS-GS, Marker Beacon and ADF modulation.

Source selection is disabled in the "LF Generator / Output" dialog:



Remote command:
[:SOURce]:ILS:LOCalizer:STATe on page 564

DDM Polarity- ILS-LOC Modulation

Defines the polarity for DDM calculation (see DDM Depth).

Remote command:
[:SOURce]:ILS:LOCalizer:DDM:POLarity on page 558

Sum of Depth - ILS-LOC Modulation

Enters the arithmetic sum of the modulation depths of the left lobe (90Hz) and right lobe (150Hz) ILS-LOC signal contents. The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones. The sum of Sum of Depth and COM/ID depth must be smaller than 100 PCT.

Remote command:
`[:SOURce]:ILS:LOCalizer:SDM` on page 563

Fly - ILS-LOC Modulation

Selects the simulation mode for the ILS-LOC modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Left" The 150-Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

"Right" The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

Remote command:
`[:SOURce]:ILS:LOCalizer:DDM:DIRection` on page 556

DDM Current - ILS-LOC Modulation

Enters the current of the ILS indicating instrument corresponding to the DDM value. The instrument current is calculated according to:

DDM uA = DDM × 967.75 uA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Remote command:
`[:SOURce]:ILS:LOCalizer:DDM:CURRent` on page 555

DDM Depth - ILS-LOC Modulation

Enters the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz).

The DDM value is calculated to formula:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)] / 100%

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Remote command:
`[:SOURce]:ILS:LOCalizer:DDM[:DEPTh]` on page 556

DDM Logarithmic - ILS-LOC Modulation

Enters the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Remote command:
[:SOURce]:ILS:LOCalizer:DDM:LOGarithmic on page 557

DDM Percent - ILS-LOC Modulation
Enters the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz).

The DDM value in percent is calculated to formula:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)]
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)]

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Remote command:
[:SOURce]:ILS:LOCalizer:DDM:PCT on page 557

DDM - SDM Coupling - ILS-LOC Modulation
Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed" The absolute DDM values stays constant when the SDM is changed.

"SDM" The absolute DDM values changes when the SDM is changed. The DDM value expressed in dB stays constant.

Remote command:
[:SOURce]:ILS:LOCalizer:DDM:COUPling on page 555

Mode - ILS-LOC Modulation
Selects the operating mode for the ILS-LOC modulation signal.

"Norm" ILS-LOC modulation is active.

"90 Hz" Amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS-LOC signal.

The modulation depth of the 90Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

- parameter "Fly" = "Right"
  AM(90 Hz) = 0,5 × (SDM + DDM × 100%)
- parameter "Fly" = "Left"
  AM(90 Hz) = 0,5 × (SDM - DDM × 100%)

"150 Hz" Amplitude modulation of the output signal with the right lobe (150Hz) signal component of the ILS-LOC signal.

The modulation depth of the 150Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

- parameter "Fly" = "Right"
  AM (150 Hz) = 0,5 × (SDM + DDM × 100%)
- parameter "Fly" = "Left"
  AM (150 Hz) = 0,5 × (SDM - DDM × 100%)

Remote command:
[:SOURce]:ILS:LOCalizer:MODE on page 561

Left Frequency - ILS-LOC Modulation
Enters the modulation frequency of the antenna lobe arranged at the left viewed from the air plane.

Remote command:
`[:SOURce]:ILS:LOCalizer:LLOBe[:FREQuency]` on page 560

Right Frequency - ILS-LOC Modulation
Enters the modulation frequency of the antenna lobe arranged at the right viewed from the air plane.

Remote command:
`[:SOURce]:ILS:LOCalizer:RLOBe[:FREQuency]` on page 563

Left/Right Phase - ILS-LOC Modulation
Enters the phase between the modulation signals of the left and right antenna lobe. The zero crossing of the right lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

Remote command:
`[:SOURce]:ILS:LOCalizer:PHASe` on page 562

Set to Default - ILS-LOC Modulation
Activates the ILS-LOC default setting.

Parameter	Value
State	Not affected by Set to default
Sum of Depth	40 Percent
Fly	Up
DDM	0
Mode	Norm
Left frequency	90 Hz
Right Frequency	150 Hz
Left/Right Phase	0 deg
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Period	9 s
COM/ID Depth	10 percent

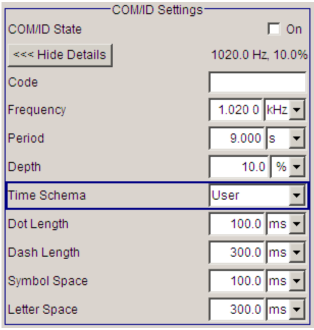
Remote command:
`[:SOURce]:ILS:LOCalizer:PRESet` on page 563

COM/ID State - ILS-LOC Modulation
Switches on/off an additional communication/identification signal (COM/ID signal).

Remote command:
`[:SOURce]:ILS:LOCalizer:COMid[:STATe]` on page 553

Show Details - ILS-LOC Modulation

Reveals the detailed setting options for the COM/Id signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again. (COM/ID signal).



Remote command:
n.a.

COM/ID Code - ILS-LOC Modulation

Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below).The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-11: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:
The following values are default values:
- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms the word space between the words varies accordingly.

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100
= 3100 ms

Remote command:
`[:SOURce]:ILS:LOCalizer:COMid:CODE` on page 550

COM/ID Frequency - ILS-LOC Modulation
Enters the frequency of the COM/ID signals.

Remote command:
`[:SOURce]:ILS:LOCalizer:COMid:FREQuency` on page 552

COM/ID Period - ILS-LOC Modulation
Enters the period of the COM/ID signal in seconds.

Remote command:
`[:SOURce]:ILS:LOCalizer:COMid:PERiod` on page 553

COM/ID Depth - ILS-LOC Modulation
Enters the AM modulation depth of the COM/ID signal. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

Remote command:
`[:SOURce]:ILS:LOCalizer:COMid:DEPTh` on page 551

COM/ID Time Schema - ILS-LOC Modulation
Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

Remote command:
`[:SOURce]:ILS:LOCalizer:COMid:TSCHema` on page 554

COM/ID Dot Length - ILS-LOC Modulation
Enters the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

Remote command:
[:SOURce]:ILS:LOCalizer:COMid:DOT on page 552

COM/ID Dash Length - ILS-LOC Modulation
(user time schema only)

Enters the length of a Morse dash by means of seconds.

Remote command:
[:SOURce]:ILS:LOCalizer:COMid:DASH on page 551

COM/ID Symbol Space - ILS-LOC Modulation
(user time schema only)

Enters the length of a symbol space by means of seconds.

Remote command:
[:SOURce]:ILS:LOCalizer:COMid:SYMBol on page 554

COM/ID Letter Space - ILS-LOC Modulation
(user time schema only)

Enters the length of a letter space by means of seconds.

Remote command:
[:SOURce]:ILS:LOCalizer:COMid:LETTer on page 553

DDM Knob Step - ILS-LOC Modulation
Selects the variation of the DDM values via the rotary knob.

"Decimal" Decimal variation according to the current cursor position.

"Defined" Variation in predefined steps according to the standardized DDM values:
- -0,2000
- -0.1550 (Course Sector)
- -0,0930, -0,0460
- 0,0000 (Course Line)
- +0,0460, +0,0930
- +0,1550 (Course Sector)
- +0,2000

Remote command:
n.a.

Carrier Frequency Step - ILS-LOC Modulation
Selects the variation of the carrier frequency via the rotary knob.

"Decimal" Decimal variation according to the current cursor position.

"ICAO" Activates variation in predefined steps according to the standardized ILS-GS transmitting frequencies (see table, values in MHz). The start value can be selected in the field "ICAO Channel" below.
The selection is effective on both ILS modulations. A change to modulation ILS-GS automatically causes the RF frequency to be adapted to the glide slope value which is coupled to the localizer setting (see table).

The individual values in the table are:
- **Ch. No.** = ICAO channel number
- **LOC Freq.** = ILS Localizer transmitting frequency (MHz)
- **GS Freq.** = ILS GS frequency (MHz)

Table 5-12: Standardized ILS-GS and ILS-LOC transmitting frequencies (MHz) and the associated ICAO channels

Ch. No.	LOC Freq.	GS Freq.		Ch. No.	LOC Freq.	GS Freq.		Ch. No.	LOC Freq.	GS Freq.
18X	108.10	334.70		32X	109.50	332.60		46X	110.90	330.80
18Y	108.15	334.55		32Y	109.55	332.45		46Y	110.95	330.65
20X	108.30	334.10		34X	109.70	333.20		48X	111.10	331.70
20Y	108.35	333.95		34Y	109.75	333.05		48Y	111.15	331.55
22X	108.50	329.90		36X	109.90	333.80		50X	111.30	332.30
22Y	108.55	329.75		36Y	109.95	333.65		50Y	111.35	332.15
24X	108.70	330.50		38X	110.10	334.40		52X	111.50	332.90
24Y	108.75	330.35		38Y	110.15	334.25		52Y	111.55	332.75
26X	108.90	329.30		40X	110.30	335.00		54X	111.70	333.50
26Y	108.95	329.15		40Y	110.35	334.85		54Y	111.75	333.35
28X	109.10	331.40		42X	110.50	329.60		56X	111.90	331.10
28Y	109.15	331.25		42Y	110.55	329.45		56Y	111.95	330.95
30X	109.30	332.00		44X	110.70	330.20				
30Y	109.35	331.85		44Y	110.75	330.05				

Remote command:
`[:SOURce]:ILS:LOCalizer:FREQuency:STEP` on page 558

ICAO Channel - ILS-LOC Modulation

Selects the ICAO channel, i.e., the ILS-LOC transmitting frequency. The RF-frequency is set to the value selected here. A variation of the carrier frequency by the rotary knob is performed in predefined steps according to the standardized ILS-LOC transmitting frequencies (see table). The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

Remote command:
`[:SOURce]:ILS:LOCalizer:ICAO:CHANnel` on page 559

Change to ILS-GS - ILS-LOC Modulation
Changes to ILS-GS modulation and opens the menu. The state of the ILS LOC modulation (On or Off) is also set for ILS-GS. The RF frequency setting automatically changes to the transmitting frequency associated with the set ICAO channel for ILS-GS if the state is on.

Remote command:
n.a.

EXT AM - ILS-LOC Modulation
Switching on/off an external modulation. The external signal is input via the AM EXT connector.

"Off"	Selects the internal modulation source for ILS-LOC modulation.
"EXT (MOD AM)"	Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the AM EXT connector. The sensitivity is 10 mV per percent modulation depth. **Note:** There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated.In order to avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining ILS signal components.

Remote command:
[:SOURce]:ILS:LOCalizer:SOURce on page 564

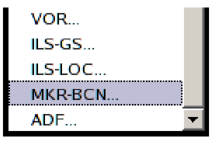
5.4.11 Marker Beacon Modulation

Option R&S SMA-K25 enables the marker beacon modulation on the R&S SMA (requires frequency option R&S SMA-B10x).

The marker beacon signal is output at the LF OUT connector at the front of the instrument.

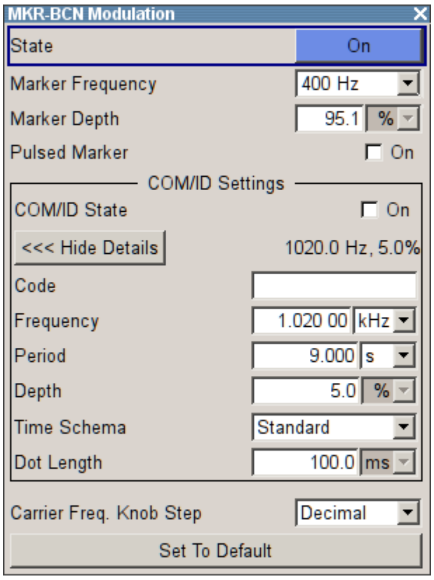
ILS systems provide information relating to the position of the air plane relative to the runway during landing. The markers indicate the distance of the air plane relative to the threshold of the runway. The modulation frequency changes from outer to the inner marker which are located at a defined distance from the runway. The altitude of the air plane must be 200 feet by the time the middle marker with a modulation frequency of 1300 Hz is reached.

5.4.11.1 Marker Beacon Modulation Settings



Access:

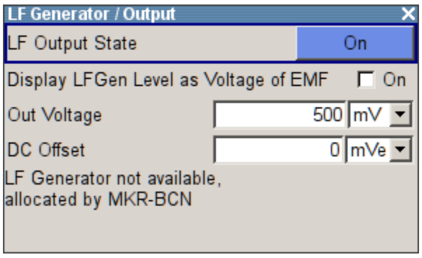
► Select "Modulation > config... > MKR-BCN".



The "MKR-BCN Modulation" dialog contains the parameters for configuration of the marker, and the COM/ID settings for the modulation.

State - Marker Beacon Modulation
Activates the marker beacon modulation.

Note: MKR-BCN modulation automatically deactivates the modulations AM, VOR, ILS-GS, ILS-LOC and ADF. In addition, the R&S SMA allocates the internal LF generator firmly to the MKR-BCN modulation, and disables the selection of the LF generator "Source" in the "LF Generator / Output" dialog.



Remote command:
[:SOURce]:MBEacon:STATe on page 598

Marker Frequency - Marker Beacon Modulation
Selects the modulation frequency of the marker signal.

The modulation operates with the frequencies: 400 Hz, 1300 Hz or 3000 Hz.

Remote command:
[:SOURce]:MBEacon[:MARKer]:FREQuency on page 598

Marker Depth - Marker Beacon Modulation
Sets the modulation depth of the marker signal.

Remote command:
[:SOURce]:MBEacon[:MARKer]:DEPTh on page 598

Pulsed Marker - Marker Beacon Modulation

Activates the pulsed marker.

If activated, the R&S SMA provides three markers at the output, with the on/off times shown in Table 5-13:

Table 5-13: On/Off time overview of the pulsed markers

	On	Off
Outer Marker (400 Hz)	375 ms	125 ms
Middle Marker (1300 Hz)	375 ms 83 ms	125 ms 83 ms
Inner Marker (3000 Hz)	83 ms	83 ms (6 dots/sec)

If deactivated, the R&S SMA provides uncoded markers at the output (key down).

Remote command:
`[:SOURce]:MBEacon[:MARKer]:PULSed` on page 598

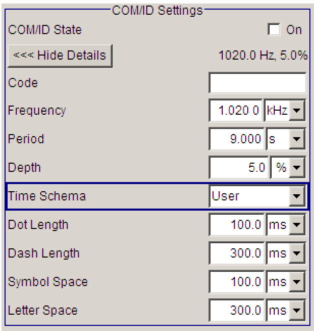
COM/ID State - Marker Beacon Modulation

Activates an additional communication and identification signal (COM/ID signal).

Remote command:
`[:SOURce]:MBEacon:COMid[:STATe]` on page 597

Show Details - Marker Beacon Modulation

Reveals the detailed setting options for the COM/ID signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this function to hide the detailed setting options display again.



Remote command:
n.a.

COM/ID Code - Marker Beacon Modulation

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below). The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-14: Morse code

Letter	Morse code	Letter	Morse code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:
The following values are default values:
- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300 ms
- The time between two tones is 100 ms
- The time between two letters is 300 ms

After each word, a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms, the word space between the words varies accordingly.

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 = 3100 ms

Remote command:
[:SOURce]:MBEacon:COMid:CODE on page 593

COM/ID Frequency - Marker Beacon Modulation
Sets the frequency of the COM/ID signals.

Remote command:
`[:SOURce]:MBEacon:COMid:FREQuency` on page 595

COM/ID Period - Marker Beacon Modulation
Sets the period of the COM/ID signal in seconds.

Remote command:
`[:SOURce]:MBEacon:COMid:PERiod` on page 596

COM/ID Depth - Marker Beacon Modulation
Sets the AM modulation depth of the COM/ID signal. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

Remote command:
`[:SOURce]:MBEacon:COMid:DEPTh` on page 594

COM/ID Time Schema - Marker Beacon Modulation
Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

Remote command:
`[:SOURce]:MBEacon:COMid:TSCHema` on page 597

COM/ID Dot Length - Marker Beacon Modulation
Sets the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

Remote command:
`[:SOURce]:MBEacon:COMid:DOT` on page 594

COM/ID Dash Length - Marker Beacon Modulation
(user time schema only)

Sets the length of a Morse dash by means of seconds.

Remote command:
`[:SOURce]:MBEacon:COMid:DASH` on page 593

COM/ID Symbol Space - Marker Beacon Modulation
(user time schema only)

Sets the length of a symbol space by means of seconds.

Remote command:
`[:SOURce]:MBEacon:COMid:SYMBol` on page 596

COM/ID Letter Space - Marker Beacon Modulation
(user time schema only)

Sets the length of a letter space by means of seconds.

Remote command:
[:SOURce]:MBEacon:COMid:LETTer on page 595

Carrier Freq. Knob Step - Marker Beacon Modulation
Selects the variation of the carrier frequency via the rotary knob.

"Decimal" Decimal variation according to the current cursor position.
An RF frequency of 75 MHz is automatically set when marker beacon modulation is switched on.

"Defined" Variation in predefined steps according to the standardized Marker Beacon transmitting frequencies (see table, values in MHz)

Note: If "Defined" is selected, the current RF frequency is automatically switched over to the next Marker Beacon transmitting frequency acc. to the table when switching on the modulation.

Table 5-15: Standardized Marker beacon transmitting frequencies (MHz)

74.600	75.675	74.750	74.825	74.900	74.975	75.050	75.125	75.200	75.275	75.350
74.625	74.700	74.775	74.850	74.925	75.000	75.075	75.150	75.225	75.300	75.375
74.650	74.725	74.800	74.875	74.950	75.025	75.100	75.175	75.250	75.325	75.400

Remote command:
n.a.

Set To Default - Marker Beacon Modulation
Activates the Marker Beacon default setting. The RF frequency is set to 75 MHz.

Parameter	Value
State	Off
Marker Frequency	400 Hz
Marker Depth	95 %
Pulsed Marker	Off
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Period	9 s
COM/ID Depth	10 percent
RF Frequency	75 MHz

Remote command:
[:SOURce]:MBEacon:PRESet on page 597

5.4.12 ADF Modulation

ADF modulation (**A**utomatic **D**irection **F**inders) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

The ADF signal is output at the LF OUT connector at the front of the instrument.

The ADF modulation provides a predefined test signal for ADF systems (Automatic Direction Finder).

ADF receivers provide the relative bearing of a basic ground based Non Directional Beacon (NDB) to the fore/aft axis of the aircraft by using a directional antenna assembly in the aircraft. The ADF determines the direction to the NDB station relative to the aircraft and is used for instrument approaches (autopilot). It provides additional information to other navigation equipment, e.g. VOR.

5.4.12.1 ADF Modulation Menu

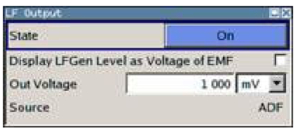
The "ADF Modulation" menu is opened in the "Mod" function block or using the MENU key under Mod.

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the communication/identification signal is performed in the lower section of the menu.

State - ADF Modulation
Activates/deactivates ADF modulation. A unmodulated carrier with a frequency of 190 kHz (default) is generated. After switching on the COM/ID tone the carrier is modulated with 95 percent AM depth at a 1,02 kHz modulation rate.

Activation of ADF modulation deactivates AM, VOR, ILS and Marker Beacon modulation.

Source selection is disabled in the "LF Output" menu:

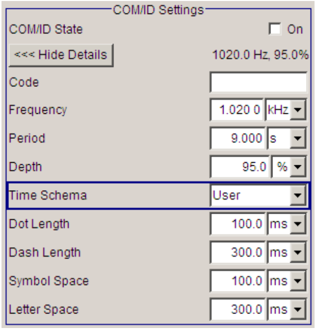


Remote command:
`[:SOURce]:ADF:STATe` on page 493

COM/ID(A0/A2) State - ADF Modulation
Switches on/off the communication/identification signal (COM/ID signal). The COM/ID tone is modulated onto the carrier (A0/A2 transmission).

Remote command:
`[:SOURce]:ADF:COMid[:STATe]` on page 493

Show Details - ADF Modulation
Reveals the detailed setting options for the COM/Id signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again. (COM/ID signal).



Remote command:
n.a.

COM/ID(A0/A2) Code - ADF Modulation
Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below).The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

The COM/ID tone is modulated onto the carrier (A0/A2 transmission).

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-16: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:
The following values are default values:
- A dot (.) has a tone duration of 100 ms

- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms the word space between the words varies accordingly.

Example:

ID code = MUC

The word length = 300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 = 3100 ms

Remote command:
[:SOURce]:ADF:COMid:CODE on page 488

COM/ID(A0/A2) Frequency - ADF Modulation
Enters the frequency of the COM/ID signals.

Remote command:
[:SOURce]:ADF:COMid:FREQuency on page 490

COM/ID(A0/A2) Period - ADF Modulation
Enters the period of the COM/ID signal in seconds.

Remote command:
[:SOURce]:ADF:COMid:PERiod on page 491

COM/ID(A0/A2) Depth - ADF Modulation
Enters the AM modulation depth of the COM/ID signal.

Remote command:
[:SOURce]:ADF:COMid:DEPTh on page 489

COM/ID(A0/A2) Time Schema - ADF Modulation
Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

Remote command:
[:SOURce]:ADF:COMid:TSCHema on page 492

COM/ID(A0/A2) Dot Length - ADF Modulation
Enters the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

Remote command:
[:SOURce]:ADF:COMid:DOT on page 490

COM/ID(A0/A2) Dash Length - ADF Modulation
(user time schema only)

Enters the length of a Morse dash by means of seconds.

Remote command:
`[:SOURce]:ADF:COMid:DASH` on page 489

COM/ID(A0/A2) Symbol Space - ADF Modulation
(user time schema only)

Enters the length of a symbol space by means of seconds.

Remote command:
`[:SOURce]:ADF:COMid:SYMBol` on page 492

COM/ID(A0/A2) Letter Space - ADF Modulation
(user time schema only)

Enters the length of a letter space by means of seconds.

Remote command:
`[:SOURce]:ADF:COMid:LETTer` on page 491

5.5 Modulation Generator and LF Output

5.5.1 Overview of LF Generator

The internal modulation generator of the instrument provides a sinusodial LF modulation signal without additional equipment options. The corresponding key data, as for example the frequency range, is specified under "Modulation sources" in the data sheet.

You can use the internal LF signal as modulation signal source for the analog modulations, as for example the amplitude modulation. The signal applies to all modulations which are using the internal modulation signal. Therefore, any modification of the LF signal impacts all currently active modulations immediately.

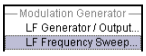
To configure the LF generator signal, see Chapter 5.5.3.1, "LF Output Dialog", on page 329. However, you can also configure the LF signal directly in the settings dialogs of the analog modulations.

Optionally, the instrument provides the following modulation sources:

- Pulse Generator (option R&S SMA-K23) for generating single and double pulse signals, see Chapter 5.5.4, "Pulse Generator", on page 333.
- Multifunction generator (option R&S SMA-K24), provides additional signal shapes and an extended frequency range.
- High-performance pulse generator (option R&S SMA-K27) for generating pulse train signals.

The R&S SMA also provides the configured LF signal at the corresponding output connector, for example as modulation signal source for interconnected instruments.

5.5.2 LF Frequency Sweep

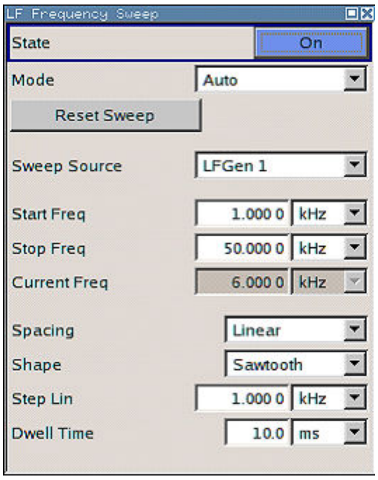


The "LF Frequency Sweep" dialog is used to configure and activate an LF frequency sweep signal.

To open the "LF Frequency Sweep" dialog, select "Mod Gen > Configure > LF Frequency Sweep" or use the MENU key under "Mod Gen".

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
Activates the LF frequency sweep signal generation.

Note:
Activating a sweep mode automatically deactivates other sweeps and the list mode.

Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 568

Mode
Selects the LF frequency sweep mode.

If you change the sweep mode during the execution, the signal generator stops the sweep and starts with the next trigger event at the initial value.

The "Reset Sweep" button sets the sweep to the start value.

"Auto"
Generates a continuously repeating sweep signal immediately after activating the sweep mode.
The sweep steps are performed atomatically, controlled by the dwell time, see "Dwell Time - LF Sweep" on page 328.

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR AUTO`

`SOUR:LFO:FREQ:MODE SWE`

"Single"
Generates a single sweep cycle after a trigger event.
The sweep steps within the cycle are performed automatically, controlled by the dwell time. If one cycle is completed, the instrument waits for the next trigger event.
To trigger the sweep, use "Execute Single Sweep" button, or the corresponding remote control commands, for example `*TRG`.

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR SING`

`SOUR:LFO:FREQ:MODE SWE`

`SOUR:LFO:SWE:FREQ:EXEC`

"Step"
Generates the sweep signal step-by-step, manually triggered.
To perform the sweep steps, enter the frequency value under Current Freq.

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"

Generates a single sweep cycle when an a external trigger event occurs.
The sweep steps within the cycle are performed automatically, controlled by the dwell time. If one cycle is completed, the instrument waits for the next trigger event.
To trigger the sweep, apply an external trigger signal.
Refer to the description of the rear panel for information on the connectors for external trigger signal input (see Chapter 2.2, "Rear Panel Tour", on page 23).

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR EXT`

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

"Extern Step"

Generates the sweep signal step-by-step, manually triggered.
To trigger a sweep step, apply an external trigger signal. The step width corresponds to the step width set for the rotary knob.

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR EXT`

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

"Extern Start/ Stop"

Generates a continuously repeating sweep signal that is started, stopped and restarted by subseqeunt external trigger events. The sweep steps are performed automatically, controlled by the dwell time.
Refer to the description of the rear panel for information on the connectors for the external trigger signal input (see Chapter 2.2, "Rear Panel Tour", on page 23).

Example:

`SOUR:LFO:SWE:FREQ:MODE AUTO`

`TRIG0:SWE:SOUR EAUT`

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

Remote command:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE` on page 572
`:TRIGger<hw>[:SWEep]:SOURce` on page 684
`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 568

Execute Single Sweep
Starts a sweep manually. This trigger button is displayed in "Single" mode.

Example:

```
SOUR:LFO:SWE:FREQ:MODE AUTO
TRIG:LFFS:SWE:SOUR SING
TRIG:LFFS
```

Remote command:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute` on page 571
`:TRIGger<hw>:LFFSweep:IMMediate` on page 682
`:TRIGger<hw>:LFFSweep` on page 682
`:TRIGger<hw>[:IMMediate]` on page 685

Reset Sweep
Resets a sweep.

With the next trigger event, the sweep starts with at the initial value.

Remote command:
`[:SOURce<hw>]:SWEep:RESet[:ALL]` on page 648

Sweep Source
Selects the sweep source.

Remote command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource` on page 572

Start Freq
Sets the start frequency.

Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:STARt` on page 569

Stop Freq
Sets the stop frequency.

Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:STOP` on page 569

Current Freq
Displays the current frequency.

In sweep "Step" mode, the parameter is editable and you can enter frequency for the next step.

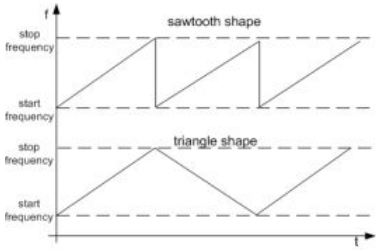
Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:MANual` on page 568

Spacing
Selects the mode for the calculation of the frequency sweep intervals.

"Linear"	Takes the frequency value entered as an absolute value in Hz
"Logarithmic"	Takes the value entered as a lograithmic value, that means as a constant fraction of teh current frequency in %.

Remote command:
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing on page 575

Shape
Selects the waveform shape of the sweep signal.

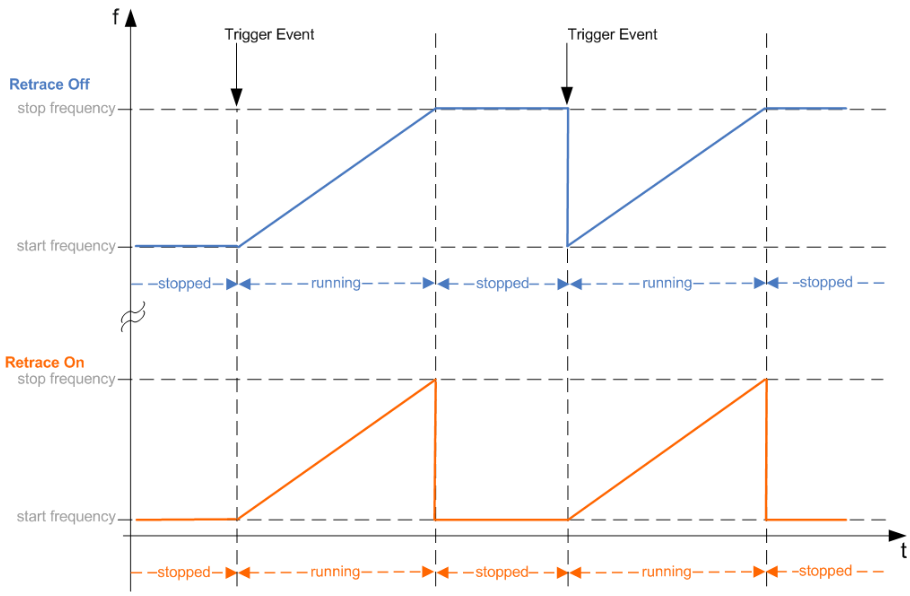


"Sawtooth"	The sweep runs from the start to the stop frequency. Each subsequent sweep starts at the start frequency, that means the shape of the sweep sequence resembles a sawtooth.
"Triangle"	The sweep runs from start to stop frequency and back, that means the shape of the sweep resembles a triangle. A subsequent sweep starts at the start frequency.

Remote command:
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe on page 575

Retrace - LF Frequency Sweep
Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single", see Mode.



Remote command:
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace on page 574

Step Lin/Log - LF Sweep

Sets the step width for the individual frequency sweep steps.

At each step this value is added to the current frequency.

Depending on the Spacing mode you have set, the corresponding parameter is displayed.

"Step Lin" The step width is a constant value in Hz.

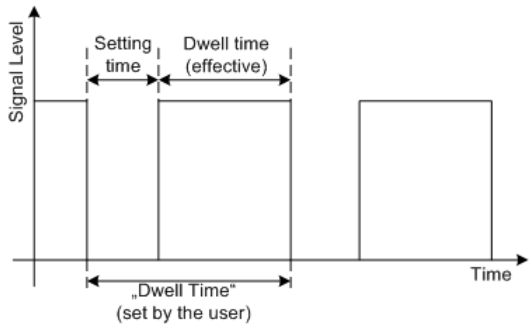
Remote command:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]` on page 576

"Step Log" The step width is determined logarithmically in %, that means as a constant fraction of the current frequency.

Remote command:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic`
on page 576

Dwell Time - LF Sweep

Defines 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 display update for optimum sweep performance especially with short dwell times (see Chapter 5.2.3.8, "Display Update", on page 103).

Remote command:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl` on page 571

Ext. Trigger Input Slope

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

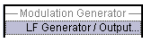
This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive" activates the rising edge of the trigger signal.

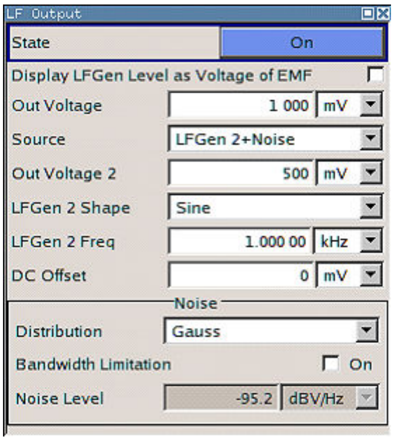
"Negative" activates the falling edge of the trigger signal.

Remote command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 566

5.5.3 LF Output



► To open the "LF Generator / Output" dialog, select "Mod Gen > Configure > LF Generator / Output" or use the MENU key under "Mod Gen".



The dialog provides access to the configuration of the internal modulation generators, and you can activate the output of the LF signal
The available settings depend on the source selected and on the installed options. For a fully equipped instrument two LF generators and a noise generator are available as internal sources.
Alternatively, you can perform the settings also in the correpsonding dialogs of the analog modulations, like "Amplitude Modulation". The configured LF signal applies to all modulations which use the internal modulation sources, and to the LF output.

The remote commands required to define these settings are described in Chapter 7.14.10, "SOURce:LFOutput Subsystem", on page 566.

5.5.3.1 LF Output Dialog

LF Output State
Activates the LF output. This setting has no effect on the modulations.

The modulation signal is output at the LF OUTPUT connector of the instrument.

Remote command:
`[:SOURce]:LFOutput[:STATe]` on page 571

Display LF Gen Level as Voltage of EMF
Activates the 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).

Note: This setting is not affected by an instrument preset (PRESET key), `*RST`) or the "Save/Recall" function. Only the Chapter 5.2.3.21, "Factory Preset", on page 123 resets the setting.

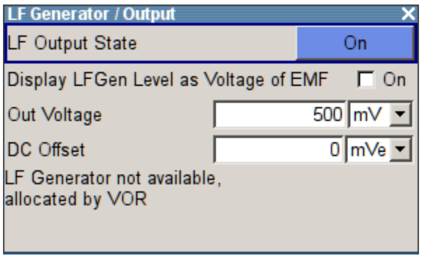
Remote command:
n.a.

Out Voltage
Sets the voltage (peak) of the LF output signal.

Remote command:
[:SOURce]:LFOutput:VOLTage on page 579

Source
Selects the internal source to be used for the LF Output signal. The available selection parameters vary according to the fitted options.

Note: If an avionic modulation (VOR/ILS) is running, the source is not selectable, since the LF generator is allocated by the modulation.



To enable the source selection, deactivate the avionic modulation first.

"None" Switches off all internal modulation sources.

"LFGen1 / LFGen2"
Selects one of the internal LF generators as the source for the LF Output signal.

"LFGen1+2"
Selects both internal LF generators as the source for the LF Output signal. LF frequency and output voltage can be set separately for the two LF generators. The added output voltage of the two modulation generators must not exceed the overall voltage.

"Noise" Selects the internal noise signal. The LF output signal is white noise either with Gaussian distribution or equal distribution.
See also Chapter 5.5.3.2, "Noise Settings", on page 332.

"LFGen1+Noise / LFGen2+Noise"
Selects one LF generator and the noise signal as the source for LF Output.

Remote command:
[:SOURce<hw>]:AM:INTernal:SOURce on page 495

Out Voltage 1/2
(Source LFGen1+2 only)

Selects the output voltage for the two LF generators. The sum of the two values must not exceed the overall output voltage set in the upper part of the menu.

Remote command:
[:SOURce]:LFOutput<ch>:INTernal:VOLTage on page 570

LFGen 1/2 Freq
(Source LFGen1+2 only)

Sets the frequency of the two LF generators.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

Note: VOR/ILS is indicated and setting the frequency is disabled if VOR/ILS modulation is activated.

Remote command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 567

LF Gen Shape
Selects the waveform shape for the signal of the second LF generator. For trapezoidal shapes, the instrument also displays the time parameters required to configure the signal.

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe` on page 577

Trapeze Rise
(Source LFGen2 only)

Selects the rise time for the trapeze shape of the second LF generator.

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE` on page 578

Trapeze High
(Source LFGen2 only)

Selects the high time for the trapeze shape of the second LF generator.

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH` on page 578

Trapeze Fall
(Source LFGen2 only)

Selects the fall time for the trapeze shape of the second LF generator.

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL` on page 577

Trapeze Low
(Source LFGen2 only)

Selects the low time for the trapeze shape of the second LF generator.

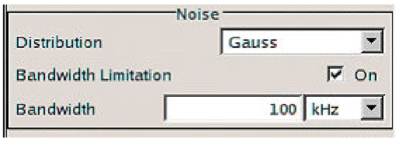
Remote command:
`[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:LOW` on page 578

DC Offset
Sets a DC offset at the LF Output.

Remote command:
`[:SOURce]:LFOutput:OFFSet` on page 570

5.5.3.2 Noise Settings

The settings for the noise source are offered in the "Noise" section of the "LF Output" menu of the "Mod Gen" block. This setting affects all analog modulations which use the noise generator as the internal modulation source



Distribution - Noise

Source Internal, Noise only

Selects the noise power density distribution of noise.

"Gaussian" The noise power density has a Gaussian distribution.

"Equal" The noise power density has an even distribution.

Remote command:

[:SOURce<hw>]:NOISe:DISTribution on page 600

Bandwidth Limitation

Source Internal, Noise only

Enabled /disables bandwidth limitation of noise.

"On" The noise signal is generated within the set frequency bandwidth. The noise level in the frequency band is indicated at "Noise Level (System Bandwidth)" ("LF Output" menu of the "Mod Gen" block).

"Off" The noise signal is generated within the maximum bandwidth of 10 MHz. The noise level per Hz is indicated at "Noise Level - Noise" ("LF Output" menu of the "Mod Gen" block)

Remote command:

[:SOURce<hw>]:NOISe:BWIDth:STATe on page 600

Noise Level - Noise

Indicates the level of the noise signal per Hz in the total bandwidth.

Remote command:

[:SOURce<hw>]:NOISe:LEVel:RELative? on page 600

Bandwidth

Source Internal, Noise only

Enters the noise bandwidth in case bandwidth limitation is enabled. Distinct bandwidth settings between 10 kHz and 10 MHz in 100 kHz steps (range 100 .. 1 MHz), 1 MHz (range 1 MHz .. 5 MHz) and 5 MHz (5 MHz … 10 MHz) are possible.

The noise signal is generated within the set frequency bandwidth. Noise level per Hz and noise level in the system bandwidth are indicated at "Noise Level (System Bandwidth)" ("LF Output" menu of the "Mod Gen" block).

Remote command:

[:SOURce<hw>]:NOISe:BANDwidth|BWIDth on page 600

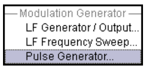
Noise Level (System Bandwidth)
Indicates the noise level in the system bandwidth for enabled bandwidth limitation. Distinct bandwidth settings between 10 kHz and 10 MHz in 100 kHz steps are possible.

Remote command:
[:SOURce<hw>]:NOISe:LEVel[:ABSolute]? on page 601

5.5.4 Pulse Generator

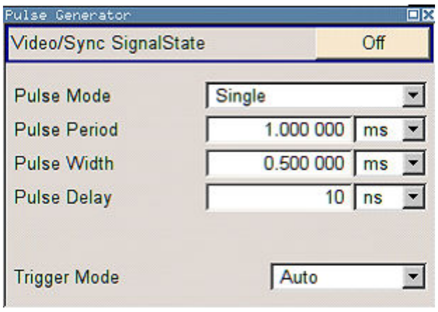
The "Pulse Generator" dialog is used to configure and activate a pulse modulation signal.

5.5.4.1 Pulse Generator Settings



To access the pulse generator settings ...

► Select "Mod Gen > config... > Pulse Generator" or use the MENU key under "Mod Gen".
Alternatively, the R&S SMA provides the pulse generator parameters in the "Pulse Modulation" dialog accessed via the "Modulation" block.



The dialog provides the settings for the pulse characteristics and trigger mode. Depending on the selected modulation source and pulse mode the provided parameters vary.
Note: Extended features as the generation of double pulse signals with selectable pulse widths and periods, or selectable trigger mode require option R&S SMA-K23.

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.

Remote command:
[:SOURce<hw>]:PGENerator:STATe on page 601

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 SMA-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 339).
A pulse train is a sequence of pulses with user-defined on and off times. The on-time/off-time value pairs are defined in a pulse train list.
The currently used pulse train file is displayed in the sub menu.

Remote command:
`[:SOURce<hw>]:PULM:MODE` on page 622

Pulse Period - Pulse Generator
Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Remote command:
`[:SOURce<hw>]:PULM:PERiod` on page 622

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.

Remote command:
`[:SOURce<hw>]:PULM:WIDTh` on page 634

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.

Remote command:
`[:SOURce<hw>]:PULM:DELay` on page 621

Double Pulse Width - Pulse Generator
(Double Pulse only)

Sets the width of the second pulse.

Remote command:
`[:SOURce<hw>]:PULM:DOUBle:WIDTh` on page 622

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.

Remote command:
`[:SOURce<hw>]:PULM:DOUBle:DELay` on page 621

Trigger Mode - Pulse Generator
Selects the trigger mode for pulse modulation.

Note: An external trigger signal is supplied via the PULSE EXT connector.

"Auto"
The pulse generator signal is generated continuously.

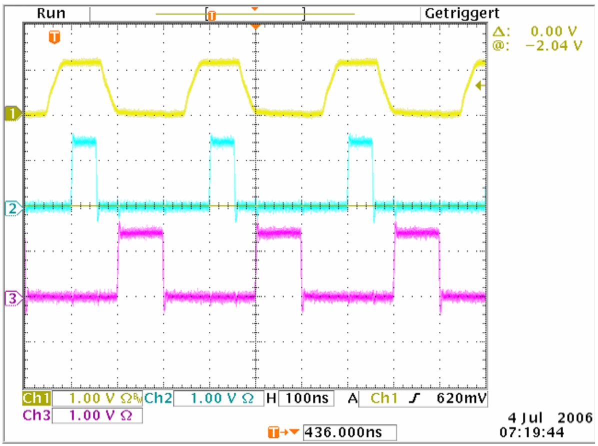
"Ext Triggered"

The pulse generator signal is triggered by an external trigger event.

Example: Generation of pulse signals using trigger modes Ext Triggered (Single Pulse)

The measurement is performed using a 6-dB-attenuator.

Parameter	**Value**
Trigger Mode	Ext Triggered
Double Pulse State	Off
External Trigger Input Slope	Positive
Pulse Delay	100 ns
Pulse Width	100 ns
Pulse Period	-



Channel 1 = Indicates the external trigger signal. The positive slope is active.
Channel 2 = Indicates the sync signal. The sync signal starts after a trigger delay of typically 50 ns (see specifications).
Channel 3 = Indicates the pulse signal. The pulse signal starts after the set pulse delay of 100 ns.

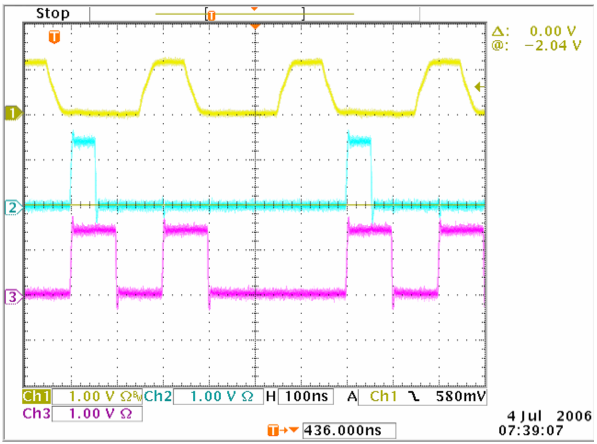
Note: The sync signal is output at the PULSE SYNC connector, and the pulse signal at the PULSE VIDEO connector.

Example: Generation of pulse signals using trigger modes Ext Triggered (Double Pulse)

The measurement were made using a 6-dB-attenuator.

Parameter	**Value**
Trigger Mode	Ext Triggered
Double Pulse State	On
External Trigger Input Slope	Negative
Pulse Width	100 ns

Parameter	Value
Double Pulse Width	100 ns
Double Pulse Delay	200 ns
Pulse Period, Pulse Delay	-



Channel 1 = Indicates the external trigger signal. The negative slope is active. A second trigger signal during double pulse generation is without effect.

Channel 2 = Indicates the sync signal. The sync signal starts after a trigger delay of typically 50 ns (see specifications).

Channel 3 = Indicates the double pulse signal. The first pulse starts without a delay. The second pulse starts after the set double pulse delay (time between start of first pulse to start of second pulse).

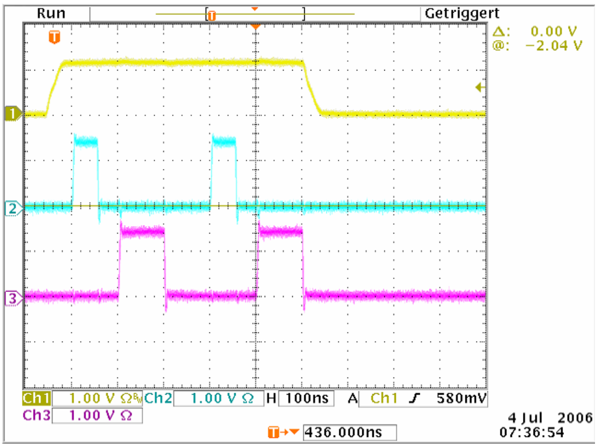
Note: The sync signal is output at the PULSE SYNC connector, and the double pulse signal at the PULSE VIDEO connector.

"Ext Gated"
The pulse generator signal is gated by an external gate signal.

Example: Generation of pulse signals using trigger mode External Gated (Single Pulse)

The measurement is performed using a 6-dB-attenuator.

Parameter	Value
Trigger Mode	Extern Gated
Double Pulse State	Off
External Trigger Input Slope	Positive
Pulse Delay	100 ns
Pulse Width	100 ns
Pulse Period	300 ns



Channel 1 = Indicates the external gate signal. The signal is active when it is high (positive).
Channel 2 = Indicates the sync signal. The sync signal starts after a trigger delay of typically 50 ns (see specifications). It is repeated after the set pulse period of 300 ns as long as the gate signal is active.
Channel 3 = Indicates the pulse signal. The first pulse starts after the pulse delay of 100 ns. The second pulse starts after the set pulse period.

Note: The sync signal is output at the PULSE SYNC connector, and the pulse signal at the PULSE VIDEO connector.

Remote command:
[:SOURce<hw>]:PULM:TRIGger:MODE on page 629

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.

Remote command:
[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe on page 629

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.

Remote command:
[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity on page 628

External Impedance
Selects the input impedance (10 kOhm or 50 Ohm) for the external trigger and gate signal input (PULSE EXT).

Remote command:
[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance on page 629

5.5.4.2 Pulse Train Generation

In "Pulse Train" mode, the instrument provides the associated parameters for configuring a user-defined pulse train signal.

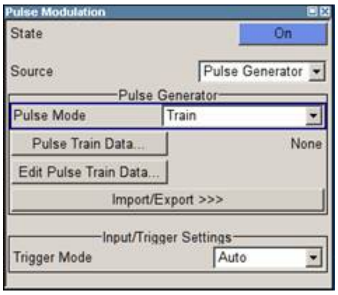
A pulse train is a sequence of pulses with user-defined on and off times. The "ON Time / OFF Time" value pairs are defined in a pulse train table and can be stored in a file. The currently loaded file is displayed in the dialog. You can export an internally created pulse train list as well as import an externally created one.

In remote control mode, you must first create a data file, before you switch to pulse train mode. Otherwise you get the error message "No current list" in the "Info" line, see Example "Generating a pulse train signal" on page 619.

How to configure a pulse train signal

To perform pulse train generation, perform the following steps:

1. In the block diagram, select "Modulation > config... > Pulse Modulation".
2. Select "Source > Pulse Generator".
3. Select "Pulse Mode > Train".



The instrument displays the parameters required for configuring pulse train data.

4. Select "Pulse Train Data... > New List / Select List or File Manager".
5. Navigate to the target directory and select an existing file, or create a new file by assigning the "File Name".
6. According to your selection, confirm with "Save" or "Select".

   The R&S SMA automatically uses the new file for further editing. Pulse train data files have the fixed file extension `*.pulstrn`.
7. In the "Pulse Modulation" dialog, select "Edit Pulse Train Data... > Edit" to define the on and off time value pairs and the repetition factor for each value pair.
8. When completed, save the file.
9. Starting in the block diagram, perform the following steps to activate signal generation:
   a) Select "Mod Gen > config... > Pulse Generator > Video/Sync Signal State > On".
   b) Select "Modulation > config... > Pulse Modulation > State > On".
   c) Activate RF signal generation in the "RF" block.

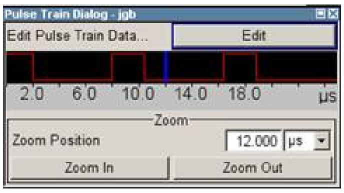
   The R&S SMA generates an RF pulse sequence signal according to the values specified in the file.

Pulse Train Data – Pulse Generator
Opens the "File Select" dialog for selecting and creating a pulse train file, and provides access to the "File Manager".

Remote command:
`[:SOURce<hw>]:PULM:TRAin:CATalog?` on page 624
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 628
`[:SOURce<hw>]:PULM:TRAin:DELete` on page 624

Edit Pulse Train Data – Pulse Generator
Opens the Pulse Train Dialog.

Pulse Train Dialog



Displays the pulse sequence as defined in the file.

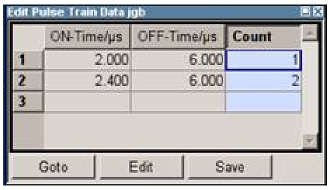
"Edit" Opens the pulse train dialog, see Edit Pulse Train Data. The dialog graphically represents the pulse train signal and provides access to the data editor.

"Zoom Position"
Sets the blue marker in the pulse train graph. The marker defines the center of any zoom in or zoom out action.

"Zoom In / Zoom Out"
Enlarges the diagram by factor 2 per "Zoom In", or scales it down accordingly when you select "Zoom Out".

Edit Pulse Train Data

Opens an editor allowing you to enter the "On-Time / OFF-Time" value pairs in a table. In addition, you can assign a repetition rate to each pair. Based on these values, the instrument then generates the pulse train signal. You can enter any number of value pairs and save your list in a file. The file name is displayed in the header of the dialog.



"ON-Time/µs" Determines the length of the respective pulse (signal is high).

Remote command:
[:SOURce<hw>]:PULM:TRAin:ONTime on page 626

"OFF-Time/µs" Determines the time length, the signal level of the pulse remains low.

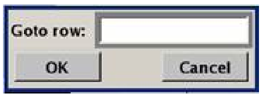
Remote command:
[:SOURce<hw>]:PULM:TRAin:OFFTime on page 625

"Count" Sets the number of repetitions for each pulse ("ON-Time/µs"/"OFF-Time/µs" value pair).
Tip: If you set "Count = 0", the corresponding value pair is ignored in the pulse sequence. With this function you can skip value pairs individually, without deleting them from the table. This allows re-enabling a value pair by entering a number unequal to zero.

Remote command:
[:SOURce<hw>]:PULM:TRAin:REPetition on page 627

"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" Opens a menu containing editing functions.

"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 dialog 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" Opens the file dialog to save the list under a new name.
Each list is saved to the CompactFlash™ 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.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 633

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.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension` on page 630

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

Remote command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal`
on page 632

Column Separator- ASCII File Settings
Selects the separator between the frequency and level column of the ASCII table.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn`
on page 631

Select ASCII Source / Destination - Import/Export Pulse Train Files
Opens 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.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?` on page 630
`[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect` on page 631

Select Destination / Source - Import/Export Pulse Train Files
Opens 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.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect` on page 634

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.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute` on page 633

5.6 Clock Synthesis

The clock synthesis provides a separate system clock with a freely selectable frequency for test setups that require an additional clock reference. For example, in a test setup that uses an A/D converter the required system clock for data sampling can be provided without the need of additional signal generator.

The generated clock reference is synchronized to the selected reference clock of the signal generator (internal or external). The differential signal is output at the "CLK SYN" and "CLK SYN N" connector at the rear of the instrument.

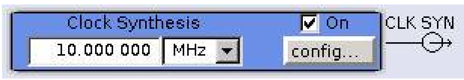
Settings are made in the "Clock Synthesis" block. The function block is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) including option R&S SMA-B29.

5.6.1 Clock Synthesis Dialog

To access the "Clock Synthesis" dialog, select the "Clock Synthesis" function block or use the MENU key under "Clock Synthesis".

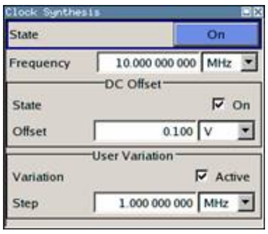
The clock signal can be activated and deactivated directly using the TOGGLE ON/OFF key (the function block must be highlighted beforehand).

The activated and deactivated state is indicated in the block diagram by means of the different block color and the status of the "On" checkbox. The disconnected connection to the output is additionally shown when the output is deactivated.



The Clock Synthesis state can also be set in the "Configure" menu of the block:

The clock synthesis state is activated and frequency is set in the top section of the menu.



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

5.6.1.1 Clock Synthesis general Settings

State - Clock Synthesis
Activates/deactivates generation of a system clock for output CLK SYN at the rear of the instrument .

Remote command:
:CSYNthesis:STATe on page 402

Frequency - Clock Synthesis
Sets the frequency. The frequency entered and displayed here corresponds to the frequency at the CLK SYN output.

Remote command:
:CSYNthesis:FREQuency on page 401

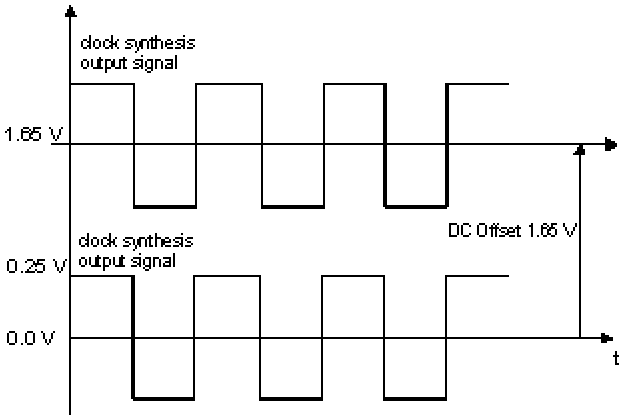
5.6.1.2 DC Offset

A DC offset can be defined in the "DC Offset" section.

State DC Offset - Clock Synthesis
Requires modules with part number 1400.2749.02 (see "Setup" menu).

Activates a DC offset for both clock synthesis signal outputs.

The DC offset can be used e.g. to shift the clock synthesis output signal into the trigger threshold of some logic elements.



Remote command:
:CSYNthesis:OFFSet:STATe on page 403

DC Offset - Clock Synthesis
Requires modules with order number 1400.2749.02 (see "Setup" menu).

Enters the value of the DC offset for both clock synthesis signal outputs.

Remote command:
:CSYNthesis:OFFSet on page 403

5.6.1.3 User Variation

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

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

Remote command:
`:CSYNthesis:FREQuency:STEP` on page 402

Variation Active
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).

Remote command:
`:CSYNthesis:FREQuency:STEP:MODE` on page 402

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:
	• HiSLIP High-Speed LAN Instrument Protocol (IVI-6.1)
	VISA*) address string:
	`TCPIP::host address::hislip0[::INSTR]`
	• VXI-11
	VISA*) address string:
	`TCPIP::host address[::LAN device name][::INSTR]`
	• socket communication (Raw Ethernet, simple telnet)
	VISA*) address string:
	`TCPIP::host address[::LAN device name]::<port>::SOCKET`
		A LAN connector is located on the front or rear panel of the instrument, or both.
		The interface is based on TCP/IP and supports various protocols.
		For a description of the protocols refer to:
		• Chapter 6.1.3.1, "HiSLIP Protocol", on page 351
		• Chapter 6.1.3.2, "VXI-11 Protocol", on page 351
		• Chapter 6.1.3.3, "Socket Communication", on page 351

Serial Interface	VISA*) address string: `ASRL[0-9][::INSTR]`	For a description of the interface, refer to Chapter 6.1.5, "Serial Interface", on page 353.
GPIB (IEC/IEEE Bus Interface)	VISA*) address string: `GPIB::primary address[::INSTR]` (no secondary address)	Optional GPIB bus interfaces according to standard IEC 625.1/ IEEE 488.1 are located on the rear panel of the instrument. For a description of the interface, refer to Chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353. **Note:** Within this interface description, the term GPIB is used as a synonym for the IEC/IEEE bus interface.
*) 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 or HiSLIP protocol), USB and serial interface. For remote control via socket communication VISA installation is optional. For more information, see Chapter 6.1.1, "VISA Libraries", on page 348.		

Rohde & Schwarz provides the standardized I/O software library R&S VISA for communication via TCP/IP (LAN: HiSlip, VXI-11 and raw socket) or USB (USBTMC) interfaces.

R&S VISA is available for download at the Rohde & Schwarz website http://www.rohde-schwarz.com/rsvisa.

How to configure the remote control interfaces, see Chapter 6.2, "Starting a Remote Control Session", on page 356.

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. Thus, you can configure the interface and must not adjust the application program to the used interface. The I/O channel (LAN or TCP/IP, USB, GPIB,...) is selected at initialization time with the channel-specific address string ("VISA resource string"), or by a defined VISA alias (short name). See also Chapter 6.1, "Remote Control Interfaces and Protocols", on page 347 for an overview.

Instrument access via VXI-11 or HiSLIP protocols is 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.

A VISA installation is a prerequisite for remote control using the following interfaces:

- LAN Interface using Chapter 6.1.3, "LAN Interface", on page 349
- LAN interface using Chapter 6.1.3.2, "VXI-11 Protocol", on page 351
- Chapter 6.1.4, "USB Interface", on page 352
- Chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353
- Chapter 6.1.5, "Serial Interface", on page 353

Instrument access via the LAN socket protocol or GPIB connections can be operated both, with or without the VISA library.

See also Chapter 6.1.3.3, "Socket Communication", on page 351 and Chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353.

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 370. 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 confirmed" 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 VXI-11 or HiSLIP protocols is 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 348 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.

Forms of the VISA resource string:

- `TCPIP::host address[::LAN device name][::INSTR]`
- `TCPIP::host address::port::SOCKET`

Where:

- `TCPIP` designates the network protocol used
- `host address` is the IP address or host name of the device
- `LAN device name` defines the protocol and the instance number of a subinstrument:
  - `inst0` selects the VXI-11 protocol (optional, default)
  - `hislip0` selects the newer HiSLIP protocol
- `INSTR` indicates the instrument resource class (optional)
- **`port`** determines the used port number
- `SOCKET` indicates the raw network socket resource class

Example:

- Instrument has the IP address *192.1.2.3*; the valid resource string using VXI-11 protocol is:
  `TCPIP::192.1.2.3::INSTR`
- The DNS host name is *RSSM1*; the valid resource string is:
  `TCPIP::RSSM1::hislip0` (HiSLIP)
  `TCPIP::RSSM1::INSTR` (VXI-11)
- A raw socket connection can be established using:
  `TCPIP::192.1.2.3::5025::SOCKET`

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 the resource string.

6.1.3.1 HiSLIP Protocol

The HiSLIP (**Hi**gh **S**peed **L**AN **I**nstrument **P**rotocol) is the successor protocol for VXI-11 for TCP-based instruments specified by the IVI foundation. The protocol uses two TCP sockets for a single connection - one for fast data transfer, the other for non-sequential control commands (e.g. `Device Clear` or `SRQ`).

HiSLIP has the following characteristics:

- High performance as with raw socket network connections
- Compatible IEEE 488.2 support for Message Exchange Protocol, Device Clear, Serial Poll, Remote/Local, Trigger, and Service Request
- Uses a single IANA registered port (4880), which simplifies the configuration of firewalls
- Supports simultaneous access of multiple users by providing versatile locking mechanisms
- Usable for IPv6 or IPv4 networks

Using VXI-11, each operation is blocked until a VXI-11 device handshake returns. However, using HiSLIP, data is sent to the device using the "fire and forget" method with immediate return. Thus, a successful return of a VISA operation such as `viWrite()` does not guarantee that the instrument has finished or started the requested command, but is delivered to the TCP/IP buffers.

For more information see also the application note: 1MA208: Fast Remote Instrument Control with HiSLIP.

6.1.3.2 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.

6.1.3.3 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 to as "Raw Ethernet communication", does not necessarily require a VISA installation on the remote controller side. It is available by default on all operating systems.

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 more convenience 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 SMA 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.

6.1.3.4 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). (The instrument automatically returns to remote state when a remote command is sent UNLESS `&NREN` was sent before.)
&GTR	Go to Remote	Enables automatic transition from local state to remote state by a subsequent remote command (after `&NREN` was sent).
&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 transition from remote control to manual control by means of the front panel keys.
&NREN	Not Remote Enable	Disables automatic transition from local state to remote state by a subsequent remote command. (To re-activate automatic transition use `&GTR`.)
&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::0x0048::100001::INSTR`

0x0AAD is the vendor ID for Rohde&Schwarz

0x0048 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 connected via an external USB/serial-adapter (see recommended extras, data sheet) and a serial crossover (null modem) cable. A USB connection requires the VISA library to be installed on the controller. VISA detects and configures the R&S SMA 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 5.2.3.19, "Security", on page 117).

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 5.2.3.15, "Remote Channel Settings", on page 112).

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 355).

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.
2. Select "Remote > GPIB".

3. Enter the GPIB address.
4. Remotely: use the remote control command:
   `SYST:COMM:GPIB:ADDR 18`

6.1.7 LXI Browser Interface

LAN extension for instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology, see also Chapter 2.8, "LXI Configuration", on page 46.

The LXI browser interface allows easy configuration of the LAN and remote control of the R&S SMA without additional installation requirements. The instrument's LXI browser interface works correctly with all W3C compliant browsers.

The LAN settings are configured using the LXI Browser Interface of the R&S SMA described in Chapter 2.8.2, "LAN Configuration", on page 49. The LXI status settings in the R&S SMA are described in Chapter 5.2.3.17, "LXI Status", on page 115.

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 349, Chapter 6.1.4, "USB Interface", on page 352, Chapter 6.1.5, "Serial Interface", on page 353, Chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 353 or Chapter 6.1.7, "LXI Browser Interface", on page 355 for details.

The VISA resource strings are indicated in the "Setup > Remote Channel Settings" menu.

Securing the display

To prevent unauthorized personnel from reading the display, you can disable the frequency and level display explicitly. This is useful when you remotely control the instrument from a different location.

For information on how to disable the frequency and level display, refer to "Annotation Frequency" on page 121 and "Annotation Amplitude" on page 121.

Refer to Chapter 6.2.3, "Examples", on page 357 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

After switching on, the instrument is usually in the local state and can be operated via the front panel controls (for instruments equipped with a display), a mouse and an external keyboard.

Starting remote control

1. Send a command from a controller to the instrument.

   The instrument changes to remote state as soon as it receives the command from the controller.

   Note: If you have sent `&NREN` before, the automatic transition from local state to manual control by a subsequent remote command is disabled (use `&GTR` to enable it again).

   In remote state, operation via the front panel or via mouse and keyboard is disabled. The status line indicates the "REMOTE" state.

The instrument remains in the remote state until it is reset to the local state, see Chapter 6.2.2, "Returning to Manual Operation", on page 357).

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, for example to verify settings. The buttons and setting fields are grayed out and cannot be activated.
   Additionally, you can disable the access to the dialogs with the command `SYST:KLOC ON` to protect the instrument against unauthorized readings.
3. To prevent unintentional return to manual operation, disable the LOCAL key of the instrument with the `&LLO` command (see Chapter 6.1.3.4, "LAN Interface Messages", on page 352).

   The instrument switches to "REM-LLO" state.
   The automatic transition from local state to remote state by a subsequent remote command, and the command `*GTL` are disabled.
   To return to manual mode is only possible via remote control.
4. Unlock the LOCAL key with `&GTR`.

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, perform one of the following:

- Press the LOCAL key on the front panel.
- Select "Setup > Remote Control Channels > Local".
- While using the socket communication, terminate the remote control session.
- Send the interface command `&GTL` via the remote control interface.

Use the `&GTR` to enable the LOCAL key if it is locked.

6.2.3 Examples

This sections provides examples for setting up the remote control connection, and starting a remote control session.

This section assumes basic knowledge of programming and operation of the controller. A description of the interface commands can be obtained from the corresponding 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://www.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 sent `CALL IBLOC (generator%)` or press the LOCAL key at the front panel.

6.2.3.2 Remote Control over LAN using VXI-11 Protocol

In this example, the I/O software library R&S VISA from Rohde & Schwarz is used to set up a LAN remote control link and remotely control the R&S SMA. R&S VISA is running on a controller PC with Windows operating system. When the connection is set up you can send commands to the instrument, and receive the responses.

The remote control connection requires a VISA installation but no additional hardware on the controller PC. The LAN I/O channel is selected at initialization time using the VISA resource string (also referred to as "address string"). A VISA alias (short name) is used to replace the complete resource string. The host address is either the R&S SMA's hostname or IP address. See also Chapter 6.1.3, "LAN Interface", on page 349.

In this example, it is assumed that:

- A LAN remote control link between the controller and the R&S SMA is already set up.
- The R&S VISA program is installed on the remote PC, see "http://www.rohde-schwarz.com/rsvisa > RS VISA Release Notes".

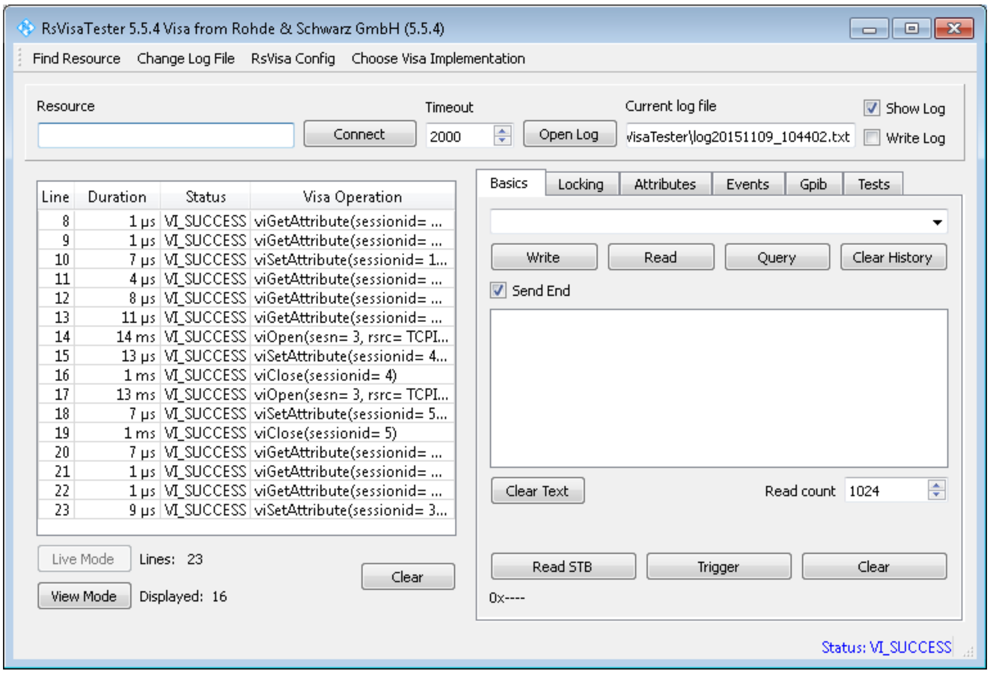
Configuring the controller

To remote control the R&S SMA, we use the R&S VISA Tester application.

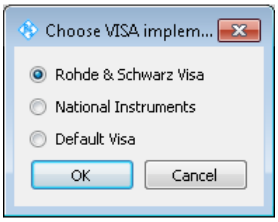
The instrument is preconfigured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, enter the computer name in the position of the IP address.

To enable the external controller to communicate with the R&S SMA via TCP/IP protocol, set up a remote control link as follows:

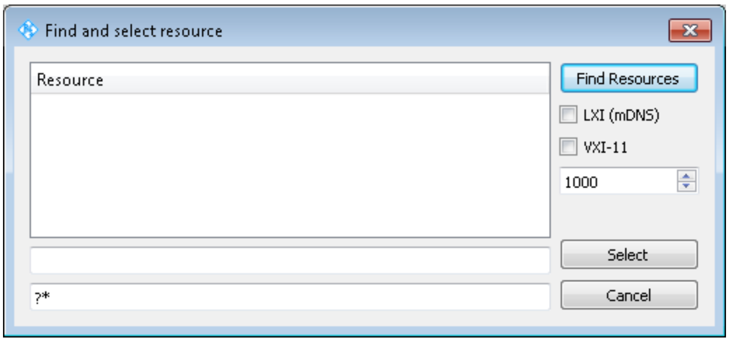
1. Make sure that the controller and the instrument are connected in the network (network cable) and switched on.
2. On the controller, start "R&S VISA > Tester 32bit" or "R&S VISA > Tester 64bit", respectively.



3. In the menu bar, select "Choose VISA Implementation > Rohde & Schwarz Visa".

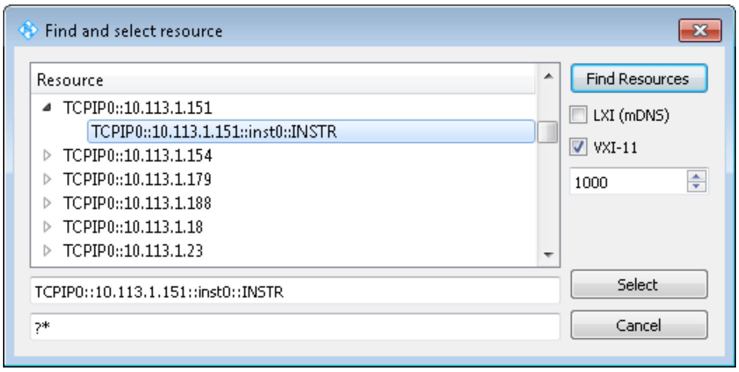


4. Select "Rohde & Schwarz Visa" and confirm with "OK".
5. In the menu bar, select "Find Resource" to search for the instrument in the LAN.



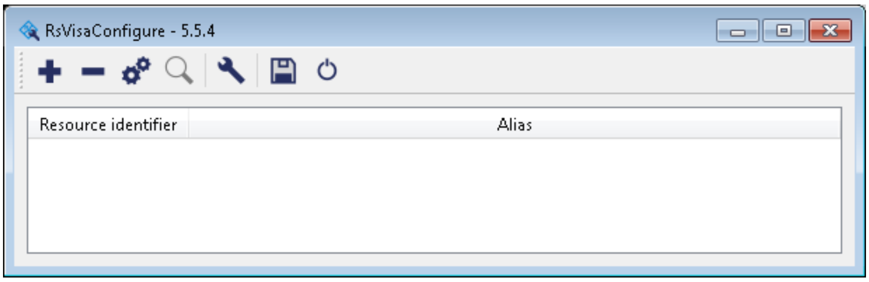
6. Select "VXI-11" and "Find Resources".

   R&S VISA scans the network for connected instruments and lists all detected instruments in the "Resource" list.
   Note: The search may take some time, particularly in large networks.
7. Select the required instrument and confirm with "Select".



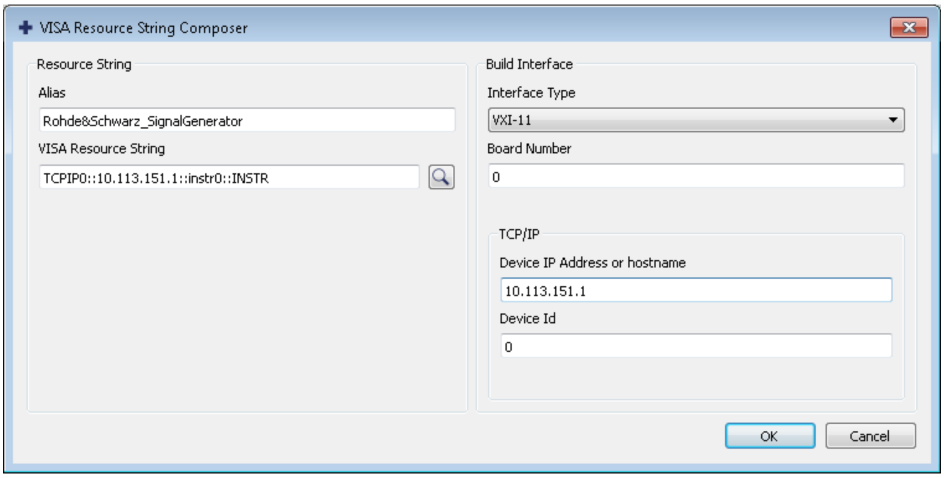
   The "Find and select resource" dialog closes and R&S VISA indicates the instruments IP address in the "Resource" field of the main application window.
8. As an alternative to the IP address, you can assign an alias name to the R&S SMA:

a) In the menu bar, select "RsVisaConfig".

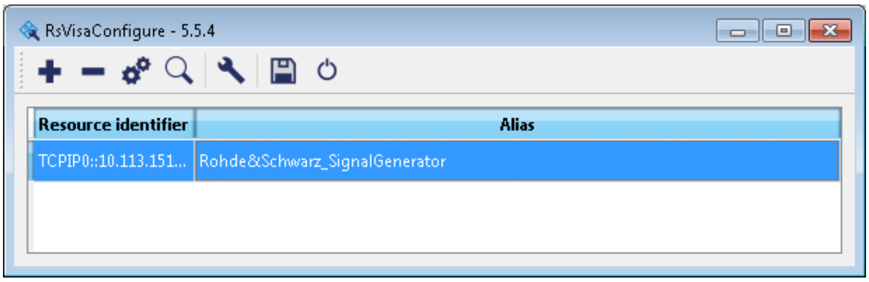


b) In the toolbar, select "+" to access the "VISA Rexource String Composer".

c) Fill in the "Alias" name, the "VISA Resource String" and the "Device IP Address or host name" as shown in the figure, and confirm with "OK".



The "Alias" name is assigned to the instrument.



d) Close the dialog.
The R&S SMA is now registered in the program and can be addressed via the resource string or alias name.

9. In the main window, select "Connect".

R&S VISA establishes the connection to the R&S SMA.

Now you can send settings to configure the instrument and receive its responses.

Note: If the connection cannot be set up, R&S VISA displays an error in the log view. For information on how to proceed when network failures occur, see Chapter 9.5, "Resolving Network Connection Failures", on page 694.

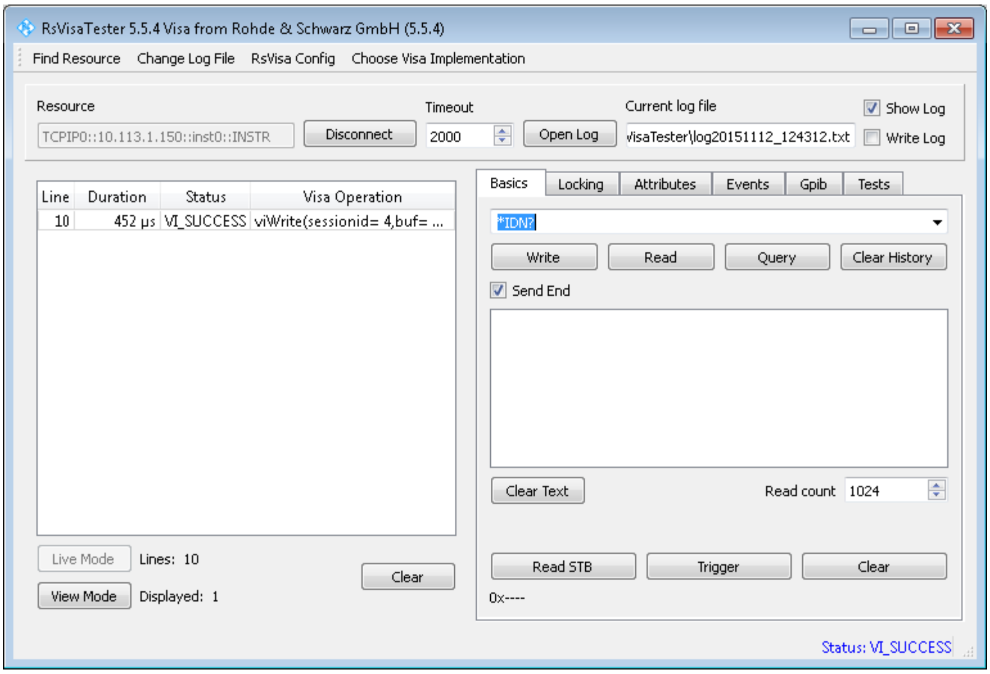
For further information on the functions to read and write to an open session, as well as the utility applications the software provides, see the R&S VISA User Manual.

Starting a remote control over LAN (using VXI-11)

To set the instrument to remote control, you can use the addressed command `&GTR`, or send any command from the controller.

1. Start the R&S VISA Tester and establish the connection to the R&S SMA, see "Configuring the controller" on page 359.
2. In the R&S VISA "Basics" tab, enter a SCPI command, e.g. "*IDN?" and confirm with "Query".

   The instrument is switched to remote control when it receives a command from the controller.
3. Select "Read" to obtain the instrument response.

   Tip: If the "Show Log" checkbox is checked R&S VISA displays each VISA function call in the log-view on the left. If you check the "Write Log" checkbox the log-view entry is written to the log file as well. You can operate the log-view in two modes: the "Live Mode" shows only the most recent messages whereas the "View Mode" allows you to scroll the history.
4. To set, e.g. the frequency, enter `SOUR1:FREQ 4 GHz` and select "Write".

   To check the performed setting, `SOUR1:FREQ?` and select "Read".

The instrument response is `4000000000`, i.e. the frequency is returned in Hz.

While remote control is active, the "Remote" icon in the status bar indicates that the instrument is in remote control mode. The operation via the front panel or via mouse and keyboard are locked, allowing a remote control program to be performed without interruption.
On the display, keys and entry fields are grayed out and cannot be activated or modified, but you can still open dialogs, for example to verify settings.

5. To disable the access to the dialogs, use the command `SYST:KLOC ON`.
6. To prevent unintentional return to manual operation, use the command `&LLO`.
   See also Chapter 6.1.3.4, "LAN Interface Messages", on page 352.
   The instrument switches to "Remote LLO" state. The LOCAL key is disabled.
7. To enable the LOCAL key, use the command `&GTR`.
8. To return to manual operation, see Chapter 6.2.2, "Returning to Manual Operation", on page 357.
   Tip: Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

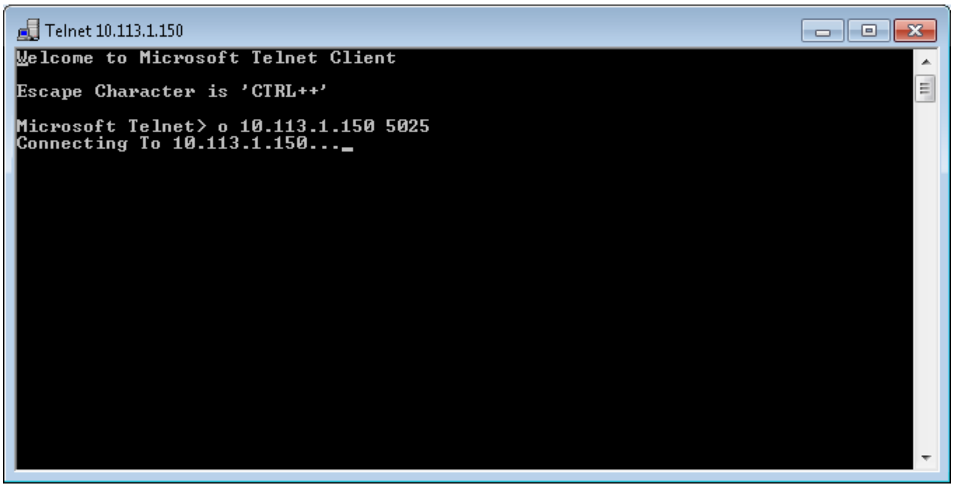
6.2.3.3 Remote Control over LAN using Socket Communication

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

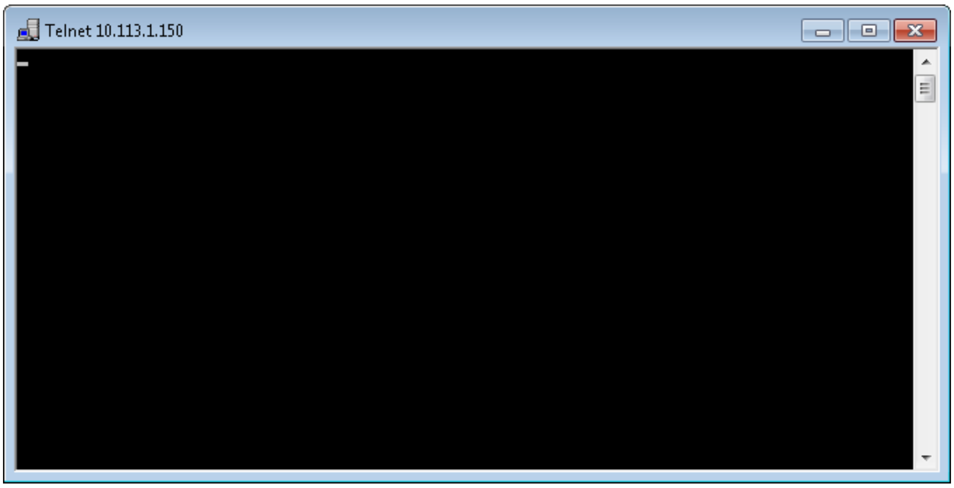
To control the software, only a telnet program is required. The telnet program is part of every operating system.

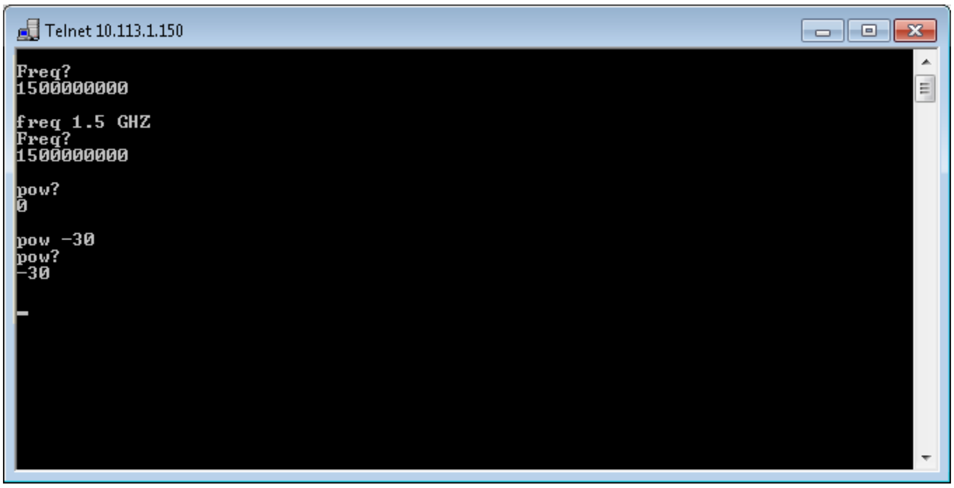
1. To establish a Telnet connection with the R&S SMA, start the telnet program.
2. Enter the access string to connect to the instrument and confirm with ENTER.
   The access string is composed of the open command short form) and the socket address. The socket address is a combination of the IP address or the host name of the R&S SMA and the number of the port configured for remote-control via telnet. The R&S SMA uses the port number 5025 for remote connection via Telnet.
   Example: `o 10.113.1.150 5025`



The connection to the instrument is set up and you can send remote-control commands.

3. 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 has been sent, 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 SMA 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 373.

Example:

Definition:`HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`

Command:`HCOP:DEV:CMAP:COL:RGB 3,32,44`

Special characters

<table>
<tr><td>|</td><td>Parameters
A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
Example:
Definition:HCOPy:PAGE:ORIentation LANDscape | PORTrait
Command HCOP:PAGE:ORI LAND specifies landscape orientation
Command HCOP:PAGE:ORI PORT specifies portrait orientation
Mnemonics
A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used.
Example:
DefinitionSENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>
The two following commands with identical meaning can be created:
SENS:BAND:RES 1
SENS:BWID:RES 1</td></tr>
<tr><td>[ ]</td><td>Mnemonics in square brackets are optional and may be inserted into the header or omitted.
Example: HCOPy[:IMMediate]
HCOP:IMM is equivalent to HCOP</td></tr>
<tr><td>{ }</td><td>Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
Example: SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}
The following are valid commands:
SENS:LIST:FREQ 10
SENS:LIST:FREQ 10,20
SENS:LIST:FREQ 10,20,30,40</td></tr>
</table>

6.3.3 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `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.
' ' "	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. • Binary: #B10110 • Octal: #O7612 • Hexa: #HF3A7 • Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

6.3.5 Structure of a command line

A command line may consist of one or several commands. It is terminated by one of the following:

- a <New Line>
- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

`MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL`

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Example:

`HCOP:ITEM ALL;:HCOP:IMM`

This command line 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 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. Keeping the order is called synchronization between the controller and the instrument.

Setting commands within one command line, even though they can be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. To make sure that commands are actually executed 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 can 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 • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending *OPC? directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Sending *WAI directly after the command whose processing should be terminated before other commands are executed.

Command synchronization using *WAI or *OPC? is a good choice if the overlapped command takes only little time to process. The two synchronization commands simply block overlapped execution of the command. Append the synchronization command to the overlapping command, for example:

```
SINGle; *OPC?
```

For time consuming overlapped commands you can 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.

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.

You can query both with the commands of the STATus Subsystem.

6.5.1 Hierarchy of the Status Registers

The Figure 6-1 shows the hierarchical structure of information in the status registers (ascending from left to right).

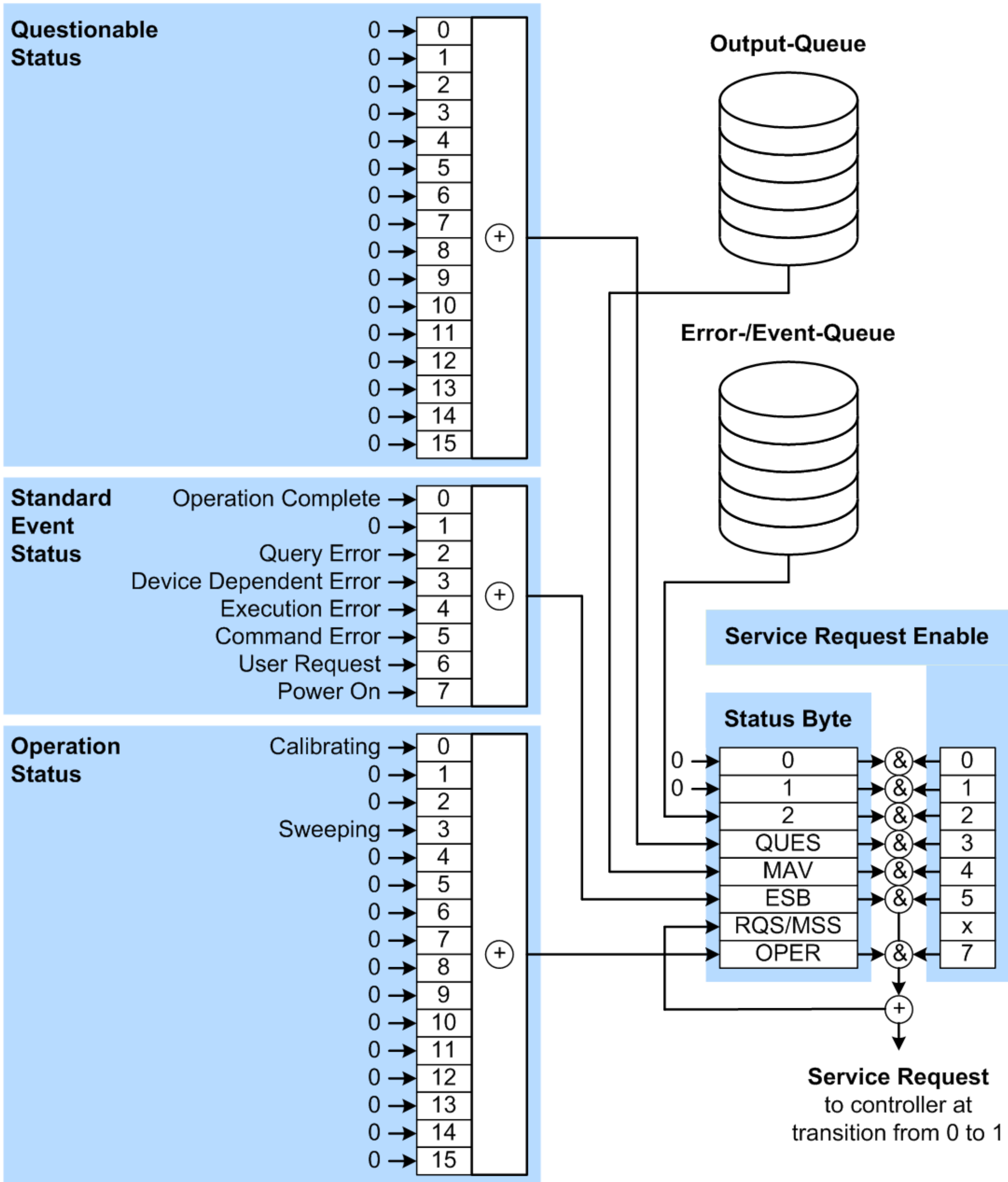


Figure 6-1: Graphical overview of the status registers hierarchy

OPER	= Operation Status Summary Bit
RQS/MSS	= Service Request Generation
ESB	= Standard Event Status Summary Bit
MAV	= Message Available in Output Queue
QUES	= Questionable Status Summary Bit
2	= Error- /Event-Queue
1, 0	= not used

Note: This legend explains the abbreviations to the Status Byte Register.

The R&S SMA uses the following status registers:

- **Status Byte** (STB) and **Service Request Enable** (SRE), see Chapter 6.5.3, "Status Byte (STB) and Service Request Enable Register (SRE)", on page 385.

- **Standard Event Status**, i.e. the Event status Register (ESR) and the Event Status Enable (ESE), see Chapter 6.5.4, "Event Status Register (ESR) and Event Status Enable Register (ESE)", on page 386.
- **Questionable Status** and **Operation Status**, the (SCPI status registers, see Chapter 6.5.2, "Structure of a SCPI Status Register", on page 383, Chapter 6.5.5, "Questionable Status Register (STATus:QUEStionable)", on page 386 and Chapter 6.5.6, "Operation Status Register (STATus:OPERation)", on page 387.
- **Output-Queue**
The output queue 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.
- **Error- /Event-Queue**
The error-/event-queue contains all errors and events that have occurred in the past. When reading the queue, the instrument starts with the first occurred error/ event.

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.

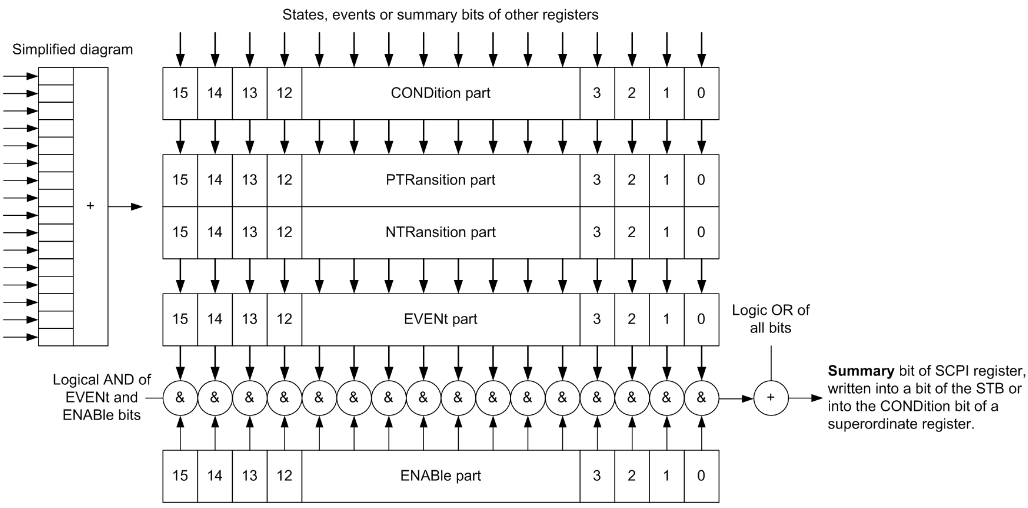


Figure 6-2: The status-register model

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 / NTRansition**
  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.
  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 Status Byte (STB) and Service Request Enable Register (SRE)

The `STatus Byte` (STB) is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB is read using the command `*STB?` or a serial poll.

The `STatus Byte` (STB) is linked to the `Service Request Enable` (SRE) register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated. The SRE can be set using the command `*SRE` and read using the command `*SRE?`.

Table 6-3: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
2	Error Queue not empty The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	QUEStionable status register summary bit The bit is set if an `EVENt` bit is set in the `QUEStionable` status register and the associated `ENABle` bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by querying the `STATus:QUEStionable` status register.
4	MAV bit (message available) The bit is set if a message is available in the output queue 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 Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	MSS bit (master status summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	`STATus:OPERation` status register summary bit The bit is set if an `EVENt` bit is set in the `OPERation` status register and the associated `ENABle` bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by querying the `STATus:OPERation` status register.

6.5.4 Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the `EVENt` part of a SCPI register. The event status register can be read out using command *ESR?.

The ESE corresponds to the `ENABle` part of a SCPI register. If a bit is set in the ESE and the associated bit in the ESR changes from 0 to 1, the ESB bit in the STB is set. The ESE register can be set using the command `*ESE` and read using the command `*ESE?`.

Table 6-4: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	Not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.
5	Command Error This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	User Request This bit is set when the instrument is switched over to manual control.
7	Power On (supply voltage on) This bit is set on switching on the instrument.

6.5.5 Questionable Status Register (STATus:QUEStionable)

This register contains information on questionable instrument states. Such states may occur when the instrument is not operated in compliance with its specifications.

To read the register, use the query commands STAT:QUEST:COND? or STAT:QUEST[:EVEN]?.

Table 6-5: Meaning of the bits used in the questionable status register

Bit No.	Meaning
0–15	Not used

6.5.6 Operation Status Register (STATus:OPERation)

This condition part contains information on the actions currently being performed by the instrument, while the event part contains information on the actions performed by the instrument since the last readout of the register.

To read the register, use the query commands STAT:OPER:COND? or STAT:OPER[:EVEN]?.

Table 6-6: Meaning of the bits used in the operation status register

Bit No.	Meaning
0	Calibrating The bit is set during the calibration phase.
1–2	Not used
3	Sweeping This bit is set during a sweep in automatic or single mode.
4–15	Not used

6.5.7 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 to find out who sent an SRQ and why
- Query of a **specific instrument status** by commands
- Query of the **error queue**

6.5.7.1 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. 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.

6.5.7.2 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.

6.5.7.3 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.

6.5.7.4 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.

6.5.8 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 of `*RST` and `SYSTem:PRESet` affect the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table 6-7: Resetting the status reporting system

Event	**Switching on supply voltage** **Power-On-Status-Clear**		`DCL`, `SDC` **(Device Clear, Selected Device Clear)**	`*RST` **or** `SYSTem:PRESet`	`STATus:PRESet`	`*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 347.

7.1 Conventions used in SCPI Command Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S SMA follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

7.2 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:

***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,SMA,`
`1407.6004k02/000000,3.1.17.1-03.01.158`

Usage: Query only

Manual operation: See "Hardware Options / Software Options" on page 100

***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 data sheet.

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

Manual operation: See "Hardware Options / Software Options" on page 100

***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

Loads 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.

Manual operation: See "Recall" on page 133

***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

Manual operation: See "Preset" on page 94

***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`.

Manual operation: See "Save" on page 131

***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. This common command complements the commands of the `TRIGger` subsystem.

Usage: Event

***TST?**

Self-test query

Initiates self-tests of the instrument and returns an error code

Return values:

<ErrorCode> **integer > 0 (in decimal format)**
An error occurred.
(For details see the Service Manual supplied with the instrument).

0
No errors occurred.

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

7.3 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 394). 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 397)
- Activating the preset state of all parameters that are not related to the signal path (`:DEVice:PRESet` on page 396)
- Activating the original state of delivery (factory reset, `:SYSTem:FPReset` on page 397). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

:DEVice:PRESet

Presets all parameters which are not related to the signal path, including the LF generator.

Example: Presets all instruments settings that are not related to the signal path

Usage: Event

:SOURce<hw>:PRESet

Presets all parameters which are related to the selected signal path.

The following functions are only preset by command `*RST`: Fading, transient recorder.

Example: `SOUR:PRES`
Presets all settings that are related to signal path

Usage: Event

:SYSTem:PRESet

Triggers an instrument reset. It has the same effect as:

- The PRESET key
- 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 94.

Example: `SYST:PRES`
All instrument settings (also the settings that are not currently active) are reset to their default values.

Usage: Setting only

:SYSTem:FPReset

Triggers an instrument reset to the original state of delivery.

Note: "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 display 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 the settings that are not currently active) are reset to the factory values.

Usage: Event

Manual operation: See "Factory Preset" on page 124

7.4 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<hw>:ALL[:MEASure]? [<Force>]

Starts all internal adjustments that do not require external measurement equipment.

Query parameters:

<Force> string

Return values:

<Measure> select

Example:
```
CAL:ALL:MEAS?
// Response "0"
// Adjustment has been performed successfully
```

Usage: Query only

Manual operation: See "Adjust All" on page 97

:CALibration:CSYNthesis[:MEASure]?

The command performs all adjustments which affect the clock synthesis.

Return values:

<Measure> 0 | 1 | OFF | ON

Example: `CAL:CSYN?`
starts the adjustment of all functions for the entire instrument.
`Response: 0`
adjustment has been performed successfully.

Usage: Query only

Options: R&S SMA-B29

Manual operation: See "Adjust Clock Synthesis" on page 98

:CALibration:DME[:MEASure]?

The command starts internal adjustment of the DME pulse slope for best linearity.

Return values:

<Measure> 0 | 1 | OFF | ON
*RST: 0

Example: `CAL:DME?`
starts the adjustments of the DME pulse slope for best linearity.
`Response: 0`
the adjustments have been performed successfully.

Usage: Query only

Manual operation: See "Adjust DME Pulse Slope" on page 98

: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

Options: R&S SMA-B20 or R&S SMA-B22

Manual operation: See "Adjust FM Offset" on page 254

:CALibration<hw>:FREQuency[:MEASure]?

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

Manual operation: See "Adjust Synthesis" on page 97

:CALibration<hw>:LEVel[:MEASure]? [<Force>]

Starts level adjustment in the mixer range. The acquired correction values are only used with FM/PhiM or Pulse modulation

Query parameters:

<Force> string
*RST: force

Return values:

<Measure> 0 | 1

Example: `CAL:LEV:MEAS?`
starts the level adjustment in the mixer range.
Response: "0"
adjustment has been performed successfully.

Usage: Query only

Manual operation: See "Adjust Level" on page 97

:CALibration<hw>:LEVel:EXTern:DATA <Data>

Queries what data has been used for the level calibration.

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> FACTory | CUSTomer
*RST: FACTory

Example: `CAL:LEV:EXT:DATA FACT`
selects the use of the data aquired at the factory for external level correction.

Manual operation: See "Adjustment Data" on page 161

:CALibration:LFOutput[:MEASure]?

Performs all adjustments which affect the internal modulation generator.

Return values:

<Measure>	0 | 1 | OFF | ON

Example:	`CAL:LFO?`
	starts the adjustments for the modulation generators.
	`Response: 0`
	the adjustments have been performed successfully.

Usage:	Query only
Manual operation:	See "Adjust LF Gen/Mod Gen" on page 97

:CALibration<hw>:ROSCillator[:DATA] <Data>

Sets the calibration value for the custom defined external adjustment.

Parameters:

<Data> integer

Range: 0 to INT_MAX
*RST: 0

7.5 CSYNthesis Subsystem

This subsystem contains the commands used to define the frequency settings for the separate clock source (Clock Synthesis).

:CSYNthesis:FREQuency <Frequency>

Sets the frequency of the clock synthesis output signal.

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 `CSYNthesis:FREQuency:STEP`.

Parameters:

<Frequency> float

Range: 100E3 to 1.5E9
Increment: 0.001
*RST: 10E6

Example:	`CSYN:FREQ 500kHz` sets the frequency of clock synthesis signal to 500kHz.
Options:	R&S SMA-B29

Manual operation: See "Frequency - Clock Synthesis" on page 345

:CSYNthesis:STATe <State>

Activates/deactivates generation of a system clock for differential outputs CLK SYN and CLK SYN N at the rear of the instrument

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CSYN:STAT ON`

a clock signal with the set frequency is output.

Options: R&S SMA-B29

Manual operation: See "State - Clock Synthesis" on page 345

:CSYNthesis:FREQuency:STEP <Step>

Sets the step width for the clock synthesis frequency setting if the frequency values UP/DOWN are used in variation mode `SOUR:FREQ:STEP:MODE USER`. 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:

<Step> float

Range: 0 to RFmax - 100 KHz
Increment: 0.001
*RST: 1E6

Example: `CSYN:FREQ:STEP 50 kHz`

sets the step width for the clock synthesis frequency setting to 50 kHz.

Options: R&S SMA-B29

Manual operation: See "Variation Step - Clock Synthesis" on page 346

:CSYNthesis:FREQuency:STEP:MODE <Mode>

Activates (`USER`) or deactivates (`DECimal`) the user-defined step width used when varying the clock synthesis 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: `CSYN:FREQ:STEP 50 kHz`
sets the step width for the clock synthesis frequency setting to 50 kHz.
`CSYN:FREQ:STEP:MODE USER`
actives this step width for clock synthesis frequency variation with the rotary knob (manual control) and with frequency values UP/DOWN (remote control).

Options: R&S SMA-B29

Manual operation: See "Variation Active" on page 346

:CSYNthesis:OFFSet <Offset>

Sets a DC offset which is added to both clock synthesis output signals.

Parameters:

<Offset> float

Range: -5 to 5
Increment: 0.001
*RST: 0
Default unit: V

Example: `CSYN:OFFS 0.25V`
sets a DC offset of 0.25 volts

Manual operation: See "DC Offset - Clock Synthesis" on page 345

:CSYNthesis:OFFSet:STATe <State>

Activates the addition of the DC offset to both clock synthesis output signals. The DC offset value is set with command `CSYNthesis:OFFSet`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CSYN:OFFS 0.4V`
sets a DC offset of 0.4V
`CSYN:OFFS:STAT ON`
adds a DC offset of 0.4V to the clock signal

Manual operation: See "State DC Offset - Clock Synthesis" on page 345

7.6 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? [<Board>]

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 404.

Query parameters:

<Board> string

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.
Response: `MBRD,SSYN,....`
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 part number 1141.3501.01 has revision 1.5.3 and serial number 100023.

Usage: Query only

Manual operation: See "Assembly" on page 99

:DIAGnostic<hw>:BGINfo:CATalog?

Queries the names of the assemblies available in the instrument.

Return values:

<Catalog> string

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.

Example: `DIAG:BGIN:CAT`
Queries the names of the assemblies.
Response: `MBRD,SSYN,....`

Usage: Query only

:DIAGnostic:INFO:OTIMe?

The command queries the number of operation hours.

Return values:
<OTIMe> float

Example: `DIAG:INFO:OTIM`
queries the operation hours.
`Response: 100023`
The instrument was operated for 100023 hours up to now.

Usage: Query only

Manual operation: See "Operation Time / h" on page 98

: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

Manual operation: See "Power On Count" on page 98

7.7 DISPlay Subsystem

The `DISPlay` subsystem contains the commands to set the power-save mode of the instrument.

:DISPlay:ANNotation:AMPLitude <State>

Indicates asterisks instead of the level values in the status bar.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `DISP:ANN:AMPL ON`

Suppresses the level display.

Manual operation: See "Annotation Amplitude" on page 121

:DISPlay:ANNotation:FREQuency <State>

Indicates asterisks instead of the frequency values in the status bar.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `DISP:ANN:FREQ ON`

Supresses the frequency display.

Manual operation: See "Annotation Frequency" on page 121

:DISPlay:ANNotation[:ALL] <State>

Displays asterisks instead of the level and frequency values in the status bar of the instrument. This setting is useful when you remotely control the instrument.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `DISP:ANN:AMPL ON`

Shows asterisks instead of frequency and level values.

:DISPlay:DIALog:CLOSe <DialogId>

Closes the specified dialog. To determine the dialog identifier, use command `:DISPlay:DIALog:ID?`.

Setting parameters:

<DialogId> string

Example: `DISP:DIAL:CLOS "<dialog ID>"`

Closes the dialog, determined with the "<dialog ID>".

Usage: Setting only

:DISPlay:DIALog:CLOSe:ALL

Closes all open dialogs.

Example: `DISP:DIAL:CLOS:ALL`

Usage: Event

:DISPlay:DIALog:ID?

Returns the dialog identifiers of the open dialogs in a string separated by blanks.

Return values:

<DialogIdList> string

Example: `DISP:DIAL:ID?`

Response: "`<dialog ID(1)> <dialog ID(2)> ... <dialog ID(n)>`"

Returns the dialog identifiers of all opened dialogs.

Usage: Query only

:DISPlay:DIALog:OPEN <DialogId>

Opens the specified dialog. To determine the dialog identifier, use command `:DISPlay:DIALog:ID?`.

Setting parameters:

<DialogId> string

Example: `DISP:DIAL:OPEN "<dialog ID>"`

Opens the dialog, determined with the "<dialog ID>".

Usage: Setting only

:DISPlay:PSAVe:HOLDoff <HoldoffTimeMin>

Sets the waiting time for the screen-save mode of the display.

Parameters:

<HoldoffTimeMin> integer

Range: 1 to 60

*RST: 10

Default unit: minute

Example: `DISP:PSAV:HOLD 8`

Sets the timeout of the screen saver to 8 minutes.

Manual operation: See "Wait Time" on page 111

:DISPlay:PSAVe[:STATe] <State>

Activates the screen-save mode of the display.

If activated, the display including backlight is switched off after the wait time elapses and if no entries via front panel, external mouse or external keyboard are made. To set the wait time, use command `:DISPlay:PSAVe:HOLDoff`.

This mode is recommended for protecting the display, especially if you operate the instrument via remote control.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `DISP:PSAV ON`

Activates screen saver mode.

Manual operation: See "Screen Saver Active" on page 111

:DISPlay:UPDate <Update>

Activates the refresh mode of the display.

Parameters:

<Update> 0 | 1 | OFF | ON

*RST: 1

Example: `DISP:UPD ON`

Activates automatic update of the display at defined time intervals.

7.8 FORMat Subsystem

The `FORMat` subsystem contains the commands which determine the format of the data that the R&S SMA returns to the controller. This affects all query commands which return a list of numerical data or block data. Reference is made to this in the descriptions of the commands.

:FORMat:BORDer <Border>

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 instrument 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>

Determines the data format which the R&S SMA 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 <Format>

Determines the numerical format which is returned when the status registers are queried.

Parameters:

<Format> 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.

7.9 HCOPy Subsystem

The `HCOPy` subsystem contains the commands to generate a hardcopy of the display.

:HCOPy:DATA?

Transfers the hardcopy data directly as a NByte stream to the remote client.

Return values:
<Data> block data

Example: `HCOP:DEV:LANG JPG`
`HCOP:DATA?`
Transfers the hardcopy to the remote client.

Usage: Query only

:HCOPy:DEVice <Device>

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 is stored in a file.

Manual operation: See "Destination" on page 125

:HCOPy:DEVice:LANGuage <Language>

Selects the bitmap graphic format for the screenshot.

You can also retrieve the data using command `HCOP:DATA?`. This command is an alias to command `HCOPy:IMAGe:FORMat`.

Parameters:
<Language> BMP | JPG | XPM | PNG
*RST: PNG

Example: `HCOP:DEV:LANG BMP`
Selects bitmap as image format.
`HCOP:FILE '/usb/HCopy'`
Defines the directory, path and filename for storing the hardcopy.
`HCOP`
Triggers the hardcopy generation.

Manual operation: See "File Options" on page 126

:HCOPy[:EXECute]

Triggers the generation of a hardcopy.

The data is written into the file selected/created with the `HCOP:FILE` commands.

Example: `HCOP`
Triggers the generation of a hardcopy of the current display.

Usage: Event

Manual operation: See "Save" on page 128

:HCOPy:FILE[:NAME] <Name>

Creates/selects a file into which the hardcopy is stored.

The path is specified together with the filename. 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 filename.

Manual operation: See "File Info" on page 126

:HCOPy:FILE[:NAME]:AUTO?

Queries the path including the filename of the file with automatically generated name.

Return values:
<Auto> string

Example: See `:HCOPy:FILE[:NAME]:AUTO:FILE?` on page 413

Usage: Query only

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

Sets the directory into which the hardcopy files are stored if auto naming is activated (`HCOP:FILE:AUTO:STAT ON`).The directory is created if it does not exist yet.

Parameters:
<Directory> string
*RST: .\HCopy

Example: `HCOP:FILE:AUTO:DIR '/usb/'`
Defines the destination directory '/usb/'

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

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

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO:FILE?

Queries the filename that what generated using the automatic naming settings. By default the automatically generated filename is composed of:

<Prefix><YYYY><MM><DD><Number>.<Format>.

Each component can be deactivated/activated separately.

Return values:

<File> string

Example: `HCOP:DEV:LANG BMP`
Selects output format *.bmp.
`HCOP:FILE:AUTO:DIR '/usb/'`
Defines the destination directory '/usb/'
`HCOP:FILE:AUTO:PREF 'gen'`
The filename starts with the prefix `'gen'`. The usage of automatic naming with prefix and date in the filename is preset (...:`STAT ON`).
`HCOP`
Triggers the generation of a hardcopy of the current trace.
`HCOP:FILE:AUTO?`
Queries the path including the filename
`Response:`
`/usb/gen101012008001.bmp'`
`HCOP:FILE:AUTO:FILE?`
Queries the filename
`Response: 'gen101012008001.bmp'`

Usage: Query only

Manual operation: See "File Info" on page 126

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?

Queries the day of the current system date which is used in the filename if automatic naming is activated.

Return values:

<Day> integer

Range: 1 to 31

*RST: 1

Example: `HCOP:FILE:AUTO:DAY?`

Returns the day in the date part of the automatic filename.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>

Activates the usage of the day in the automatic filename.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `HCOP:FILE:AUTO:DAY:STAT OFF`

Deactivates the use of the day in the automatically generated filename.

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?

Queries the month in the date part in the automatic filename.

Return values:

<Month> integer

Range: 1 to 12

*RST: 1

Example: `HCOP:FILE:AUTO:MONT?`

Queries the month in the date part in the automatic filename.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>

Activates the usage of the month in the automatic filename.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `HCOP:FILE:AUTO:MONT:STAT OFF`

Deactivates the usage of the month in the automatic filename.

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

Queries the number in the automatic filename. The number is assigned in such a way that always the lowest possible value for a unique filename within the selected path is used.

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

Return values:

<Number> integer

Range: 0 to 999999
*RST: 0

Example: `HCOP:FILE:AUTO:NUMB?`
Queries the number in the automatic filename.

Usage: Query only

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>

Sets the prefix part in the automatic filename. 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 filename.

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

Activates the usage of the prefix in the automatic filename. The prefix is entered with command `HCOP:FILE:AUTO:PREF`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `HCOP:FILE:AUTO:PREF:STAT OFF`
Deactivates the usage of the prefix in the automatic filename.

Manual operation: See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?

Queries the year in the date part in the automatic filename.

Return values:

<Year>	integer Range: 1784 to 8000 *RST: 0
Example:	`HCOPy:FILE:AUTO:YEAR?` Queries the year in the date part in the automatic filename.
Usage:	Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

Activates the usage of the year in the automatic filename.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 1
Example:	`HCOP:FILE:AUTO:YEAR:STAT OFF` Deactivates the usage of the year in the automatic filename.
Manual operation:	See "File Options" on page 126

:HCOPy:FILE[:NAME]:AUTO:STATe <State>

Activates/deactivates automatic naming of the hardcopy files.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 1
Example:	`HCOP:FILE:AUTO:STAT OFF` Deactivates automatic naming.
Manual operation:	See "Automatic Naming" on page 126

:HCOPy:IMAGe:FORMat <Format>

This command selects the bitmap graphic format for the screenshot. You can also retrieve the data using command `HCOP:DATA?`.

This command is an alias to command `HCOPy:DEVice:LANGuage`.

Parameters:

<Format>	BMP | JPG | XPM | PNG *RST: PNG
Example:	`HCOP:IMAG:FORM XPM` Selects the image format XPM.

Manual operation: See "File Options" on page 126

:HCOPy:IMAGe:SIZE <Size>

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> string

*RST: depends on device

Example: `HCOP:IMAG:SIZE 640,480`

Sets width and height of the image.

7.10 KBOard Subsystem

The KBOard system contains the commands to set the external keyboard.

:KBOard:LANGuage <Language>

This command selects the keyboard language. The assignment of some keys depends on the selected language.

Parameters:

<Language> US | DE

*RST: US

Example: `KBO:LANG US`

selects keyboard language American English.

Usage: SCPI confirmed

Manual operation: See "Layout (USB Keyboard Settings)" on page 111

:KBOard:LAYout <Layout>

Selects the keyboard language. The assignment of some keys depends on the selected language.

Parameters:

<Layout> CHINese | DANish | DUTCh | DUTBe | ENGLish | ENGUK | FINNish | FRENch | FREBe | FRECa | GERMan | ITALian | JAPanese | KORean | NORWegian | PORTuguese | RUSSian | SPANish | SWEDish | ENGUS

*RST: ENGLish

Example: `KBO:LAY US`

Activates American English keyboard layout.

Manual operation: See "Layout (USB Keyboard Settings)" on page 111

7.11 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 CompactFlash™ Card of the instrument or on external USB memory devices.

The `/var/user/` directory can be used to save user-defined data; any subdirectory structure can be created on `/var/user/`. Some default subdirectories are predefined, but can be changed at any time.

The default directory is determined using the command `MMEMory:CDIR`.

Use the command `:SYSTem:MMEMory:PATH:USER?` to query the path of the directory for user-defined data.

The `/opt` directory is a protected and therefore a not accessible 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.

7.11.1 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 is case-sensitive, meaning it is distinguished 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). If possible, special characters should not be used. The use of the slashes "\" and "/" should be avoided since they are used in file paths. A number of names are reserved for the operating system, e.g. `CLOCK$`, `CON`, `AUX`, `COM1...COM4`, `LPT1...LPT3`, `NUL` and `PRN`.

In the R&S SMA 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 88 for an overview of the file types).

The two characters "*" and "?" function as "wildcards", meaning 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 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 the 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 the drive settings 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` on page 426 command. Also, subsequently to loading a file with instrument settings with command `:MMEMory:LOAD:STATe` on page 425, these settings have to be activated with the common command `*RCL <number>`.

7.11.2 Extensions for User Files

The following table lists all available file extensions for user files. The currently available files on the instrument depend 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`

7.11.3 Examples

In these examples, the current instrument setting is stored in the file `test.savrcltxt` in the directory `/var/user/.`.

Storing and Loading Current Settings

1. Store the current setting in an intermediate memory with the number 4. This setting can be called using command `*RCL` and the associated number of the memory, for example `*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/new'`
4. Copy the file `state` to a new file.
   `MMEM:COPY '/var/user/state.savrcltxt','/usb/new'`
5. Rename the file `state`.
   `MMEM:MOVE 'state.savrcltxt','state_new.savrcltxt'`
6. Remove the `test` directory.
   `MMEM:RDIR '/usb/test'`

7.11.4 Remote Control Commands

:MMEMory:CATalog? <path>

Returns the content of a particular directory.

Query parameters:

<path> string

String parameter to specify the directory.
If you leave out the path, the command returns the contents of the directory selected with `:MMEMory:CDIRectory`.
The path may be relative or absolute.

Return values:

<UsedDiskSpace> Byte size of all files in the directory.

<FreeDiskSpace> Remaining disk space in bytes.

<FileInfo> <NameFileN>,<SuffixFileN>,<SizeFileN>

List of files, separated by commas

<NameFileN>
Name of the file.

<SuffixFileN>
Type of the file. Possible suffixes are: ASCii, BINary, DIRectory

<SizeFileN>
Size of the file in bytes.

Example: See "Working with Files and Directories" on page 420.

Usage: Query only

Manual operation: See "Directory, File List and File Name" on page 131

:MMEMory:CATalog:LENGth? <Path>

Returns the number of files in the current or in the specified directory.

Query parameters:

<Path> string

String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:

<FileCount> integer

Number of files.

Example: See "Working with Files and Directories" on page 420.

Usage: Query only

:MMEMory:CDIRectory <Directory>

Changes the default directory for mass memory storage. The directory is used for all subsequent `MMEM` commands if no path is specified with them.

Parameters:

<Directory> <directory_name>

String containing the path to another directory. The path can be relative or absolute.
To change to a higher directory, use two dots '..' .

Example: See "Working with Files and Directories" on page 420.

Usage: SCPI confirmed

Manual operation: See "Directory, File List and File Name" on page 131

:MMEMory:COPY <SourceFile>[,<DestinationFile>]

Copies an existing file 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.

Setting parameters:

<SourceFile> string

String containing the path and file name of the source file

<DestinationFile> string

String containing the path and name of the target file. The path can be relative or absolute.
If `<DestinationFile>` is not specified, the `<SourceFile>` is copied to the current directory, queried with the `:MMEMory:CDIRectory` command.
Note: Existing files with the same name in the destination directory are overwritten without an error message.

Example: See "Working with Files and Directories" on page 420.

Usage: Setting only
SCPI confirmed

Manual operation: See "Copy " on page 135

:MMEMory:DATA <Filename>, <BinaryBlock>
:MMEMory:DATA? <Filename>

The setting command writes the block data `<BinaryBlock>` to the file identified by `<Filename>`.

Set the GPIB-bus terminator to `EOI` to ensure correct data transfer.

The query command transfers the specified file from the instrument to the GPIB-bus and then on to the controller. It is important to ensure that the intermediate memory on the controller is large enough to take the file. The setting for the GPIB-bus terminator is irrelevant.

Tip: Use this command to read/transfer stored instrument settings or waveforms directly from/to the instrument.

Parameters:

<BinaryBlock> #<number><length_entry><data>

`#`: Hash sign; 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
`<data>`: binary block data for the specified length.
For files with a size with more than nine digits (gigabytes), the instrument allows the syntax `#(<Length>)`, where `<Length>` is the file size in decimal format.

Parameters for setting and query:

<Filename> string

String parameter to specify the name of the file.

Example: `MMEMory:DATA '/var/user/test.txt',#15hallo`
Writes the block data to the file `test.txt`.
The digit `1` indicates a length entry of one digit; the digit `5` indicate a length of the binary data (`hallo`) in bytes.
`MMEMory:DATA? '/var/user/test.txt'`
Sends the data of the file `test.txt` from the instrument to the controller in the form of a binary block.
`Response: #15hallo`

Usage: SCPI confirmed

:MMEMory:DCATalog? <path>

Returns the subdirectories of a particular directory.

Query parameters:

<path> String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:
<Catalog> <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 420.

Usage: Query only

:MMEMory:DCATalog:LENGth? [<Path>]

Returns the number of subdirectories in the current or specified directory.

Query parameters:
<Path> String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory, to be queried with `:MMEMory:CDIRectory` command.

Return values:
<DirectoryCount> integer

Number of parent and subdirectories.

Example: See "Working with Files and Directories" on page 420.

Usage: Query only

:MMEMory:DELete <Filename>

Removes a file from the specified directory.

Setting parameters:
<Filename> string

String parameter to specify the name and directory of the file to be removed.

Example: See "Working with Files and Directories" on page 420.

Usage: Event
SCPI confirmed

Manual operation: See "Cut" on page 135

:MEMory:HFRee?

Returns the used and available memory in Kb.

Return values:
<TotalPhysMemKb> integer

Total physical memory.

<ApplicMemKb> integer

Application memory.

<HeapUsedKb>	integer Used heap memory.
<HeapAvailableKb>	integer Available heap memory.
Usage:	Query only

:MMEMory:LOAD:STATe <SavRclStateNumb>, <file_name>

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:

<SavRclStateNumb>	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 419.
Usage:	Setting only
Manual operation:	See "Recall" on page 133

:MMEMory:MDIRectory <Directory>

Creates a 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>	string String parameter to specify the new directory.
Example:	See "Working with Files and Directories" on page 420.
Usage:	Event
Manual operation:	See "Create New Directory" on page 135

:MMEMory:MOVE <SourceFile>, <DestinationFile>

Moves an existing file to a new location or, if no path is specified, renames an existing file.

Setting parameters:

<SourceFile>	string String parameter to specify the name of the file to be moved.

<DestinationFile> string
String parameters to specify the name of the new file.

Example: See "Working with Files and Directories" on page 420.

Usage: Event
SCPI confirmed

Manual operation: See "Rename " on page 135

:MMEMory:MSIS <Msis>

Defines the drive or network resource (in the case of networks) for instruments with windows operating system, using `msis` (MSIS = Mass Storage Identification String).

Note: Instruments with Linux operating system ignore this command, since Linux does not use drive letter assignment.

Usage: SCPI confirmed

:MMEMory:RDIRectory <Directory>

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:
<Directory> string
String parameter to specify the directory to be deleted.

Example: See "Working with Files and Directories" on page 420.

Usage: Event

:MMEMory:STORe:STATe <savrcl_state_nr>, <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:
<savrcl_state_nr> 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 419.

Usage: Event

Manual operation: See "Save" on page 131

7.12 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 SOURce:LFOutput Subsystem system.

:OUTPut<hw>:AFIXed:RANGe:LOWer?

Queries the minimum level which can be set when the attenuator is fixed, see `:OUTPut<hw>:AMODe`.

Return values:

<Lower> float

Increment: 0.01

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

Manual operation: See "Fixed Range (PEP) In" on page 160

:OUTPut<hw>:AFIXed:RANGe:UPPer?

Queries the maximum level which can be set when the attenuator is fixed, see `:OUTPut<hw>:AMODe`.

Return values:

<Upper> float

Increment: 0.01

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

Manual operation: See "Fixed Range (PEP) In" on page 160

:OUTPut<hw>:AMODe <AMode>

Selects the mode of the attenuator at the RF output (Attenuator MODe).

Parameters:

<AMode> AUTO | FIXed | NORMal | HPOWer

AUTO
The level settings are made in the area of the electronically switching attenuator as well as in the area of the relay-switched high power bypass. The entire level range is available.

FIXed
The level settings are made without switching the attenuator or the relays. When this operating mode is switched on, the attenuator and the relays are fixed in their current positions and the resulting variation range is defined.

NORMal
The level settings are made only in the area of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made only in the area of the high level ranges. Only the high level range is available. The relays are not switched.

*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.

Manual operation: See "Attenuator Mode" on page 159

:OUTPut<hw>:IMPedance?

Queries the impedance of the RF outputs. It enables you to convert the output level units between V and W. The impedances cannot be changed.

Return values:

<Impedance> G1K | G50 | G10K

*RST: G50
Default unit: Ohm

Example:

`OUTP:IMP`
queries the impedance of RF output.
`Response: 50`
the impedance is 50 ohms

Usage: Query only

:OUTPut<hw>:PROTection:CLEar

Resets the protective circuit after it has been tripped. The state of the output is again determined by `OUTPut:STATe`.

The outputs are protected by a protective circuit which deactivates the output in the case of an externally applied overvoltage. This does not change the value of `OUTPut:STATe`.

Example: `OUTP:PROT:CLE`
resets the protective circuit for RF output.

Usage: Event

Manual operation: See "Overload" on page 175

:OUTPut<hw>:PROTection:TRIPped?

Queries the state of the protective circuit.

Return values:
<Tripped> 0 | 1 | OFF | ON
*RST: 0

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

Manual operation: See "Overload" on page 175

:OUTPut<hw>[:STATe] <State>

Activates and deactivates the RF output signal (RF ON / RF OFF).

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `OUTP OFF`
deactivates the RF output.

Manual operation: See "RF On" on page 139

:OUTPut<hw>[:STATe]:PON <Pon>

Selects the state of the RF output when the instrument is switched on.

Parameters:

<Pon> OFF | UNCHanged

OFF
deactivates the output when the instrument is switched on (RF OFF).

UNCHanged
restores the initial state of the RF output before the last turn off. sets the output status as it was when the instrument was switched off.

*RST: UNCHanged

Example: `OUTP:PON OFF`
RF output A is deactivated when the instrument is switched on.

Manual operation: See "Power-On State - RF Signal" on page 161

7.13 Power Sensor Measurement Subsystems

The power sensor measurement uses several subsystems:

- The `CALCulate` subsystem is used to configure the time gated measurements in power analysis.
- The `DISPlay` subsystem is used to configure the diagram appearance.
- The `INITiate` command switches the local state of the continuous power measurement on and off.
- The `READ` system is used to start and to retrieve the measurement result of the power viewer measurement.
- The `SENSe` subsystem contains the commands for configuring the power viewer and power analysis measurements with power sensors connected to the generator. Up to three sensors can be connected to the signal generator.
- The `TRACe` subsystem is used to configure the traces in power analysis and to retrieve the measurement results.

Power Viewer

The power viewer measurement is started with the `READ` command, this command also retrieves the measurement results.

The sensors are distinguished by means of the suffix under `SENSe`:

- Power sensor connected to the SENSOR port = `SENSe[1]`
- First Power sensor connected to the USB interface = `SENSe2`
- Second Power sensor connected to the USB interface = `SENSe3`

Third Power sensor connected to the USB interface = `SENSe4`

Power and Pulse Data Analysis, Gated Measurements (option R&S SMA-K28)

The power analysis measurement commands are subsumed under the `SENSe[:POWer]:SWEep:…` commands. Three measurement modes are available: Frequency, Power and Time.

The power analysis measurement is started with the `SENSe[:POWer]:SWEep:INITiate` command and the measurement result retrieved with the `TRACe[:POWer]:SWEep:…` commands.

The four sensors are distinguished by means of the suffix at the second key word `SENSe`.

The time gate settings are performed using the `CALCulate[:POWer]:SWEep:…` commands.

The measurement diagram and results can be stored in a hardcopy with the `SENSe[:POWer]:SWEep:HCOPy:…` commands.

General parameter and measurement settings are valid for all connected sensors, therefore, no suffix is used in these commands.

7.13.1 CALCulate Subsystem

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:AVERage?

Queries the average power value of the time gated measurement.

Return values:

<Average>	float	
	Range:	-1000 to 1000
	Increment:	1E-12
	*RST:	0

Example: `SENS:SWE:MODE TIME`
activates time mode for power analysis.
`CALC:SWE:TIME:GATE:STAT ON`
activates time gated measurement.
`SENS:SWE:INIT`
activates a single power analysis measurement.
`CALC:SWE:TIME:GATE2:AVER?`
queries the average power in time gate 2 for trace 1 (=default).

Usage: Query only

Options: Option R&S SMA-K28

Manual operation: See "State - Gate" on page 202

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED <Feed>

Selects the trace for time gated measurement. Both gates are assigned to the same trace.

Parameters:

<Feed> TRAC1 | TRAC2 | TRAC3 | TRACe1 | TRACe2 | TRACe3 | TRAC4 | TRACe4
*RST: TRAC1

Example: `CALC:SWE:TIME:GATE:FEED TRAC2`
assignes the gates to trace 2.

Options: Option R&S SMA-K28

Manual operation: See "Trace - Gate" on page 202

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:MAXimum?

Queries the average power value of the time gated measurement.

Return values:

<Maximum> float
Range: -1000 to 1000
Increment: 1E-12
*RST: 0

Example: `SENS:SWE:MODE TIME`
activates time mode for power analysis.
`CALC:SWE:TIME:GATE:STAT ON`
activates time gated measurement.
`SENS:SWE:INIT`
activates a single power analysis measurement.
`CALC:SWE:TIME:GATE2:MAX?`
queries the peak power in time gate 2 for trace 1 (=default).

Usage: Query only

Options: Option R&S SMA-K28

Manual operation: See "State - Gate" on page 202

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STOP <Stop>
:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STARt <Start>

Sets the start time of the selected gate. Insert value and unit.

Parameters:

<Start> float

Increment: 1E-12
*RST: Start/Stop: 5/15 (Gate1), 25/35 (Gate2)

Example: `CALC:SWE:TIME:GATE2:STAR 20us`
sets a start time of 20 us for gate 2.

Example: `CALC:SWE:TIME:GATE2:STOP 30us`
sets a stop time of 30us for gate 2.

Options: Option R&S SMA-K28

Manual operation: See "Start / Stop - Gate" on page 202

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe <State>

Activates the gate settings for the selected trace. The measurement ist started with command `SENS:POW:INIT`. Both gates are active at one time.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CALC:SWE:TIME:GATE:STAT ON`
'enables time gated measurement.

Options: Option R&S SMA-K28

Manual operation: See "State - Gate" on page 202

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe <State>

Activates the trace mathematics mode for "Frequency" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CALC:POW:SWE:FREQ:MATH2:STATe`

Example: switches on math mode in trace 2.

Options: R&S SMA-K28

Manual operation: See "Mathematics - Trace Power Analysis" on page 192

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract <Subtract>

Subtracts the operands 1 and 2 and assigns the result to the selected trace in "Frequency" measurement mode.

Parameters:

<Subtract> T1T1 | T1T2 | T1T3 | T1T4 | T1REf | T2T1 | T2T2 | T2T3 | T2T4 | T2REf | T3T1 | T3T2 | T3T3 | T3T4 | T3REf | T4T1 | T4T2 | T4T3 | T4T4 | T4REf

Example: `CALC:POW:SWE:FREQ:MATH4:SUBT T2REF`

Example: Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.

Options: R&S SMA-K28

Manual operation: See "Mathematics - Trace Power Analysis" on page 192

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe <State>

Activates the trace mathematics mode for "Power" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CALC:POW:SWE:POW:MATH2:STATe`

Example: switches on math mode in trace 2.

Options: R&S SMA-K28

Manual operation: See "Mathematics - Trace Power Analysis" on page 192

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract <Subtract>

Subtracts the operands 1 and 2 and assigns the result to the selected trace in "Power" measurement mode.

Parameters:

<Subtract> T1T1 | T1T2 | T1T3 | T1T4 | T1REf | T2T1 | T2T2 | T2T3 | T2T4 | T2REf | T3T1 | T3T2 | T3T3 | T3T4 | T3REf | T4T1 | T4T2 | T4T3 | T4T4 | T4REf

Example: `CALC:POW:SWE:POW:MATH4:SUBT T2REF`

Example: Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.

Options: R&S SMA-K28

Manual operation: See "Mathematics - Trace Power Analysis" on page 192

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe <State>

Activates the trace mathematics mode for "Time" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CALC:POW:SWE:TIME:MATH1:STATe`

Example: switches on math mode.

Options: R&S SMA-K28

Manual operation: See "Mathematics - Trace Power Analysis" on page 192

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract <Subtract>

Substracts the operands 1 and 2 and assigns the result to the selected trace in "Time" measurement mode.

Parameters:

<Subtract> T1T1 | T1T2 | T1T3 | T1T4 | T1REf | T2T1 | T2T2 | T2T3 | T2T4 | T2REf | T3T1 | T3T2 | T3T3 | T3T4 | T3REf | T4T1 | T4T2 | T4T3 | T4T4 | T4REf

Example: `CALC:POW:SWE:TIME:MATH4:SUBT T2REF`

Example: Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.

Options: R&S SMA-K28

Manual operation: See "Mathematics - Trace Power Analysis" on page 192

7.13.2 DISPlay Subsystem

:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor <Color>

Defines the background color of the measurement diagram. The selected color applies also to the hardcopy of the diagram.

Parameters:

<Color> BLACk | WHITe

*RST: BLACk

Example: `DISP:SWE:BACK:COL WHIT`
the measurement is indicated with a white background.

Manual operation: See "Bg Color - Power Analysis" on page 198

:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe <State>

Indacates a grid in the diagram.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `DISP:SWE:GRID:STAT OFF`

deactivates the indication of a grid in the diagram area.

Manual operation: See "Grid - Power Analysis" on page 198

7.13.3 INITiate Command

:INITiate<ch>[:POWer]:CONTinuous <Continuous>

The command switches the local state of the continuous power measurement by the R&S NRP-Zxx power sensors on and off. Switching the local state off enhances the measurement performance during remote control

The remote measurement is triggered by the READ query (command `:READ<ch>[:POWer]?` on page 436) 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.

Manual operation: See "State" on page 178

7.13.4 READ Subsystem

:READ<ch>[:POWer]?

The command triggers the measurement with power sensors and provides the power measurement result of the selected power sensor. The value is provided with the unit set with command `SENSe:UNIT[:POWer]`.

For certain power sensors, e.g. R&S NRP-Z81, two values are returned, first the value for the average level and - separated by a comma - the peak level

Note: The local state is not influenced by this command, measurements results can be retrieved with local state on or off. For long measurement times it is recommended to use a SRQ (MAV bit) for command synchronization.

Suffix:
<ch> 1..3

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

Manual operation: See "Level (Peak)" on page 179

7.13.5 SENSe Subsystem

:SENSe<ch>[:POWer]:APERture:DEFault:STATe <UseDefAp>

Deactivates the default aperture time of the respective sensor.

To specify a user-defined value, use the command `:SENSe<ch>[:POWer]:APERture:TIMe` on page 440.

Parameters:

<UseDefAp>	0 | 1 | OFF | ON	
	*RST:	1

Example: `SENS:POW:APER:DEF:STAT 0`
deactivates the default aperture time of the sensor.

Manual operation: See "Use Default Aperture Time" on page 183

:SENSe<ch>[:POWer]:APERture:TIMe <ApTime>

Defines the aperture time (size of the acquisition interval) for the corresponding sensor.

Parameters:

<ApTime> float

Range: depends on connected power sensor
Increment: 1E-9
*RST: depends on connected power sensor

Example: `SENS:POW:APER:TIM 23ms`
sets 23 ms aperture time.

Manual operation: See "Aperture Time" on page 183

: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.

Manual operation: See "Use SParameter - Power Sensors" on page 167

: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: PEAK

Example: `SENS1:DISP:PERM:STAT ON`
the permanent viewer is switched on.
`SENS1:DISP:PERM:PRI AVER`
the measured average power is indicated.

Manual operation: See "Display Priority" on page 180

: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: ON

Example: `SENS1:POW:DISP:PERM:STAT ON`
the permanent viewer is switched on.

Manual operation: See "Permanent Display State" on page 179

: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

Range: 1 to 65536

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

Manual operation: See "Filter Length" on page 182

: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 settable.

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).

Manual operation: See "Filter Length" on page 182

:SENSe<ch>[:POWer]:FILTer:NSRatio <NSRatio>

The command defines the noise content for fixed noise filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE NSRatio`). This value determines the proportion of intrinsic noise in the measured result.

Parameters:

<NSRatio> float

Range: 0.001 to 1
Increment: 0.001
*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.

Manual operation: See "Noise Content" on page 182

:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe <MTime>

The command defines the timeout for fixed noise filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE NSRatio`). This value ensures limited settling times.

Parameters:

<MTime> float

Range: 1 to 999.99
Increment: 0.01
*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

Manual operation: See "Timeout" on page 182

: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

Manual operation: See "Auto Once" on page 182

: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.

Manual operation: See "Filter" on page 181

: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.

Manual operation: See "Frequency" on page 181

:SENSe<ch>[:POWer]:LOGGing:STATe <State>

Activates the recording of the power values, measured by a connected R&S NRP-Z power sensor.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: `SENS:LOGG:STAT ON`
activates recording of the power measurement of the first sensor.

Manual operation: See "Enable Logging" on page 183

: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 considered.

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

Manual operation: See "Level Offset" on page 181

: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.

Manual operation: See "Level Offset" on page 181

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

Manual operation: See "Current Sensors" on page 102

:SENSe<ch>[:POWer]:SOURce <Source>

The command selects the signal source for the measurement.

Parameters:

<Source> A | B | USER | RF
*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.

Manual operation: See "Source" on page 180

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

Manual operation: See "Sensor" on page 178

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

Manual operation: See "Current Sensors" on page 102

:SENSe[:POWer]:SWEep:ABORt

Aborts the power analysis with NRP power sensors.

Example: `SENS:SWE:ABOR;*OPC?`
aborts the current power measurement.

Usage: Setting only

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY

Generates a reference curve for "Frequency" measurement.

Example: `SENS:POW:SWE:FREQ:REF:DATA:COPY`

Example: generates a reference curve in frequency mode.

Usage: Event

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:POINts?

Queries the number of points from the reference curve in "Frequency" measurement.

Return values:
<Points> integer
Range: 10 to 1000

Example: `SENS:POW:SWE:FREQ:REF:DATA:POIN?`

Example: queries the number of points from the reference curve in frequency mode.

Usage: Query only

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues <XValues>

Sets or queries the x values of the two reference points, i.e. "Frequency X (Point A)" and "Frequency X (Point B)" in "Frequency" measurement.

Parameters:

<XValues> string

Example: `SENSe:POW:SWE:FREQ:REF:DATA:XVAL 100MHZ,22GHZ`

Example: sets the x value of reference "Point A" to 10 MHz, and the value of "Point B" to 10 GHz.

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues <YValues>

Sets or queries the y values of the two reference points, i.e. "Pow Y (Point A)" and "Power Y (Point B)" in "Frequency" measurement.

Parameters:

<YValues> string

Example: `SENSe:POW:SWE:FREQ:REF:DATA:YVAL -10,25`

Example: sets the y value of reference "Point A" to -10 dBm, and the value of "Point B" to -25 dBm.

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe[:POWer]:SWEep:FREQuency:RMODe <RMode>

Selects single or continuous mode for measurement mode frequency in power analysis.

Parameters:

<RMode> SINGle | CONTinuous

*RST: CONTinuous

Example: `SENS:SWE:FREQ:RMOD SING`
selects single measurement

Manual operation: See "Execution - Power Analysis" on page 197

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet <Offset>

Defines the level offset at the sensor input in dB. Activate the offset with the command `:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet:STATe`.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example: `SENS2:SWE:FREQ:OFFS -3dB`
defines a level offset of -3 dB.
`SENS2:SWE:FREQ:OFFS:STAT ON`
activates the specified level offset.

Options: Option R&S SMA-K28

Manual operation: See "Level Offset - Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet:STATe <State>

Activates a level offset at the sensor input. Define the appropriate value with the command `:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:OFFSet`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS2:SWE:FREQ:OFFS:STAT ON`

activates the specified level offset.

Options: Option R&S SMA-K28

Manual operation: See "Level Offset State- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe] <State>

Activates the use of a frequency range for the power measurement that is different to the set signal generator frequency range. The separate frequency range is entered with commands `SENS:SWE:FREQ:SENS:STAR` and `SENS:SWE:FREQ:SENS:STop`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS2:SWE:FREQ:SENS:SRAN ON`

activates use of a separate frequency range for frequency versus power measurement for sensor 2.

`SENS2:SWE:FREQ:SENS:STAR 2.0GHZ`

sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.

`SENS2:SWE:FREQ:SENS:STOP 2.9GHZ`

sets a sweep stop at 2.9 GHz irrespective of the current signal generator frequency settings.

Manual operation: See "Use Separate Frequency- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt <Start>

Sets the start frequency for the frequency power analysis with separate frequencies.

Parameters:

<Start> integer

Range: 0 to 1E12

*RST: 1E6

Example: `SENS2:SWE:FREQ:SENS:SRAN:STAT ON`
activates use of a separate frequency range for frequency versus power measurement for sensor 2.
`SENS2:SWE:FREQ:SENS:STAR 2.0GHZ`
sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.

Manual operation: See "Min Frequency - Power Analysis" on page 205

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP <Stop>

Sets the stop frequency for the frequency power analysis with separate frequencies.

Parameters:
<Stop> integer

Range: 0 to 1E12
*RST: 10E6

Example: `SENS:SWE:FREQ:SENS2:SRAN:STAT ON`
activates use of a separate frequency range for frequency versus power measurement.
`SENS:SWE:FREQ:SENS2:STAR 2.0GHZ`
sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.
`SENS:SWE:FREQ:SENS2:STOP 2.9GHZ`
sets a sweep stop at 2.9 GHz irrespective of the current signal generator frequency settings.

Manual operation: See "Max Frequency - Power Analysis" on page 205

:SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE] <Mode>

Selects the spacing for the frequency power analysis.

Parameters:
<Mode> LINear | LOGarithmic

*RST: LINear

Example: `SENS:SWE:FREQ:SPAC:MODE LIN`
sets linear spacing of the sweep

Manual operation: See "Spacing - Power Analysis" on page 196

:SENSe[:POWer]:SWEep:FREQuency:STARt <Start>

Sets the start frequency for the frequency mode.

Parameters:
<Start> float

Range: 0 to 1E12
*RST: 1E6

Example: `SENS:SWE:FREQ:STAR 2.0GHZ`
'sets a sweep start at 2 GHz.

Manual operation: See "Min - Power Analysis" on page 194

:SENSe[:POWer]:SWEep:FREQuency:STEPs <Steps>

Sets the number of measurement steps for the frequency mode.

Parameters:

<Steps> integer

Range: 10 to 1000
*RST: 200

Example: `SENS:SWE:FREQ:STEP 500`
sets 500 steps

Manual operation: See "Steps - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:FREQuency:STOP <Stop>

Sets the stop frequency for the frequency mode.

Parameters:

<Stop> float

Range: 0 to 1E12
*RST: 22GHZ

Example: `SENS:SWE:FREQ:STOP 20.0GHZ`
sets the sweep stop to 20 GHz

Manual operation: See "Max - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE] <Mode>

Selects the mode in terms of speed and precision of the response of a measurement.

Parameters:

<Mode> FAST | NORMal | HPRecision

FAST
Selection FAST leads to a fast measurement with a short integration time for each measurement step.

NORMal
NORMal leads to a longer but more precise measurement due to a higher integration time for each step.

*RST: FAST

Example: `SENS:SWE:FREQ:TIM:MODE FAST`
the fast measurement mode is selected.

Manual operation: See "Timing - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO <Auto>

Activates autoscaling of the Y axis of the diagram.

Parameters:

<Auto> OFF | CEXPanding | FEXPanding | CFLoating | FFLoating

OFF
Auto scaling is deactivated. If switching from activated to deactivated Auto scaling, the scaling is maintained.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: CEXPanding

Example: `SENS:SWE:FREQ:YSC:AUTO OFF`
deactivates auto scale

Manual operation: See "Auto Scale - Power Analysis" on page 198

:SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet

Resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function resets the diagram in such a way that it matches smaller power values again.

Example: `SENS:SWE:FREQ:YSC:AUTO:RES`
resets auto scale

Usage: Event

Manual operation: See "Reset Auto Scale - Power Analysis" on page 198

:SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum <Maximum>

Sets the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

Range: -200 to 100
Increment: 0.01
*RST: 40

Example: `SENS:SWE:FREQ:YSC:MAX 10DBM`
sets 10 dBm as the upper limit of the measurement diagram.

Manual operation: See "Min - Max y-Axis - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum <Minimum>

Sets the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

Range: -200 to 100
Increment: 0.01
*RST: -40

Example: `SENS:SWE:FREQ:YSC:MIN -10DBM`
sets -10 dBm as the lower limit of the measurement diagram.

Manual operation: See "Min - Max y-Axis - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:HCOPy:DATA?

Queries the measurement data directly. The data is transferred to the remote client as data stream, e.g. for further processing (see Chapter 6.3.3, "SCPI Parameters", on page 373, description of block data).

Readable ASCII data is available for hardcopy language CSV. The representation of the values depends on the selected orientation for the CSV format.

Return values:

<Data> block data

Example: `SENS:SWE:HCOP:DEV:LANG CSV`
selects output format *.csv.
`SENS:SWE:HCOP:DEV:LANG:CSV:ORI HOR`
selects horizontal orientation
`SENS:SWE:HCOP:DEV:LANG:CSV:SEP SEM`
selects ";" as the separator between the values
`SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT`
selects "." as decimal point
`SENS:SWE:HCOP:DATA?`
queries the measurement data of the current traces
`Response:`
#2651009500000;1019000000;1028500000;1038000000
-9.5;-9.7;-6.3;-2.5
The hash symbol # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 2 following digit indicates the length to be 65 characters.
Because horizontal representation is selected, a row with all the x-values of the active trace (frequency) follows. The second row contains all the y-values of the active trace (power). The rows end with a new line (each counts as one character).
Note: if more than one trace is active, the third row contains the x values of the second active trace, and so on.

Example: `SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT`
selects horizontal orientation
`SENS:SWE:HCOP:DATA?`
queries the measurement data of the current traces
`Response:`
#2681009500000;-9.5; 1019000000;-9.7; 1028500000;-6.3; 1038000000;-2.5;
for vertical representation the length of the data block is 68
the first power value, the second row contains the second frequency value of the active trace followed by the second power value, and so on. The rows end with a new line (each counts as one character).
Note: if more than one trace is active, the first row also contains the value pairs of the second active trace, and so on.

Usage: Query only

:SENSe[:POWer]:SWEep:HCOPy:DEVice <Device>

Defines the output device. The setting is fixed to FILE, i.e. the hardcopy is stored in a file.

Parameters:

<Device> FILE | PRINter

*RST: FILE

Example: SENS:SWE:HCOP:DEV FIL
selects output device file

Manual operation: See "Destination - Power Analysis" on page 217

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage <Language>

Selects the bitmap graphic format for the screenshot of the power analysis trace.

In addition, ASCII file format *.csv is offered. If file format *.csv is selected, the trace data is saved as an ASCII file with comma separated values. It is also possible to directly retrieve the data using commandSENS:SWE:HCOP:DATA?.

Parameters:

<Language> BMP | JPG | XPM | PNG | CSV
*RST: BMP

Example: SENS:SWE:HCOP:DEV:LANG BMP
selects output format *.bmp.

Manual operation: See "Format - Power Analysis" on page 217

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint <DPoint>

Defines which character should be used as the decimal point of the values, either dot or comma.

Parameters:

<DPoint> DOT | COMMa
*RST: DOT

Example: SENS:SWE:HCOP:DEV:LANG CSV
selects output format *.csv.
SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT
selects character dot for being used as decimal point.

Manual operation: See "CSV Options Hardcopy- Power Analysis" on page 219

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer <Header>

Defines whether each row (or column depending on the orientation) should be preceded by a header containing information about the trace (see also :SENSe[:POWer]:SWEep:HCOPy:DATA? on page 452).

Parameters:

<Header> OFF | STANdard
*RST: OFF

Example: SENS:SWE:HCOP:DEV:LANG CSV
selects output format *.csv.
SENS:SWE:HCOP:DEV:LANG:CSV:HEAD STAN
selects the standard header for the *.csv file.

Manual operation: See "CSV Options Hardcopy- Power Analysis" on page 219

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation <Orientation>

Defines the orientation of the X/Y value pairs. For examples on how the data are arranged see "CSV Options Hardcopy- Power Analysis" on page 219.

Parameters:

<Orientation> HORizontal | VERTical

*RST: HORizontal

Example:
`SENS:SWE:HCOP:DEV:LANG CSV`
selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT`
selects vertical orientation, the value pairs are written in a column like structure (separated by the selected separator, e.g. tab)

Manual operation: See "CSV Options Hardcopy- Power Analysis" on page 219

:SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator <Separator>

Defines which character is to separate the values, either tabulator, semicolon, comma or blank.

Parameters:

<Separator> TABulator | SEMicolon | COMMa | BLANk

*RST: SEMicolon

Example:
`SENS:SWE:HCOP:DEV:LANG CSV`
selects output format `*.csv`.
`SENS:SWE:HCOP:DEV:LANG:CSV:SEP TAB`
a tab separates the values

Manual operation: See "CSV Options Hardcopy- Power Analysis" on page 219

:SENSe[:POWer]:SWEep:HCOPy:DEVice:SIZE <Size>

Sets the size of the hardcopy in number of pixels. The first value of the size setting defines the width, the second value the height of the image.

Parameters:

<Size> 320,240 | 640,480 | 800,600 | 1024,768

*RST: 320,240

Example:
`SENS:SWE:HCOP:DEV:LANG BMP`
selects output format `*.bmp`.
`SENS:SWE:HCOP:DEV:SIZE 320,240`
the size of the bitmap is 320 pixels by 240 pixels.

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy[:EXECute]

Triggers the generation of a hardcopy of the current measurement diagram. The data is written into the file selected/created with the :SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME] command.

Example: SENS:SWE:HCOP:DEV:LANG BMP
selects output format *.bmp.
SENS:SWE:HCOP:FILE:AUTO:STAT OFF
switches off automatic file naming.
SENS:SWE:HCOP:FILE 'var/nrp_trace1'
creates the file nrp_trace1.bmp in the set path.
SENS:SWE:HCOP
triggers the generation of a hardcopy of the current measurement diagram. The hardcopy is stored in the file nrp_trace1.bmp.

Usage: Event

Manual operation: See "Save Hardcopy - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME] <Name>

Creates of selects a file for storing the hardcopy after the SENS:SWE:HCOP:EXEC command is sent. The directory is either defined with the command MMEMory:CDIR or the path is specified together with the file name. Access to the file via remote control is possible using the commands of the MMEM-Subsystem. In contrast, command SENSe:SWEep:HCOPy:DATA? transfers the hardcopy contents directly to the remote client where they can be further processed.

Parameters:
<Name> string

Example: SENS:SWE:HCOP:DEV:LANG BMP
selects output format *,bmp.
SENS:SWE:HCOP:FILE:AUTO:STAT OFF
switches off automatic naming.
SENS:SWE:HCOP:FILE 'var/trace/nrp_trace1'
creates the file nrp_trace1.bmp in the trace directory.
SENS:SWE:HCOP:EXEC
triggers the generation of a hardcopy of the current trace. The hardcopy is stored in the file nrp_trace1.bmp.

Manual operation: See "File name - Power Analysis" on page 217

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

Defines the directory into which the hardcopy files will be stored if auto naming is activated (SENS:SWE:HCOP:FILE:AUTO:STAT ON).

Parameters:

<Directory> string

Example: `SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
hardcopy file are stored in directory `var/nrp` if automatic naming is activated.

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

Deletes all files with extensions `bmp` , `img`, `png`, `xpm` and `csv` in the directory set for automatic naming.

Example: `SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
hardcopy file are stored in directory `var/nrp` if automatic naming is activated.
`SENS:SWE:HCOP:FILEAUTO:DIR:CLE`
deletes all hardcopy file that are stored in directory `var/nrp`.

Usage: Event

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE?

Queries the file name generated with the automatic naming settings.

Note: As default the automatically generated file name is composed of: `>Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`. Each component can be deactivated/activated separately to individually design the file name.

Return values:

<File> string

Example: `SENS:SWE:HCOP:DEV:LANG BMP`
selects output format `*.bmp`.
`SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
hardcopy file are stored in directory `var/nrp` if automatic naming is activated.
`SENS:SWE:HCOP:FILE:AUTO:PREF 'sens1'`
the file name starts with the prefix `sens1`. The usage of automatic naming with prefix and date in the file name is preset (…`:STAT ON`).
`SENS:SWE:HCOP`
triggers the generation of a hardcopy of the current trace.
`SENS:SWE:HCOP:FILE:AUTO:FILE?`
queries the file name

Usage: Query only

Manual operation: See "File name - Power Analysis" on page 217

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?

Aueries the day of the date part in the automatic file name.

Return values:

<Day> integer

Range: 1 to 31

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:DAY?`

queries the day of the date part in the automatic file name.

Usage: Query only

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>

Activates the usage of the day in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:DAY:STAT OFF`

deactivates the usage of the day in the automatic file name.

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?

Queries the day of the date part in the automatic file name.

Return values:

<Month> integer

Range: 1 to 12

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:MONT?`

queries the month of the date part in the automatic file name.

Usage: Query only

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>

Activates the usage of the month in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:MONT:STAT OFF`
deactivates the usage of the month in the automatic file name.

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

Queries the generated number in the automatic file name.

Return values:

<Number> integer

Range: 0 to 999999
*RST: 0

Example: `SENS:SWE:HCOP:FILE:AUTO:NUMB?`
queries the number in the automatic file name.

Usage: Query only

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>

Sets the prefix part in the automatic file name.

Parameters:

<Prefix> string

Example: `SENS:SWE:HCOP:FILE:AUTO:PREF 'sensor'`
the prefix sensor is used in the automatically generated file name of the hardcopy file.

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

Activates the usage of the prefix in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:PREF:STAT OFF`
deactivates the usage of the prefix in the automatic file name.

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?

Queries the year of the date part in the automatic file name.

Return values:

<Year> integer

Range: 1784 to 8000
*RST: 0

Example: `SENS:SWE:HCOP:FILE:AUTO:YEAR?`
queries the year of the date part in the automatic file name.

Usage: Query only

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

Activates the usage of the year in the automatic file name.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:YEAR:STAT OFF`
deactivates the usage of the year in the automatic file name.

Manual operation: See "Save Options - Power Analysis" on page 218

:SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe <State>

Activates/deactivates automatic naming of the hardcopy files.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:SWE:HCOP:FILE:AUTO:STAT OFF`
deactivates automatic naming of the hardcopy files. The file name and directory is now defined with command `SENS:SWE:HCOP:FILE:NAME <path>`.

Manual operation: See "File name - Power Analysis" on page 217

:SENSe[:POWer]:SWEep:INITiate

Starts the power analysis with NRP power sensor.

Example: `SENS:SWE:INIT`
start the power measurement.

Usage: Setting only

Manual operation: See "Start - Power Analysis" on page 189

:SENSe[:POWer]:SWEep:MODE <Mode>

Selects power versus frequency measurement (frequency response), power vs power measurement (power sweep, AM/AM) or power vs. time measurement.

Parameters:

<Mode> FREQuency | POWer | TIME

*RST: FREQuency

Example: `SENS:SWE:MODE FREQ`
selects frequency mode.

Manual operation: See "Measurement Mode - Power Analysis" on page 194

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:COPY

Generates a reference curve for "Power" measurement.

Example: `SENS:POW:SWE:POW:REF:DATA:COPY`

Example: generates a reference curve in power mode.

Usage: Event

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:POINts?

Queries the number of points from the reference curve in "Power" measurement.

Return values:

<Points> integer

Range: 10 to 1000

Example: `SENS:POW:SWE:POW:REF:DATA:POIN?`

Example: queries the number of points from the reference curve in power mode.

Usage: Query only

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues <XValues>

Sets or queries the x values of the two reference points, i.e. "Power X (Point A)" and "Power X (Point B)" in "Power" measurement.

Parameters:

<XValues> string

Example: `SENSe:POW:SWE:POW:REF:DATA:XVAL -15DBM,20DBM`

Example: sets the x value of reference "Point A" to -15 dBm, and the value of "Point B" to 20 dBm.

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues <YValues>

Sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Power" measurement.

Parameters:

<YValues> string

Example: `SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10`

Example: sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe[:POWer]:SWEep:POWer:RMODe <RMode>

Selects single or continuous mode for measurement mode power in power analysis.

Parameters:

<RMode> SINGle | CONTinuous

*RST: SINGle

Example: `SENS:SWE:POW:RMOD SING`
selects single measurement

Manual operation: See "Execution - Power Analysis" on page 197

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet <Offset>

Defines the level offset at the sensor input in dB. Activate the offset with the command `:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet:STATe` on page 462.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example: `SENS2:SWE:POW:OFFS -5dB`
defines a level offset of -5 dB.
`SENS2:SWE:POW:OFFS:STAT ON`
activates that the specified level offset is taken into account.

Options: Option R&S SMA-K28

Manual operation: See "Level Offset - Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet:STATe <State>

Activates a level offset at the sensor input. Define the appropriate value with the command `:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:OFFSet` on page 462.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS2:SWE:POW:OFFS:STAT ON`
activates the specified level offset.

Options: Option R&S SMA-K28

Manual operation: See "Level Offset State- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency <SFRequency>

Defines the separate frequency used for power vs. power measurement.

Parameters:

<SFRequency> float

Range: 0 to 1E12
Increment: 1
*RST: 1E6

Example: `SENS1:SWE:POW:SENS:SFR 2GHz`
'the measurement is performed at 2 GHz

Manual operation: See "Use Separate Frequency- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe <State>

Activates the use of a different frequency for the power measurement.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS1:SWE:POW:SENS:SFR:STAT ON`
activates the use of a separate frequency than the generator frequency for power analysis

Manual operation: See "Use Separate Frequency- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet <Offset>

Defines the level offset at the sensor input in dB. Activate the offset with the command `:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet:STATe`.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example: `SENS2:SWE:TIME:OFFS -7dB`
defines a level offset of -7 dB.
`SENS2:SWE:TIME:OFFS:STAT ON`
activates that the specified level offset is taken into account.

Options: Option R&S SMA-K28

Manual operation: See "Level Offset - Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet:STATe <State>

Activates a level offset at the sensor input. Define the appropriate value with the command `:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:OFFSet`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS2:SWE:POW:TIME:STAT ON`
activates the specified level offset.

Options: Option R&S SMA-K28

Manual operation: See "Level Offset State- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe <State>

Enables pulse data analysis. The measurement is started with command INITiate.

Note: The command are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS1:SWE:TIM:PULS:STAT ON`
enables pulse data analysis.

Options: Option R&S SMA-K28

Manual operation: See "State - Pulse Data Analysis" on page 208

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE <Base>

Selects how the threshold parameters for pulse analysis are calculated.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<Base> VOLTage | POWer

*RST: VOLTage

Example: `SENS1:SWE:TIME:PULS:THR:BASE POW`
activates threshold calculation related to power.

Options: Option R&S SMA-K28

Manual operation: See "Voltage / Power Related - Pulse Data Analysis" on page 208

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:HREFerence <HReference>

Sets the upper reference level in terms of percentage of the overall pulse level (power or voltage). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<HReference> float

Range: 0 to 100
Increment: 0.01
*RST: 90

Options: Option R&S SMA-K28

Manual operation: See "Distal - Pulse Data Analysis" on page 209

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:REFerence <Reference>

Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define pulse width and pulse period.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<Reference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 50.0

Example: `SENS1:SWE:TIM:PULS:THR:REF 40`
sets the medial reference level to 40% of the overall pulse level.

Options: Option R&S SMA-K28

Manual operation: See "Mesial - Pulse Data Analysis" on page 209

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer: LREFerence <LReference>

Sets the lower reference level in terms of percentage of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<LReference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 10.0

Example: `SENS:SWE:TIM:PULS:THR:LREF 10`
sets the lower reference level to 10%.

Options: Option R&S SMA-K28

Manual operation: See "Proximal - Pulse Data Analysis" on page 209

:SENSe[:POWer]:SWEep:POWer:SPACing[:MODE] <Mode>

Queries the sweep spacing for the power versus power measurement. The setting is fixed to LINear.

Parameters:

<Mode> LINear

*RST: LINear

Example: `SENS:SWE:POW:SPAC?`

Manual operation: See "Spacing - Power Analysis" on page 196

:SENSe[:POWer]:SWEep:POWer:STARt <Start>

Sets the start level for the power versus power measurement.

Parameters:

<Start> float

Range: -145 to 20
Increment: 0.01
*RST: -40 dBm

Example: `SENS:SWE:POW:STAR -20DBM`
sets the start level to -20 dBm

Manual operation: See "Min - Power Analysis" on page 194

:SENSe[:POWer]:SWEep:POWer:STEPs <Steps>

Sets the number of measurement steps for the power versus power measurement.

Parameters:

<Steps> integer

Range: 10 to 1000
*RST: 500

Example: `SENS:SWE:POW:STEP 500`
sets the 500 measurement steps

Manual operation: See "Steps - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:POWer:STOP <Stop>

Sets the stop level for the power versus power measurement.

Parameters:

<Stop> float

Range: -145 to 20
Increment: 0.01
*RST: 40

Example: `SENS:SWE:POW:STOP 20.0DBM`
sets the stop level to 20 dBm

Manual operation: See "Max - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:POWer:TIMing[:MODE] <Mode>

Selects the timing mode of the measurement.

Parameters:

<Mode> FAST | NORMal | HPRecision

FAST
Selection FAST leads to a fast measurement with a short integration times for each measurement step.

NORMal
NORMal leads to a longer but more precise measurement due to a higher integration time for each step.

*RST: NORMal

Example: `SENS:SWE:POW:TIM:MODE FAST`
selects fast mode.

Manual operation: See "Timing - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO <Auto>

Activates autoscaling of the Y axis of the diagram.

Parameters:

<Auto> OFF | CEXPanding | FEXPanding | CFLoating | FFLoating

OFF
Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: OFF

Example: `SENS:SWE:POW:YSC:AUTO OFF`
deactivates auto scale

Manual operation: See "Auto Scale - Power Analysis" on page 198

:SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet

Resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example: `SENS:SWE:POW:YSC:AUTO:RES`
resets auto scale

Usage: Event

Manual operation: See "Reset Auto Scale - Power Analysis" on page 198

:SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum <Maximum>

Sets the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

Range: min level to max level
Increment: 0.01
*RST: 40 dBm

Example: `SENS:SWE:POW:YSC:MAX 10DBM`
sets 10 dBm as the upper limit of the measurement diagram.

Manual operation: See "Min - Max y-Axis - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:POWer:YSCale:MINimum <Minimum>

Sets the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

Range: min level to max level
Increment: 0.01
*RST: -40 dBm

Example: `SENS:SWE:POW:YSC:MIN -10DBM`
sets -10 dBm as the lower limit of the measurement diagram.

Manual operation: See "Min - Max y-Axis - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:RMODe <RMode>

Selects single or continuous mode for power analysis (all measurement modes).

Parameters:

<RMode> SINGle | CONTinuous

*RST: SINGle

Example: `SENS:SWE:RMOD SING`
selects single measurement

Manual operation: See "Execution - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:TIME:RMODe <RMode>

Selects single or continuous mode for measurement mode time in power analysis.

Parameters:

<RMode> SINGle | CONTinuous

*RST: SINGle

Example: `SENS:SWE:TIME:RMOD SING`
selects single measurement

Manual operation: See "Execution - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt] <Count>

Selects the averaging factor in time mode. The count number determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing.

Parameters:

<Count> 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024

*RST: 1

Example: `SENS:SWE:MODE TIME`
selects time mode
`SENS:SWE:TIME:AVER 128`
selects averaging factor 128

Options: Option R&S SMA-K28

Manual operation: See "Average - Power Analysis" on page 196

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY

Generates a reference curve for "Time" measurement.

Example: `SENS:POW:SWE:TIME:REF:DATA:COPY`

Example: generates a reference curve in time mode.

Usage: Event

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:POINts?

Queries the number of points from the reference curve in "Time" measurement.

Return values:

<Points> integer

Range: 10 to 1000
*RST: 0

Example: `SENS:POW:SWE:TIME:REF:DATA:POIN?`

Example: queries the number of points from the reference curve in time mode.

Usage: Query only

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues <XValues>

Sets or queries the x values of the two reference points, i.e. "Time X (Point A)" and "Time X (Point B)" in "Time" measurement.

Parameters:

<XValues> string

Example: `SENSe:POW:SWE:TIME:REF:DATA:XVAL 5,45`

Example: sets the x value of reference "Point A" to 5 µs, and the value of "Point B" to 45 µs.

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues <YValues>

Sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Time" measurement.

Parameters:

<YValues> string

Example: `SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10`

Example: sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.

Manual operation: See "Define Reference - Trace Power Analysis" on page 191

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency <SFrequency>

Defines the separate frequency used for power vs. time measurement.

Parameters:

<SFrequency> float

Range: 0 to 1E12
Increment: 1
*RST: 1E6

Example: `SENS1:SWE:TIME:SENS:SFR 2GHz`
the measurement is performed at 2 GHz

Manual operation: See "Use Separate Frequency- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe <State>

Activates the use of a different frequency for the power measurement.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS1:SWE:TIME:SENS:SFR:STAT ON`
activates the use of a separate frequency than the generator frequency for power analysis

Manual operation: See "Use Separate Frequency- Power Analysis" on page 204

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO <Auto>

Sets the trigger level, the hysteresis and the dropout time to default values.

Parameters:

<Auto> ONCE

*RST: ---

Example: `SENS1:SWE:TIME:SENS:TRIG:AUTO ONCE`

the trigger level is automatically determined

Manual operation: See "Auto Set - Power Analysis" on page 216

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe <DTime>

Determines the minimum time for which the signal must be below (above) the power level defined by level and hysteresis before triggering can occur again.

Parameters:

<DTime> float

Range: 0 to 10

*RST: 200E-9

Example: `SENS1:SWE:TIME:SENS:TRIG:DTIM 10 us`

the drop out time is 10 us

Manual operation: See "Drop out Time - Power Analysis" on page 215

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis <Hysteresis>

Sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

Parameters:

<Hysteresis> float

Range: 0 to 10

Increment: 0.001

*RST: 0.5

Example: `SENS1:SWE:TIME:SENS:TRIG:HYST 0.5 dB`

the hysteresis is 0.5 dB

Manual operation: See "Hysteresis - Power Analysis" on page 215

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel <Level>

Sets the trigger threshold.

Parameters:

<Level>	float Range: -200 to 100 Increment: 0.001 *RST: 1

Example: `SENS1:SWE:TIME:SENS:TRIG:LEV -20 dBm`
sets the trigger level to -20 dBm.

Manual operation: See "Level - Power Analysis " on page 214

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SLOPe <TriggerSlope>

Sets the polarity of the active slope for the trigger signals.

Parameters:

<TriggerSlope>	POSitive | NEGative *RST: POSitive

Example: `SENS1:SWE:TIME:TRIG:SLOP POS`
the positive edge of a trigger signal is active.

Options: Option R&S SMA-K28

Manual operation: See "Slope - Power Analysis" on page 215

:SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce <Source>

Selects if the measurement is free running (FREE) or starts only after a trigger event. The trigger can be applied internally or externally.

Parameters:

<Source>	FREE | AUTO | INTernal | EXTernal *RST: AUTO

Example: `SENS1:SWE:TIME:SENS:TRIG:SOUR FREE`
the power versus time measurement is performed free running

Manual operation: See "Mode - Power Analysis" on page 214

:SENSe[:POWer]:SWEep:TIME:SPACing[:MODE] <Mode>

Queries the sweep spacing for the power versus time measurement. The spacing is fixed to linear.

Parameters:

<Mode>	LINear *RST: LINear

Example: `SENS:SWE:TIME:SPAC?`
queries the sweep spacing

Manual operation: See "Spacing - Power Analysis" on page 196

:SENSe[:POWer]:SWEep:TIME:STARt <Start>

Sets the start time for the power versus time measurement. Value 0 defines the trigger point. By choosing a negative time value, the trace can be shifted in the diagram. It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

Parameters:

<Start> float

Range: -1 to 1
Increment: 1E-12
*RST: -5E-6

Example: `SENS:SWE:TIME:STAR 0s`
sets the start time to 0 s

Manual operation: See "Min - Power Analysis" on page 194

:SENSe[:POWer]:SWEep:TIME:STEPs <Steps>

Sets the number of measurement steps for the power versus time measurement. Value 0 defines the trigger point.

Parameters:

<Steps> integer

Range: 10 to 1000
*RST: 200

Example: `SENS:SWE:TIME:STEP 500`
sets the 500 measurement steps

Manual operation: See "Steps - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:TIME:STOP <Stop>

Sets the stop time for the power versus time measurement.

Parameters:

<Stop> float

Range: 0 to 2
Increment: 1E-12
*RST: 1E-3

Example: `SENS:SWE:TIME:STOP 1ms`
sets the stop time to 1 ms

Manual operation: See "Max - Power Analysis" on page 195

:SENSe[:POWer]:SWEep:TIME:TEVents <TriggerTEvents>

Determines, whether the measurement data processing starts with a trigger event in one of the sensors (Logical OR), or whether all channels have to be triggered (logical AND). Each sensor evaluates a trigger event according to its setting independently. This function supports the internal or external trigger modes with multi-channel time measurements.

Parameters:

<TriggerTEvents> AND | OR

*RST: AND

Example: `SENS:POW:SWE:TIME:TEV AND`

the measurement data processing starts when all channels are triggered.

Options: Option R&S SMA-K28

Manual operation: See "All Trigger Events - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO <Auto>

Activates autoscaling of the Y axis in the diagram.

Parameters:

<Auto> OFF | CEXPanding | FEXPanding | CFLoating | FFLoating

OFF

Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

CEXPanding | FEXPanding

Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating

Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: OFF

Example: `SENS:SWE:TIME:YSC:AUTO OFF`

deactivates auto scale

Manual operation: See "Auto Scale - Power Analysis" on page 198

:SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet

Resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example: `SENS:SWE:TIME:YSC:AUTO:RES`
resets auto scale

Usage: Event

Manual operation: See "Reset Auto Scale - Power Analysis" on page 198

:SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum <Maximum>

Sets the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum> float

Range: min level to max level
Increment: 0.01
*RST: 40
Default unit: dBm

Example: `SENS:SWE:TIME:YSC:MAX 10DBM`
sets 10 dBm as the upper limit of the measurement diagram.

Manual operation: See "Min - Max y-Axis - Power Analysis" on page 197

:SENSe[:POWer]:SWEep:TIME:YSCale:MINimum <Minimum>

Sets the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum> float

Range: min level to max level
Increment: 0.01
*RST: -40
Default unit: dBm

Example: `SENS:SWE:TIME:YSC:MIN -10DBM`
sets -10 dBm as the lower limit of the measurement diagram.

Manual operation: See "Min - Max y-Axis - Power Analysis" on page 197

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

Manual operation: See "Current Sensors" on page 102

: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

Manual operation: See "Zero - Power Sensors" on page 165

: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.

Manual operation: See "Unit" on page 179

7.13.6 TRACe Subsystem

:TRACe<ch>[:POWer]:SWEep:COLor <Color>

Defines the color of a trace.

Parameters:

<Color> INVers | GRAY | YELLow | BLUE | GREen | RED | MAGenta

*RST: trace 1 = YELLow, trace 2 = GREen, trace 3 = RED.

Example: `TRAC2:SWE:COL GRAY`
trace2 is indicated in gray color

Manual operation: See "Color - Trace Power Analysis" on page 193

:TRACe<ch>[:POWer]:SWEep:COPY <Copy>

Stores the selected trace data as reference trace.

Setting parameters:

<Copy> REFerence

Example: `TRAC2:SWE:COPY REF`
stores the current trace2 as reference trace'
`TRAC1:SWE:FEED REF`
assigns the reference trace to trace 1.

Usage: Setting only

Manual operation: See "Indication - Power Analysis" on page 190

:TRACe<ch>[:POWer]:SWEep:DATA:POINts?

Queries the number of measurement points of the selected trace of the current power analysis.

Return values:

<Points> integer

Range: 10 to 1000

*RST: 0

Example: `TRAC1:SWE:DATA:POIN?`

Response: `624`

Measurement trace 1 contains 624 measurement points

Usage: Query only

Manual operation: See "Start - Power Analysis" on page 189

:TRACe<ch>[:POWer]:SWEep:DATA:XVALues?

Queries the x-axis values - frequency, power or time values - of the selected trace of the current power analysis.

Return values:

<XValues> string

Example: `SENS:SWE:MODE FREQ`

sets measurement mode **frequency versus power**.

`SENS:SWE:RMOD SING`

selects single measurement.

`SENS:SWE:INIT`

starts the measurement.

`*OPC?`

waits until measurement is performed.

`TRAC1:SWE:DATA:XVAL?`

queries the x-axis values of trace 1.

`TRAC1:SWE:DATA:YVAL`

queries the measurement values of trace 1.

Usage: Query only

Manual operation: See "Start - Power Analysis" on page 189

:TRACe<ch>[:POWer]:SWEep:DATA:YVALues?

Queries the measurement (y-axis) values of the selected trace of the current power analysis.

Return values:

<YValues> string

Example: `SENS:SWE:TRAC2:DATA:YVAL?`

queries the power values of trace 2.

Usage: Query only

Manual operation: See "Start - Power Analysis" on page 189

:TRACe<ch>[:POWer]:SWEep:FEED <Feed>

Selects the source for the trace data.

Parameters:

<Feed> SENS1 | SENS2 | SENS3 | REFerence | NONE | SENSor1 | SENSor2 | SENSor3 | SENS4 | SENSor4

*RST: The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with number corresponding to the trace number, the preset value of the trace is "Off".

Example:

`TRAC2:SWE:COPY REF`
stores trace2 as reference trace.
`TRAC1:SWE:FEED REF`
assigns the reference trace to trace 1.
`TRAC1:SWE:STAT ON`
assigns the reference trace to trace 1.
`SENS:SWE:RMOD SING`
selects single measurement
`SENS:SWE:INIT`
starts the measurement

Manual operation: See "Indication - Power Analysis" on page 190

:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe] <State>

Selects fullscreen display of the measurement diagram on the display and in the hardcopy file.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example:

`TRAC:SWE:MEAS:FULL:DISP:ANN ON`
the display only shows the diagram.

Options: Option R&S SMA-K28

Manual operation: See "REARR list - Power Analysis" on page 199

:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] <State>

Activates th eindication of the time gate borders and values in the measurement diagram and in the hardcopy file. The gate settings are performed with the `CALC:POW:SWE:TIME:GATE:...` commands.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `TRAC:SWE:MEAS:GATE:DISP:ANN ON`

the diagram also shows the gate information.

Options: Option R&S SMA-K28

Manual operation: See "REARR list - Power Analysis" on page 199

:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe] <State>

Activates the indication of the markers and the marker list in the measurement diagram and in the hardcopy file.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `TRAC:SWE:MEAS:MARK:DISP:ANN ON`

the diagram also shows the marker information.

Options: Option R&S SMA-K28

Manual operation: See "Marker and Pulse Data Indication - Power Analysis" on page 188

:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP?
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:STATe?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence?
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot?

The listed commands query the measured pulse parameter values.

Note: These commands are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Return values:

<Overshoot>	float Range: 0 to 100 Increment: 0.01 *RST: 0

Example:	`TRAC1:SWE:MEAS:POW:HREF?`
	queries the measured mesial threshold level of trace 1
	`TRAC3:SWE:MEAS:POW:MAX?`
	queries the measured peak power of trace 3

Usage:	Query only
Options:	Option R&S SMA-K28
Manual operation:	See "Transition Times - Pulse Data Analysis" on page 210

:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe] <State>

Activates the indication of the pulse data below the measurement diagram and storing the data in the hardcopy file. The parameters to be indicated can be selected with the following `TRAC:SWE:MEAS:….` commands. Only six parameters are indicated at one time.

Note: This command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 1
Example:	`TRAC:SWE:MEAS:PULS:DISP:ANN ON` activates indication of the selected pulse data.
Options:	Option R&S SMA-K28
Manual operation:	See "Marker and Pulse Data Indication - Power Analysis" on page 188

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:ALL:DISPlay:ANNotation[:STATe] <State>

This command deactivates the indication of all pulse data of the selected trace. The parameters to be indicated can be selected with the `TRAC:SWE:MEAS:….` commands. Only six parameters are indicated at one time.

Note: This command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `TRAC:SWE:MEAS:PULS:ALL:DISP:ANN OFF`
switches the indication of all pulse data off

Options: Option R&S SMA-K28

:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe] <State>

Selects the standard view, i.e. diagram and buttons but no lists are displayed and also stored in the hardcopy file.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 1

Example: `TRAC:SWE:MEAS:STAN:DISP:ANN ON`
activates indication of the selected pulse data

Options: Option R&S SMA-K28

Manual operation: See "REARR list - Power Analysis" on page 199

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation:DISPlay:ANNotation[:STATe] <State>

:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation: DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence: DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot: DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation: DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence: DISPlay:ANNotation[:STATe] <State>
:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot: DISPlay:ANNotation[:STATe] <State>

The listed commands select the pulse parameters which are indicated in the display and hardcopy file. Only six parameters can be indicated at a time.

Note: These commands are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `TRAC:SWE:MEAS:TRAC2:PULS:PER:DISP:ANN ON`
selects the pulse period to be indicated in the display
`TRAC:SWE:MEAS:PULS:DISP:ANN ON`
activates indication of the selected pulse data in the display

Options: Option R&S SMA-K28

Manual operation: See "Transition Times - Pulse Data Analysis" on page 210

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE?

Queries how the threshold parameters are calculated.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Base> VOLTage | POWer

*RST: VOLTage

Example: `TRAC1:SWE:PULS:THR:BAS?`
queries the threshold base of pulse data calculation.

Usage: Query only

Manual operation: See "Voltage / Power Related - Pulse Data Analysis" on page 208

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence <HReference>

Queries the upper threshold level of the overall pulse level. The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<HReference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 90.0

Example: `TRAC2:SWE:PULS:THR:POW:HREF?`
queries the upper reference level of trace 2.

Manual operation: See "Distal - Pulse Data Analysis" on page 209

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence <Reference>

Queries the medial threshold level of the overall pulse level. This level is used to define the pulse width and pulse period.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<Reference> float

Range: 0.0 to 100.0
Increment: 0.01
*RST: 50.0

Example: `TRAC3:SWE:PULS:THR:POW:REF?`
queries the medial threshold level of trace 3.

Manual operation: See "Mesial - Pulse Data Analysis" on page 209

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence <LReference>

Queries the lower medial threshold level of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<LReference>	float Range: 0.0 to 100.0 Increment: 0.01 *RST: 10.0

Example: `TRAC:SWE:PULS:THR:POW:LREF?`
queries the medial threshold level of trace 1.

Manual operation: See "Proximal - Pulse Data Analysis" on page 209

:TRACe<ch>[:POWer]:SWEep:STATe <State>

Activates the selected trace.

Parameters:

<State>	OFF | ON | HOLD *RST: The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with a number corresponding to the trace number, the preset value of the trace is "Off".

Example: `TRAC2:SWE:COPY REF`
stores trace2 as reference trace'
`TRAC1:SWE:FEED REF`
assigns the reference trace to trace 1.
`TRAC1:SWE:STAT ON`
assigns the reference trace to trace 1.
`SENS:SWE:RMOD SING`
selects single measurement
`SENS:SWE:INIT`
starts the measurement

Manual operation: See "Indication - Power Analysis" on page 190

7.14 SOURce Subsystem

The `SOURce` subsystem contains the commands for configuring the digital and analog signals.

SOURce<hw>

For one-path instruments, the keyword `SOURce` is optional and can be omitted.

7.14.1 SOURce:ADF Subsystem

The ADF subsystem contains the commands for checking the ADF modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:ADF:...` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The signal is output at the LF OUT connector.

[:SOURce]:ADF:COMid:CODE <Code>

The command enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). The COM/ID tone is sent according to the selected code (see Table 5-16). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (`ADF:COM:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`ADF:COM:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code> string

Example: `ADF:COM:CODE 'MUC'`
select COM/ID code for Munich airport.

Usage: SCPI confirmed

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Code - ADF Modulation" on page 320

[:SOURce]:ADF:COMid:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash> float

Range: 50 ms to 1 s
Increment: 0.1
*RST: 300 ms
Default unit: s

Example: `ADF:COM:CODE 'MUC'`
selects code for Munich airport
`ADF:COM:TSCH USER`
selects user time schema
`ADF:COM:DOT 200ms`
sets a dot length of 200 ms.
`ADF:COM:DASH 400ms`
sets a dash length of 400 ms.
`ADF:COM:LETT 50ms`
sets a letter space of 50 ms.
`ADF:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Dash Length - ADF Modulation" on page 321

[:SOURce]:ADF:COMid:DEPTh <Depth>

The command sets the frequency of the communication/identification signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 95
Default unit: PCT

Example: `ADF:COM:DEPT 10 PCT`
sets the AM depth of the communication/identification signal to the value of 10 PCT.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Depth - ADF Modulation" on page 321

[:SOURce]:ADF:COMid:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> <length>

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 100 ms
Default unit: s

Example: `ADF:COM:CODE 'MUC'`
selects code for Munich airport
`ADF:COM:DOT 200ms`
sets a dot length of 200 ms.

Example: `ADF:COM:CODE 'MUC'`
selects code for Munich airport
`ADF:COM:DOT 200ms`
sets a dot length of 200 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Dot Length - ADF Modulation" on page 321

[:SOURce]:ADF:COMid:FREQuency <Frequency>

Sets the frequency of the additional communication/identification signal.

Parameters:

<Frequency> float

Range: 0.1 to 20E3
Increment: 0.01
*RST: 1020
Default unit: Hz

Example: `ADF:COM:FREQ 1020`
sets the frequency of the COM/ID signal to the standard value of 1020Hz.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Frequency - ADF Modulation" on page 321

[:SOURce]:ADF:COMid:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available user time schema only.

Parameters:

<Letter> <length>

Range: 50 ms to 1s
Increment: 0.1 ms
*RST: 300 ms
Default unit: s

Example:
`ADF:COM:CODE 'MUC'`
selects code for Munich airport
`ADF:COM:TSCH USER`
selects user time schema
`ADF:COM:DOT 200ms`
sets a dot length of 200 ms.
`ADF:COM:DASH 400ms`
sets a dash length of 400 ms.
`ADF:COM:LETT 50ms`
sets a letter space of 50 ms.
`ADF:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Letter Space - ADF Modulation" on page 322

[:SOURce]:ADF:COMid:PERiod <Period>

Enters the period of the COM/ID signal in seconds.

Parameters:

<Period> float

Range: 0 ms to 120 s
Increment: 1 ms
*RST: 9 s

Example: ADF:COM:PER 22s
sets a period of 22 s for the COM/ID signal.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Period - ADF Modulation" on page 321

[:SOURce]:ADF:COMid:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:

<Symbol> <length>

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 100 ms
Default unit: s

Example:
`ADF:COM:CODE 'MUC'`
selects code for Munich airport
`ADF:COM:TSCH USER`
selects user time schema
`ADF:COM:DOT 200ms`
sets a dot length of 200 ms.
`ADF:COM:DASH 400ms`
sets a dash length of 400 ms.
`ADF:COM:LETT 50ms`
sets a letter space of 50 ms.
`ADF:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Symbol Space - ADF Modulation" on page 322

[:SOURce]:ADF:COMid:TSCHema <TSchema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ID signal).

Parameters:

<TSchema> STD | USER

*RST: STD

Example:
`ADF:COM:CODE 'MUC'`
selects code for Munich airport
`ADF:COM:TSCH STD`
'elects standard time schema
`ADF:COM:DOT 200ms`
sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) Time Schema - ADF Modulation" on page 321

[:SOURce]:ADF:COMid[:STATe] <State>

The command activates or deactivates the additional communication/identification signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `ADF:COM ON`

activates the COM/ID signal.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID(A0/A2) State - ADF Modulation" on page 319

[:SOURce]:ADF:STATe <State>

The command switches on or off the ADF modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `ADF ON`

activates the ADF signal. The RF-frequency is automatically set to 190 kHz.

Manual operation: See "State - ADF Modulation" on page 319

7.14.2 SOURce:AM Subsystem

The AM subsystem contains the commands for setting the amplitude modulation.

To configure the AM-specific characteristics of the internal modulation source use the commands `SOURce:AM:INTernal`.

An external modulation signal is input at the AM EXT connector.

The settings for the internal modulation source (LF generator) are made in the `SOURce:LFOutput` subsystem.

[:SOURce<hw>]:AM[:DEPTh] <Depth>

Sets the modulation depth of the amplitude modulation signal in percent.

Parameters:

<Depth> float

Range: 0 to 100
Increment: See data sheet
*RST: 30

Example: `AM 15PCT`
sets the 15% AM modulation depth

Manual operation: See "AM Depth" on page 248

[:SOURce<hw>]:AM:EXTernal:COUPling <Coupling>

Selects the coupling mode for the external amplitude modulation signal.

Parameters:

<Coupling> AC | DC

AC
Uses only the AC signal component of the modulation signal.

DC
Uses the modulation signal as it is, with AC and DC.

*RST: AC

Example: `AM:EXT:COUP AC`
selects the coupling mode AC for external amplitude modulation.

Manual operation: See "AM External Coupling" on page 250

[:SOURce<hw>]:AM:INTernal<ch>:DEPTh <Depth>

Sets the depth of the internal amplitude modulation signal in Hz.

The sum of the deviations of all active frequency modulation signals may not exceed the total value set with command `[:SOURce<hw>]:AM[:DEPTh]`.

Parameters:

<Depth> float

Range: 0 to dynamic
Increment: 0.1
*RST: 15

Example: `AM:INT2 15PCT`
sets the AM modulation depth of the second LF generator to 15 %. If you have set the overall modulation depth to 30 percent, the first LF generator is also set to 15 percent automatically.

Options: R&S SMA-K24

Manual operation: See "Depth 1/Depth 2" on page 249

[:SOURce<hw>]:AM:INTernal:SOURce <Source>

Selects the internal modulation signal source. The available selection depends on the installed options. To configure the modulation signal, use the commands of the Chapter 7.14.10, "SOURce:LFOutput Subsystem", on page 566 subsystem.

Parameters:

<Source> LF1 | LF2 | LF12 | NOISe | LF1Noise | LF2Noise

*RST: LF1

Example: `AM:INT:SOUR LF1`

uses the signal generated by the first LF generator for amplitude modulation.

Options: OptionR&S SMA-K24 for selections other than LF1

Manual operation: See "Internal Source" on page 249

[:SOURce<hw>]:AM:SENSitivity?

Queries the input sensitivity of the externally applied signal for amplitude modulation.

The sensitivity depends on the set modulation `[:SOURce<hw>]:AM[:DEPTh]`.

The returned value reports the sensitivity in %/V. It is assigned to the voltage value for full modulation of the input.

Return values:

<Sensitivity> float

Range: 0 to 100

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

Manual operation: See "AM Sensitivity" on page 250

[:SOURce<hw>]:AM:SOURce <Source>

Selects the modulation signal source for amplitude modulation.

You can use both, the internal and an external modulation signal at a time.

Parameters:

<Source> INTernal | EXTernal | INT,EXT

INTernal
Uses the internally generated signal for modulation. To configure the frequency, use the commands of the Chapter 7.14.10, "SOURce:LFOutput Subsystem", on page 566 subsystem.
To select the internal source, use command `[:SOURce<hw>]:AM:INTernal:SOURce` on page 495.

EXTernal
Uses an externally applied modulation signal.

INT,EXT
Uses both, the internal and external modulation signals.

*RST: INT

Example: `AM:SOUR INT`
selects the internal modulation source.

Manual operation: See "AM Source" on page 248

[:SOURce<hw>]:AM:STATe <State>

Activates amplitude modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `AM:STAT ON`
activates AM modulation.

Manual operation: See "State" on page 248

7.14.3 SOURce:CHIRp Subsystem

The `SOURce:CHIRp` subsystem contains the commands for setting the modulation chirp.

Chirp modulation requires the following equipment:

- Option R&S SMA-B20/-B22, FM/ϕM pulse modulator providing an extended range for resolution, pulse period and pulse width settings.
- Option R&S SMA-K23, High Performance Pulse Generator.
- Interface board 1400.0530.02 or 1400.0552.02. The hardware data is queried with command `DIAG:BGIN? "SMA_IF"`.

An external trigger signal is supplied via PULSE EXT connector.

The keyword SOURce is optional and can be omitted.

[:SOURce<hw>]:CHIRp:BANDwidth <Bandwidth>

Sets the modulation bandwidth of the modulation chirp.

Parameters:

<Bandwidth> float

The maximal bandwidth depends on the installed frequency options and the RF frequency (see data sheet).

Range: 0 to Depends on hardware variant
Increment: 0.01
*RST: 1E3
Default unit: Hz

Example: `CHIR:BAND 5E3`
sets the modulation bandwidth to 5 kHz.

Manual operation: See "Bandwidth - Chirp Modulation" on page 266

[:SOURce<hw>]:CHIRp:COMPression:RATio?

Queries the pulse compression ratio, that is the product of pulse width (s) and bandwidth (Hz). Pulse compression increases the range resolution as well as the signal to noise ratio of pulsed signals.

Return values:

<Ratio> float

Range: 0 to 80E6
Increment: 0.01

Example: `CHIR:COMP:RAT?`
queries the compression ratio.

Usage: Query only

Manual operation: See "Compression Ratio - Chirp Modulation" on page 267

[:SOURce<hw>]:CHIRp:DIRection <Direction>

Selects the direction of the chirp modulation.

Parameters:

<Direction> DOWN | UP

UP
The chirp starts with the lower frequency.

DOWN
The chirp starts with the higher frequency.

*RST: UP

Example: `SOUR:CHIR:DIR UP`

Manual operation: See "Direction - Chirp Modulation" on page 266

[:SOURce<hw>]:CHIRp:PULSe:PERiod <Period>

Sets the period of the generated modulation chirp. The period determines the repetition frequency of the internal signal.

Parameters:

<Period> float

Range: 5E-6 (2E-7 with K23) to 100
Increment: 1E-6
*RST: 10E-6
Default unit: s

Example: `CHIR:PULS:PER 420 ns`
the chirp period is 420 ns.

Manual operation: See "Pulse Period - Chirp Modulation" on page 267

[:SOURce<hw>]:CHIRp:PULSe:WIDTh <Width>

Sets the width of the generated pulse. The pulse width must be at least 1us less than the set pulse period.

Parameters:

<Width> float

Range: 2E-6 (1E-7 with K23) to 100
Increment: 1E-6
*RST: 2E-6

Example: `CHIR:PULS:WIDT 330 ns`
sets a width of 330 ns for the pulse.

Manual operation: See "Pulse Width - Chirp Modulation" on page 267

[:SOURce<hw>]:CHIRp:STATe <State>

Activates the generation of modulation chirp.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `CHIR:STAT ON`
activates chirp modulation.

Manual operation: See "State - Chirp Modulation" on page 266

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:GATE:POLarity <Polarity>

(External Gate only).

Selects the active level of the gate signal.

Parameters:

<Polarity> NORMal | INVerted

NORMal
Generates the chirp modulation signals while the gate signal is high.

INVerted
Generates the chirp modulation signals while the gate signal is low.

*RST: NORMal

Example: `CHIR:TRIG:EXT:GATE:POL NORM`
selects gate polarity normal.

Manual operation: See "Gate Input Polarity - Chirp Modulation" on page 268

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:IMPedance <Impedance>

Sets the impedance of the externally applied trigger signal.

Parameters:

<Impedance> G10k | G50

G10k
10 kOhm to ground

G50
50 ohm to ground

*RST: G50

Example: `CHIR:TRIG:EXT:IMP G10K`
sets 10 kOhm to ground.

Manual operation: See "External Impedance - Chirp Modulation" on page 268

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:SLOPe <Slope>

Sets the active slope of an externally applied trigger signal.

Parameters:

<Slope> NEGative | POSitive

*RST: POSitive

Example: `CHIR:TRIG:EXT:SLOP`
the active slope of the external trigger signal is the falling slope.

Manual operation: See "External Trigger Input Slope - Chirp Modulation" on page 267

[:SOURce<hw>]:CHIRp:TRIGger:MODE <Mode>

Selects the trigger mode for modulation chirp.

Parameters:

<Mode> AUTO | EXTernal | EGATe

AUTO
Generates the modulation chirp continuously.

EXTernal
Generates the chirp modulation signal initiated by an external trigger event.

EGATe
Generates the chirp modulation signal during the gate of an externally applied gate signal.

*RST: AUTO

Example: `CHIR:TRIG:EXT:MODE EXT`
selects triggering by an external trigger event.

Manual operation: See "Trigger Mode - Chirp Modulation" on page 267

7.14.4 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 SMA, 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 422. 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?

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/user/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
Manual operation:	See "Directory, File List and File Name" on page 131

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

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)

Example:
`CORR:CSET '/var/user/ucor1'`
selects the table `ucor1`.
`CORR:CSET:DATA:FREQ 100MHz,102MHz,103MHz,...`
enters the frequency value in the table `ucor1`.

Manual operation: See "Edit User Cor. Data - User Correction" on page 169

[: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> integer

Range: 0 to 10000
*RST: 0

Example:
`CORR:CSET '/var/user/'`
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>

Transfers the level data to the table selected with `[:SOURce<hw>]: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, ...]

Example:
`CORR:CSET '/var/user/ucor1'`
selects the table `ucor1`.
`CORR:CSET:DATA:POW 1dB, 0.8dB, 0.75dB,...`
enters the level values in the table `ucor1`.

Manual operation: See "Edit User Cor. Data - User Correction" on page 169

[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

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> integer

Range: 0 to 10000

*RST: 0

Example: `CORR:CSET '/var/user/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.

To select the used power sensor set the suffix in key word `SENSe`.

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

Manual operation: See "Fill User Correction Data with Sensor" on page 174

[:SOURce]:CORRection:CSET:DELete <Filename>

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.

Setting parameters:

<Filename> <table name>

Example: `MMEM:CDIR '/var/user/ucor'`

selects the directory for the user correction files.

`CORR:CSET:DEL 'UCOR1'`

deletes the table `ucor1`.

Usage: Setting only

Manual operation: See "User Cor. Data - User Correction" on page 168

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?

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/user/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>

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/user/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.

Manual operation: See "Extension - User Correction" on page 171

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect <Filename>

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:

<Filename> <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/import_ucor.csv'`
selects that ASCII file `ucor.csv` is imported.
`CORR:DEXC:SEL '/var/user/import_ucor_imp'`
selects that the ASCII file `ucor.csv` is imported into user correction list `ucor_imp`.

Manual operation: See "Select ASCII Source / Destination - User Correction" on page 171

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn <Column>

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

Parameters:

<Column> TABulator | SEMicolon | COMMa | SPACe

*RST: COMMa

Example: `CORR:DEXC:MODE EXP`
selects that the user correction list is exported into an ASCII file.
`CORR:DEXC:AFIL:SEL '/var/user/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/import_ucor_imp'`
selects that the user correction list ucor_imp is imported into ASCII file ucor.csv.

Manual operation: See "Column Separator- User Correction" on page 171

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal <Decimal>

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: `CORR:DEXC:MODE EXP`

selects that the user correction list is exported into an ASCII file.

`CORR:DEXC:AFIL:SEL '/var/user/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/import_ucor_imp'`

selects that the user correction list `ucor_imp` is imported into ASCII file `ucor.csv`.

Manual operation: See "Decimal Point - User Correction" on page 171

[:SOURce<hw>]:CORRection:DEXChange:EXECute

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/import_ucor.csv'`

selects that ASCII file ucor.csv is imported.

`CORR:DEXC:SEL '/var/user/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

Manual operation: See "Import / Export - User Correction" on page 172

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

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.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var/user/ucor_imp'`
selects that the ASCII file `ucor.csv` is imported into user correction list `ucor_imp`.

Manual operation: See "Mode - User Correction" on page 171

[:SOURce<hw>]:CORRection:DEXChange:SELect <Filename>

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:

<Filename> string

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/import_ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var/user/import_ucor_imp'`
selects that the ASCII file `ucor.csv` is imported into user correction list `ucor_imp`.

Manual operation: See "Destination / Source - User Correction" on page 172

[:SOURce<hw>]:CORRection:CSET[:SELect] <Filename>

Selects or creates a file for the user correction data.

If the file does not exist, the instrument automatically creates a new file with the name you assigned. Note the predefined file extensions under Chapter 4.7.2.1, "Extensions for User Files", on page 88.

To determine the file location (directory/path) you can either enter it with the command directly, or use the command `MMEMory:CDIR`.

To activate level correction use the command `[:SOURce<hw>]:CORRection[:STATe]`.

Parameters:

<Filename> <table name>

Example: `CORR:CSET '/var/user/ucor1'`
selects the table `ucor1`.
`CORR ON`
activates level correction. Correction is performed using the table `ucor1`.

Manual operation: See "User Cor. Data - User Correction" on page 168

[:SOURce<hw>]:CORRection[:STATe] <State>

Activates/deactivates level correction. Level correction is performed using the table which has been selected with the command `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SOUR:CORR:CSET '/var/user/ucor1'`
selects the table `ucor1`.
`SOUR:CORR ON`
activates user correction.

Manual operation: See "State - User Correction" on page 168

[:SOURce<hw>]:CORRection:VALue?

Queries the current value for user correction.

Return values:

<Value> float

Range: -100 to 100
Increment: 0.01
*RST: 0

Example: `CORR:VAL?`
queries the value currently used for level correction.
Response: `-3`
the correction value is - 3 dB.

Usage: Query only

Manual operation: See "User Correction Value - User Correction" on page 168

[:SOURce<hw>]:CORRection:ZERoing:STATe <State>

Activates the zeroing procedure before filling the user correction data acquired by a sensor.

Parameters:

<State> 0 | 1 | OFF | ON

Manual operation: See "Fill User Correction Data with Sensor" on page 174

7.14.5 SOURce:DME Subsystem

The DME subsystem contains the commands for checking the DME modulation. The characteristics of the internal modulation source are defined with commands `SOURce:DME:...` The modulation signal can be output at the LF connector.

The keyword `SOURce` is optional with commands and can be omitted.

[:SOURce]:DME:ANALysis:EFFiciency?

The command queries the measured reply efficiency in percent. The measurement is the ratio of the number of measured valid reply pulse pairs to transmitted pulse pairs in a measurement cycle.

Return values:

<Efficiency> float

Range: 0 to 100
Increment: 0.1
*RST: 100

Example: `DME:ANAL:EFF:STAT ON`
activates the reply efficiency measurement
`DME:ANAL:EFF?`
queries the measurement result

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Reply Efficiency - DME Modulation" on page 288

[:SOURce]:DME:ANALysis:EFFiciency:OK?

The command queries if there are valid measurement values available in the set measurement window.

Return values:

<Ok> 0 | 1 | OFF | ON

*RST: 1

Example: `DME:ANAL:EFF:STAT ON`
activates the reply efficiency measurement
`DME:ANAL:EFF:OK?`
queries if valid measurement values are available
`Response: 1`
there are valid measurement values
`DME:ANAL:EFF?`
queries the measurement result

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Reply Efficiency - DME Modulation" on page 288

[:SOURce]:DME:ANALysis:EFFiciency:STATe <State>

The command activates the measurement of the reply efficiency of all valid pulse pairs in a measurement cycle.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `DME:ANAL:EFF:STAT ON`
activates the reply efficiency measurement
`DME:ANAL:EFF?`
queries the measurement result

Options: Option R&S SMA-K26

Manual operation: See "Reply Efficiency State- DME Modulation" on page 287

[:SOURce]:DME:ANALysis:GATE:COUNt <Count>

Sets the number of pulse pairs which are sent from the R&S SMA (= interrogator) to the ground station in one measurement cycle. Only reply pulses for which the 50% voltage point of the rising edge of the first pulse is within the measurement window are used to evaluate the delay time and reply efficiency.

Parameters:

<Count> integer

Range: 1 to 10000
*RST: 100

Example: `DME:ANAL:GATE:COUN 100`
sets the number of sent pulse to 100.

Options: Option R&S SMA-K26

Manual operation: See "Measurement Count - DME Modulation" on page 287

[:SOURce]:DME:ANALysis:GATE:EDELay <Edelay>

The command enters the expected reply delay. The expected reply delay and the gate length determine the measurement window (expected reply delay +/- gate length/2).

Parameters:

<Edelay> float

Range: 0 us to 150 us
Increment: 1 us
*RST: Interrogation channel X: 50 us | Interrogation channel Y: 56 us
Default unit: s

Example: `DME:ANAL:GATE:EDEL 50us`
sets an expected reply delay of 50 us

Options: Option R&S SMA-K26

Manual operation: See "Expected Reply Delay - DME Modulation" on page 287

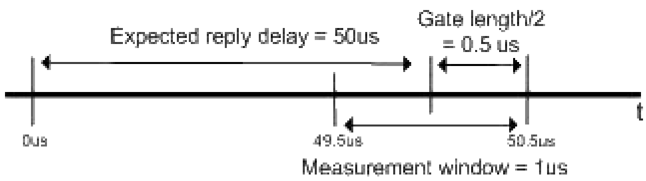
[:SOURce]:DME:ANALysis:GATE[:LENGth] <Length>

The command sets the gate length for the measurement window.

The measurement gate settings determine the measurement window (expected reply delay +/- gate length/2). Only reply pulses for which the 50% voltage point of the rising edge of the first pulse is within the measurement window are used to evaluate the delay time and reply efficiency. The delay measurement is averaged within the measurement cycle. The reply efficiency is calculated once for each measurement cycle.

Example:

The gate length is 1 us and the expected reply delay is 50 us. The measurement window lies in the range between 49.5 and 50.5 us. Only pulse pairs are used for the measurement whose 50% voltage point of the rising edge of the first pulse is within this range.



Parameters:

<Length> integer

Range: 100 ns to 326 us
Increment: 100 ns
*RST: 1 us
Default unit: s

Example: `DME:ANAL:GATE 1us`
sets a gate length of 1 us.

Options: Option R&S SMA-K26

Manual operation: See "Gate Length - DME Modulation" on page 287

[:SOURce]:DME:ANALysis:NORMalize?

The command performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the reply measurements.

Return values:
<Normalize> 0 | 1 | OFF | ON

Example: `DME:ANAL:NORM?`
activates the normalization

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Normalize Setup - DME Modulation" on page 288

[:SOURce]:DME:ANALysis:POWer?

The command queries the measured average peak level of all valid pulse pairs in a measurement cycle.

Return values:
<Power> float

Range: -200 to 200
Increment: 0.01
*RST: 0

Example: `DME:ANAL:POW:STAT ON`
activates the average peak level measurement
`DME:ANAL:POW?`
queries the measurement result

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Peak Level - DME Modulation" on page 287

[:SOURce]:DME:ANALysis:POWer:OK?

The command queries if there are measurement values available in the set measurement window.

Return values:
<Ok> 0 | 1 | OFF | ON

*RST: 1

Example: `DME:ANAL:POW:STAT ON`
activates the average peak level measurement
`DME:ANAL:POW:OK?`
queries if valid measurement values are available
Response: 1
there are valid measurement values
`DME:ANAL:POW?`
queries the measurement result

Usage: Query only

Options: Option R&S SMA-K26

[:SOURce]:DME:ANALysis:POWer:STATe <State>

The command activates the measurement of the average peak level of all valid pulse pairs in a measurement cycle.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `DME:ANAL:POW:STAT ON`
activates the average peak level measurement
`DME:ANAL:POW?`
queries the measurement result

Options: Option R&S SMA-K26

Manual operation: See "Peak Level State - DME Modulation" on page 287

[:SOURce]:DME:ANALysis:PRRate?

The command queries the measured mean pulse repetition rate of the DME ground station. For this measurement all received pulses of the DME ground station are considered.

Return values:

<Rate> float

Range: 0 to 10000
Increment: 0.1
*RST: 0

Example: `DME:ANAL:PRR:STAT ON`
activates the mean pulse repetition rate measurement
`DME:ANAL:PRR?`
queries the measurement result

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Pulse Repetition Frequency - DME Modulation" on page 288

[:SOURce]:DME:ANALysis:PRRate:OK?

The command queries if there are valid measurement values available in the set measurement window.

Return values:

<Ok> 0 | 1 | OFF | ON

*RST: 1

Example: `DME:ANAL:PRR:STAT ON`
activates the mean pulse repetition rate measurement
`DME:ANAL:PRR:OK?`
queries if valid measurement values are available
Response: 1
there are valid measurement values
`DME:ANAL:PRR?`
queries the measurement result

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Pulse Repetition Frequency - DME Modulation" on page 288

[:SOURce]:DME:ANALysis:PRRate:STATe <State>

The command activates the measurement of the mean pulse repetition rate of the DME ground station. For this measurement all received pulses of the DME ground station are considered.

This measurement and the measurement of the delay, efficiency and average peak power are performed alternately. Therefore, the speed of the pulse repetition measurement increases if all other measurements are deactivated.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `DME:ANAL:PRR:STAT ON`
activates the mean pulse repetition rate measurement
`DME:ANAL:PRR?`
queries the measurement result

Options: Option R&S SMA-K26

Manual operation: See "Pulse Repetition Frequency State - DME Modulation" on page 288

[:SOURce]:DME:ANALysis:STATe <State>

The command activates the DME analysis. The setting is only available after connecting the R&S NRP-Z81 power sensor.

Parameters:

<State>	0 | 1 | OFF | ON *RST: OFF
Example:	`DME:ANAL:STAT ON` activates the DME analysis
Options:	Option R&S SMA-K26
Manual operation:	See "DME Analysis State - DME Modulation" on page 286

[:SOURce]:DME:ANALysis:TIME?

The command queries the measured average reply delay of all valid pulse pairs in a measurement cycle.

Return values:

<Time>	float Range: -1E-3 to 1E-3 Increment: 10E-9 *RST: 0

Example:	`DME:ANAL:TIME:STAT ON`
	activates the average peak level measurement
	`DME:ANAL:TIME?`
	queries the measurement result

Usage:	Query only
Options:	Option R&S SMA-K26
Manual operation:	See "Reply Delay - DME Modulation" on page 287

[:SOURce]:DME:ANALysis:TIME:OK?

The command queries if there are valid measurement values available in the set measurement window.

Return values:

<Ok>	0 | 1 | OFF | ON

Example:	`DME:ANAL:TIME:STAT ON`
	activates the average peak level measurement
	`DME:ANAL:TIME:OK?`
	queries if valid measurement values are available
	Response: 1
	there are valid measurement values
	`DME:ANAL:TIME?`
	queries the measurement result

Usage:	Query only
Options:	Option R&S SMA-K26
Manual operation:	See "Reply Delay - DME Modulation" on page 287

[:SOURce]:DME:ANALysis:TIME:STATe <State>

The command activates the measurement of the average reply delay of all valid pulse pairs in a measurement cycle.

Parameters:

<State>	0 | 1 | OFF | ON
	*RST: ON

Example: `DME:ANAL:TIME:STAT ON`
activates the average reply delay measurement
`DME:ANAL:TIME?`
queries the measurement result

Options: Option R&S SMA-K26

Manual operation: See "Reply Delay Status- DME Modulation" on page 287

[:SOURce]:DME:ANALysis:TRIGger:SEARch?

Determines the trigger level = 50% voltage point of first pulse of the external DME interrogation signal.

This command determines the trigger point after connecting the R&S NRP-Z81 sensor to the external interrogation signal source. The search function has to be executed with each change of the level of the external DME signal.

Return values:

<Search>	0 | 1 | OFF | ON
	*RST: 0

Example: `DME:ANAL:TRIG:SEAR ON`
executes DME trigger determination.

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Search Trigger Level - DME Modulation" on page 280

[:SOURce]:DME:CSUFfix <CSuffix>

The command selects the channel that is simulated.

Standard compliant X and Y channels differ in the spacing between the two pulses of the pulse pair and the delay of the ground station.

Parameters:

<CSuffix>	X | Y | ICAO
	*RST: X

Example: `DME:CSUF Y`
selects simulation of channel Y

Options: Option R&S SMA-K26

Manual operation: See "Channel Mode - DME Modulation" on page 272

[:SOURce]:DME:ICAO:CHANnel <Channel>

Selects the ICAO channel, that means the DME transmitting frequency. The RF-frequency is set to the value selected here.

Parameters:

<Channel> CH1X | CH1Y | CH2X | CH2Y | CH3X | CH3Y | CH4X | CH4Y | CH5X | CH5Y | CH6X | CH6Y | CH7X | CH7Y | CH8X | CH8Y | CH9X | CH9Y | CH10X | CH10Y | CH11X | CH11Y | CH12X | CH12Y | CH13X | CH13Y | CH14X | CH14Y | CH15X | CH15Y | CH16X | CH16Y | CH17X | CH17Y | CH18X | CH18Y | CH19X | CH19Y | CH20X | CH20Y | CH21X | CH21Y | CH22X | CH22Y | CH23X | CH23Y | CH24X | CH24Y | CH25X | CH25Y | CH26X | CH26Y | CH27X | CH27Y | CH28X | CH28Y | CH29X | CH29Y | CH30X | CH30Y | CH31X | CH31Y | CH32X | CH32Y | CH33X | CH33Y | CH34X | CH34Y | CH35X | CH35Y | CH36X | CH36Y | CH37X | CH37Y | CH38X | CH38Y | CH39X | CH39Y | CH40X | CH40Y | CH41X | CH41Y | CH42X | CH42Y | CH43X | CH43Y | CH44X | CH44Y | CH45X | CH45Y | CH46X | CH46Y | CH47X | CH47Y | CH48X | CH48Y | CH49X | CH49Y | CH50X | CH50Y | CH51X | CH51Y | CH52X | CH52Y | CH53X | CH53Y | CH54X | CH54Y | CH55X | CH55Y | CH56X | CH56Y | CH57X | CH57Y | CH58X | CH58Y | CH59X | CH59Y | CH60X | CH60Y | CH61X | CH61Y | CH62X | CH62Y | CH63X | CH63Y | CH64X | CH64Y | CH65X | CH65Y | CH66X | CH66Y | CH67X | CH67Y | CH68X | CH68Y | CH69X | CH69Y | CH70X | CH70Y | CH71X | CH71Y | CH72X | CH72Y | CH73X | CH73Y | CH74X | CH74Y | CH75X | CH75Y | CH76X | CH76Y | CH77X | CH77Y | CH78X | CH78Y | CH79X | CH79Y | CH80X | CH80Y | CH81X | CH81Y | CH82X | CH82Y | CH83X | CH83Y | CH84X | CH84Y | CH85X | CH85Y | CH86X | CH86Y | CH87X | CH87Y | CH88X | CH88Y | CH89X | CH89Y | CH90X | CH90Y | CH91X | CH91Y | CH92X | CH92Y | CH93X | CH93Y | CH94X | CH94Y | CH95X | CH95Y | CH96X | CH96Y | CH97X | CH97Y | CH98X | CH98Y | CH99X | CH99Y | CH100X | CH100Y | CH101X | CH101Y | CH102X | CH102Y | CH103X | CH103Y | CH104X | CH104Y | CH105X | CH105Y | CH106X | CH106Y | CH107X | CH107Y | CH108X | CH108Y | CH109X | CH109Y | CH110X | CH110Y | CH111X | CH111Y | CH112X | CH112Y | CH113X | CH113Y | CH114X | CH114Y | CH115X | CH115Y | CH116X | CH116Y | CH117X | CH117Y | CH118X | CH118Y | CH119X | CH119Y | CH120X | CH120Y | CH121X | CH121Y | CH122X | CH122Y | CH123X | CH123Y | CH124X | CH124Y | CH125X | CH125Y | CH126X | CH126Y

*RST: CH1X

Example: `DME:ICAO:CHAN CH20Y`

selects ICAO frequency channel 20Y. This channel sets the RF frequency to 108.35 MHz.

Options: Option R&S SMA-K25

Manual operation: See "ICAO Channel - DME Modulation" on page 273

[:SOURce]:DME:ECHO <Echo>

The command activates an echo pulse pair. The echo pulses have the same shape and timing as the original pulses. The delay and amplitude of the echo pulses can be set. The selection is possible for pulse squitter off (`SOURce:DME:SQUitter OFF`).

Parameters:

<Echo> 0 | 1 | OFF | ON

*RST: OFF

Example: `DME:ECHO ON`
activates the simulation of an echo pulse pair.

Options: Option R&S SMA-K26

Manual operation: See "Echo Pulse - DME Modulation" on page 277

[:SOURce]:DME:ECHO:ATTenuation <Attenuation>

The command sets the attenuation of the echo pulses compared to the original pulses. A positive attenuation leads to echo pulses with reduced amplitude compared to the original pulses, and a negative attenuation leads to echo pulses with increased amplitude compared to the original pulses.

Parameters:

<Attenuation> float

Range: -6 dB to 30 dB
Increment: 0.01 dB
*RST: 0 dB

Example: `DME:ECHO ON`
activates the simulation of an echo pulse pair.
`DME:ECHO:ATT 4 dB`
an echo is simulated with an amplitude that is reduced by 4 dB compared to the original pulse pair.

Options: Option R&S SMA-K26

Manual operation: See "Echo Attenuation - DME Modulation" on page 277

[:SOURce]:DME:ECHO:DELay <Delay>

The command sets the delay from the first original pulse to the first echo pulse.

Parameters:

<Delay> float

Range: 10 us to 1000 us
Increment: 5 us
*RST: 400 us

Example: `DME:ECHO ON 'activates the simulation of an echo pulse pair.`
`DME:ECHO:ATT 4 dB`
an echo is simulated with an amplitude that is reduced by 4 dB compared to the original pulse pair.
`DME:ECHO:DEL 600 us`
the first echo pulse is generated 600 us after the first original pulse.

Options: Option R&S SMA-K26

Manual operation: See "Echo Delay - DME Modulation" on page 277

[:SOURce]:DME:EFFiciency <Efficiency>

Sets the relation between reply pulse pairs and received trigger signals, e.g. with a set efficiency of 50% only every second trigger event leads to the generation of a reply pulse pair.

Parameters:

<Efficiency> integer

Range: 0 PCT to 100 PCT
*RST: 100 PCT

Example: `DME:MODE REPL`
activates the reply mode
`DME:EFF 75PCT`
sets a reply efficiency of 75 PCT

Options: Option R&S SMA-K26

Manual operation: See "Reply Efficiency - DME Modulation" on page 276

[:SOURce]:DME:FALL <Fall>

Sets the fall time of the pulse (90% to 10% of peak voltage).

Parameters:

<Fall> float

Range: 0.5 us to 20 us
Increment: 10 ns
*RST: 2 us

Example: `DME:FALL 4us`
sets a pulse fall time of 4 us

Options: Option R&S SMA-K26

Manual operation: See "Pulse Fall - DME Modulation" on page 277

[:SOURce]:DME:ID:CODE <Code>

Enters the coding of the ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (ID signal). The ID tone is sent according to the selected code. This command is available for reply mode only.

The length of the morse code can be varied. For selection standard time scheme (`DME:ID:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`DME:ID:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code> string

*RST: empty string

Example: `DME:MODE REPL`
selects reply mode
`DME:ID:CODE 'MUC'`
selects code for Munich airport

Options: Option R&S SMA-K26

Manual operation: See "ID Code - DME Modulation" on page 282

[:SOURce]:DME:ID:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for reply mode and user time schema only.

Parameters:

<Dash> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 300 ms
Default unit: s

Example: `DME:MODE REPL`
selects reply mode
`DME:ID:CODE 'MUC'`
selects code for Munich airport
`DME:ID:TSCH USER`
selects user time schema
`DME:ID:DOT 200ms`
sets a dot length of 200 ms.
`DME:ID:DASH 400ms`
sets a dash length of 400 ms.
`DME:ID:LETT 50ms`
sets a letter space of 50 ms.
`DME:ID:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K26

Manual operation: See "ID Dash Length - DME Modulation" on page 284

[:SOURce]:DME:ID:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry. This command is available for reply mode only.

Parameters:

<Dot> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 100 ms
Default unit: s

Example:
`DME:MODE REPL`
selects reply mode
`DME:ID:CODE 'MUC'`
selects code for Munich airport
`DME:ID:DOT 200ms`
sets a dot length of 200 ms.

Options: Option R&S SMA-K26

Manual operation: See "ID Dot Length - DME Modulation" on page 284

[:SOURce]:DME:ID:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available for reply mode and user time schema only.

Parameters:

<Letter> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 300 ms
Default unit: s

Example:
`DME:MODE REPL`
'selects reply mode
`DME:ID:CODE 'MUC'`
'selects code for Munich airport
`DME:ID:TSCH USER`
'selects user time schema
`DME:ID:DOT 200ms`
'sets a dot length of 200 ms.
`DME:ID:DASH 400ms`
'sets a dash length of 400 ms.
`DME:ID:LETT 50ms`
'sets a letter space of 50 ms.
`DME:ID:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K26

Manual operation: See "ID Letter Space - DME Modulation" on page 284

[:SOURce]:DME:ID:PERiod <Period>

Sets the period of the ID sequence in seconds. This command applies to reply mode.

Parameters:

<Period> integer

Range: 10 to 120
*RST: 40
Default unit: s

Example:
`DME:MODE REPL`
selects reply mode
`DME:ID:CODE 'MUC'`
selects code for Munich airport
`DME:ID:DOT 200ms`
sets a dot length of 200 ms.
`DME:ID:PER 40`
sets a period of 40 s for the ID sequence

Options: Option R&S SMA-K26

Manual operation: See "ID Period - DME Modulation" on page 283

[:SOURce]:DME:ID:PRESet

The command sets the default settings for the ID signal. This command is available for reply mode only.

Example:
`DME:ID:PRES`
activates the default settings for all SOURce:DME:ID… commands.

Usage: Event

Options: Option R&S SMA-K26

Manual operation: See "Set To Default ID - DME Modulation" on page 284

[:SOURce]:DME:ID:RATE <Rate>

Enters the pulse repetition rate of the ID sequence. This command is available for reply mode only.

Parameters:

<Rate> float

Range: 100 Hz to 10 kHz
Increment: 0.1 Hz
*RST: 1350 Hz
Default unit: Hz

Example: `DME:ID:RATE 2500`
sets a repetition rate of the ID sequence of 2.5 kHz

Options: Option R&S SMA-K26

Manual operation: See "ID Rate - DME Modulation" on page 283

[:SOURce]:DME:ID[:STATe] <State>

Switches on/off the generation of the identification sequence (ID signal) of the ground station. The ID signal consists of a series of pulse pairs transmitted at a rate of 1350 Hz.

The transmission of the ground signal is interrupted every 40 seconds (ID period) and one ID sequence is transmitted instead. The "key down time" of the ground signal corresponds to the period of transmission for a dot or dash in the morse code ID sequence (e.g. 100ms for a dot). During the key down times reply pulses are not transmitted, however, they are transmitted between the key down times.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `DME:ID ON`
activates generation of the identification sequence.

Options: Option R&S SMA-K26

Manual operation: See "ID State - DME Modulation" on page 282

[:SOURce]:DME:ID:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for reply mode and user time schema only.

Parameters:

<Symbol> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 100 ms
Default unit: s

Example:
`DME:MODE REPL`
selects reply mode
`DME:ID:CODE 'MUC'`
selects code for Munich airport
`DME:ID:TSCH USER`
selects user time schema
`DME:ID:DOT 200ms`
sets a dot length of 200 ms.
`DME:ID:DASH 400ms`
sets a dash length of 400 ms.
`DME:ID:LETT 50ms`
sets a letter space of 50 ms.
`DME:ID:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K26

Manual operation: See "ID Symbol Space - DME Modulation" on page 284

[:SOURce]:DME:ID:TSCHema <TSchema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (ID signal).

Parameters:

<TSchema> STD | USER

*RST: USER

Example:
`DME:MODE REPL`
selects reply mode
`DME:ID:CODE 'MUC'`
selects code for Munich airport
`DME:ID:TSCH STD`
selects standard time schema
`DME:ID:DOT 200ms`
sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.

Options: Option R&S SMA-K26

Manual operation: See "ID Time Schema - DME Modulation" on page 283

[:SOURce]:DME:LOWemission <LowEmission>

Activates the generation of a DME signal with higher spectral purity but less dynamic compared to the default mode. The ON/OFF ratio of the pulses is reduced from typ. >100 dB to typ. 35 dB.

Parameters:

<LowEmission> 0 | 1 | OFF | ON

*RST: OFF

Example: `DME:LOW ON`

activates the generation of a DME signal with higher spectral purity

Options: Option R&S SMA-K26

Manual operation: See "Low Spectral Emission - DME Modulation" on page 278

[:SOURce]:DME:MODE <Mode>

Selects the mode of the DME modulation. The mode determines the signal type that is simulated. The exact timing of the signal for each mode is determined by the selected channel (X or Y, `SOURce:DME:CSUFfix`).

Parameters:

<Mode> INTerrogation | REPLy

INTerrogation

The interrogation signal of the airborne transmitter is simulated.

REPLy

The reply signal of the ground based transponder is simulated. The trigger is automatically set to external and the default trigger delay either to 50 us (channel X) or 56 us (channel Y) depending on the selected channel (`SOURce:DME:CSUFFix`). The interval between the pulse pairs can be set to a fixed value (repetition rate, `SOURce:DME:RATE`) or to random generation (pulse squitter, `SOURce:DME:SQUitter`). The trigger signal is input via the PULSE EXT connector.

*RST: INTerrogation

Example: `DME:MODE INT`

Activates generation of the interrogation signal of the airborne transmitter.

Options: Option R&S SMA-K26

Manual operation: See "Mode - DME Modulation" on page 271

[:SOURce]:DME:PPS <Pps>

Sets the spacing between the first and second pulse of a pulse pair (time between half-voltage points on the leading edge of each pulse).

Parameters:

<Pps> float

Range: 1 us to 100 us
Increment: 5 ns
*RST: 12 us

Example: `DME:PPS 14µs`
sets a spacing of 14us

Options: Option R&S SMA-K26

Manual operation: See "Pulse Spacing - DME Modulation" on page 277

[:SOURce]:DME:PRESet

The commands activate the DME default setting.

Example: `DME:PRES`
activates the DME default settings for all `SOURce:DME:...` commands.

Usage: Event

Options: Option R&S SMA-K26

Manual operation: See "Set To Default - DME Modulation" on page 278

[:SOURce]:DME:RATE <Rate>

Interrogation mode:

Sets the pulse repetition rate for trigger setting Auto or Ext Gated.

Delay mode:

Indicates the mean pulse repetition rate in squitter mode.

Parameters:

<Rate> integer

Range: 10 to 6000
*RST: 48
Default unit: Hz

Example: `DME:MODE INT`
selects interrogation mode
`DME:TRIG AUTO`
selects auto trigger mode
`DME:RATE 48 Hz`
sets a pulse repetition rate of 48 Hz

Options: Option R&S SMA-K26

Manual operation: See "Pulse Repetition Rate - DME Modulation" on page 276

[:SOURce]:DME:RDIStance <RDistance>

Sets the simulated distance between interrogator and transponder for reply mode. The distance is given in nautic miles (nm). 1 nm is 1852.01 meters and corresponds to a run time of 12.359 µs. This command is available for reply mode only.

The range distance and the external trigger delay are interdependent according to:

range distance = (trigger delay – X/Y mode delay)/12.359 µs/nm

(X mode delay = 50 µs, Y mode delay is 56 µs)

Changing one value automatically changes the other value.

Parameters:

<RDistance> float

Range: -4.046 (X), -4.531 (Y) to 400
Increment: 0.001 nm
*RST: 0 nm
Default unit: nm

Example:
`DME:MODE REPL`
selects reply mode
`DME:RDIS 0.1 nm`
sets a range distance of 0.1 nautic mile

Options: Option R&S SMA-K26

Manual operation: See "Range Distance - DME Modulation" on page 275

[:SOURce]:DME:RISE <Rise>

Sets the rise time of the pulse (10% to 90% of peak voltage).

Parameters:

<Rise> float

Range: 0.5 us to 20 us
Increment: 10 ns
*RST: 2 us

Example:
`DME:RISE 4us`
sets a pulse rise time of 4 us

Options: Option R&S SMA-K26

Manual operation: See "Pulse Rise - DME Modulation" on page 276

[:SOURce]:DME:SHAPe <Shape>

Selects the pulse shape.

Parameters:

<Shape> COS2 | LIN | COS

COS
The falling and the rising edge of the pulse are cos^2 shaped.

COS2
The rising edge is cos shaped and the falling edge is cos^2 shaped.

LIN
The falling and the rising edge of the pulse are shaped linear.

*RST: COS

Example: `DME:SHAP COS`
selects generation of pulses with cos shaped rising and falling edges

Options: Option R&S SMA-K26

Manual operation: See "Pulse Shape - DME Modulation" on page 276

[:SOURce]:DME:SINGle <Single>

Activates generation of a single test pulse.

Parameters:

<Single> 0 | 1 | OFF | ON

*RST: OFF

Example: `DME:SING ON`
a single test pulse is generated

Options: Option R&S SMA-K26

Manual operation: See "Single Pulse - DME Modulation" on page 277

[:SOURce]:DME:SQUitter <Squitter>

Activates the random pulse repetition rate. The average repetition rate is 2700 pp/s. The pulse spacing is distributed randomly in the range of 60 µs to about 1500 µs according to EUROCAE EN-54 6.2.12. The squitter pulses are constantly sent by the ground station in order to ensure proper operation and in order to ease synchronization of the aircraft interrogator to the ground station.

This command is available for Reply mode on only.

Parameters:

<Squitter> 0 | 1 | OFF | ON

*RST: OFF

Example: `DME:MODE REPL`
selects reply mode
`DME:SQU ON`
activates generation of squitter pulses.

Options: Option R&S SMA-K26

Manual operation: See "Pulse Squitter - DME Modulation" on page 276

[:SOURce]:DME:STATe <State>

The commands activate/deactivate DME modulation. The DME modulation signal can be output at the LF connector.

Note: Modulations PULSE, VOR, ILS-GS, ILS-LOC, MKR-BCN, ADF, AM, and internal FM/PhiM are automatically switched off when DME modulation is activated. Also, the pulse generator is automatically switched off.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `DME:STAT ON`

activates DME modulation.

Options: Option R&S SMA-K26

Manual operation: See "State - DME Modulation" on page 271

[:SOURce]:DME:TACan:DEPTh <Depth>

Sets the modulation depth in per cent.

Note: Observe that this value is valid for both signal components of the two-tone signal 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).

Parameters:

<Depth> float

Range: 0 PCT to 100 PCT
Increment: 0.1
*RST: 42 PCT
Default unit: PCT

Example: `DME:TAC:DEPT 30PCT`

sets the overall AM modulation depth to 30 percent. With this setting the modulation depth of the two LF generators are automatically set to 15 percent each.

Options: R&S SMA-K26

Manual operation: See "Composite AM Depth - DME Modulation" on page 285

[:SOURce]:DME:TACan:INTernal<ch>:DEPTh <Depth>

This command sets the modulation depth for one component of the two-tone signal in per cent.

Note: The sum of the two components must not exceed the overall modulation depth (see data sheet).

Parameters:

<Depth> float

Range: 0 PCT to 100 PCT
Increment: 0.1 PCT
*RST: 21 PCT
Default unit: PCT

Example: `DME:TAC:INT1:DEPT 20PCT`
sets the AM modulation depth to 20 percent for the first tone. With setting 42 percent for the overall modulation depth, the modulation depth of the second tone is automatically set to 22 percent.

Options: R&S SMA-K26

Manual operation: See "Composite AM Depth 1/2 - DME Modulation" on page 286

[:SOURce]:DME:TACan:PHASe <Phase>

This commands sets the phase of the two-tone signal.

Parameters:

<Phase> float

Range: -180 to 180
Increment: 0.01
*RST: 0
Default unit: DEGree

Example: `DME:TAC:STAT ON`
activates Composite AM modulation.

Options: Option R&S SMA-K26

[:SOURce]:DME:TACan<ch>:FREQuency <Frequency>

Sets the individual frequencies of the two-tone signal.

Parameters:

<Frequency> float

Range: 0.10 Hz to 10.0 kHz
Increment: 0.01
*RST: 15 Hz <ch1>, 135 Hz <ch2>
Default unit: Hz

Example: `SOUR:DME:TAC1:FREQ 0.7 Hz`
`SOUR:DME:TAC2:FREQ 77.33 Hz`
sets the first frequency to 0.7 Hz, and the second to 77.33 Hz.

Options: R&S SMA-K26

Manual operation: See "Composite AM Frequency 1/2 - DME Modulation" on page 286

[:SOURce]:DME:TACan:STATe <State>

This functions activates/deactivates the two-tone signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `DME:TAC:STAT ON`
activates Composite AM modulation.

Options: Option R&S SMA-K26

Manual operation: See "Composite AM State - DME Modulation" on page 285

[:SOURce]:DME:TRIGger <Trigger>

Selects the trigger mode for DME modulation signals. For Reply mode only external trigger is possible

Parameters:

<Trigger> AUTO | EXTernal | EGATe | PSENsor

AUTO
The DME modulation signals are generated continuously. This mode is only available for the interrogation signal.

EXTernal
The DME modulation signals are triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

EGATe
The DME modulation signals are gated by an external gate signal. The signal is supplied via the PULSE EXT connector. This mode is only available for the interrogation signal.

PSENsor
The DME modulation signals are triggered by an external power sensor. This mode is only available for the interrogation signal.

*RST: Interrogation Mode: AUTO; Reply Mode: EXTernal

Example: `DME:TRIG EXT`
activates external trigger mode

Options: Option R&S SMA-K26

Manual operation: See "Trigger Mode - DME Modulation" on page 279

[:SOURce]:DME:TRIGger:DELay <Delay>

Sets the delay between the external trigger and the first DME output pulse (50% voltage point of first pulse). This command is effective for external trigger only.

For DME Reply mode this simulates the defined delay of the DME transponder and twice the run time of the signal (from interrogator to transponder and back). The delay is a measure of the range distance, thus, the two values are interdependent according to:

Delay = X/Y mode delay + range distance * 12.359 nm/µs

(X mode delay = 50 µs, Y mode delay is 56 µs)

Changing one value automatically changes the other value.

Parameters:

<Delay> float

Range: 4 us to 5 ms
Increment: 20 ns
*RST: Reply X: 50 µs | Reply Y: 56 µs | Interrogation: 50 µs

Example:
`DME:TRIG EXT`
activates external trigger mode
`DME:TRIG:DEL 150us`
sets a delay of 150us

Options: Option R&S SMA-K26

Manual operation: See "Trigger Delay - DME Modulation" on page 279

[:SOURce]:DME:TRIGger:DELay:NORMalize?

Performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the trigger delay. This command is effective for external power sensor trigger only.

Return values:

<Normalize> 0 | 1 | OFF | ON

Example:
`DME:TRIG PSEN`
activates external power sensor trigger mode
`DME:TRIG:DEL:NORM?`
performs normalization of test setup

Usage: Query only

Options: Option R&S SMA-K26

Manual operation: See "Normalize Trigger Delay - DME Modulation" on page 280

[:SOURce]:DME:TRIGger:GPOLarity <GPolarity>

Sets the polarity of the active level of the external gate trigger at the PULSE EXT connector. This command is effective for external gate only.

Parameters:

<GPolarity> NORMal | INVerted

NORMal
The DME modulation signal is generated while the gate signal is high.

INVerted
The DME modulation signal is generated while the gate signal is low.

*RST: NORMal

Example: `DME:TRIG GATE`
activates external gate mode
`DME:TRIG:GPOL INV`
the signal is generated while the gate level is high.

Options: Option R&S SMA-K26

Manual operation: See "Gate Input Polarity - DME Modulation" on page 280

[:SOURce]:DME:TRIGger:IMPedance <Impedance>

Selects the input impedance for the external trigger and gate signal input PULSE EXT (10 kOhm or 50 Ohm). This command applies to external or gated trigger mode.

Parameters:

<Impedance> G50 | G10K

*RST: G50

Example: `DME:TRIG EXT`
activates external trigger mode
`DME:TRIG:IMP G50`
sets the impedance to 50 Ohm.

Options: Option R&S SMA-K26

Manual operation: See "External Impedance - DME Modulation" on page 280

[:SOURce]:DME:TRIGger:SLOPe <Slope>

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector. This command is effective for external trigger only.

Parameters:

<Slope> NEGative | POSitive

POSitive
The DME modulation signals are triggered on the positive slope of the external trigger signal.

NEGative
The DME modulation signals are triggered on the negative slope of the external trigger signal.

*RST: POSitive

Example: `DME:TRIG EXT`
activates external trigger mode
`DME:TRIG:SLOP NEG`
the active slope of the external trigger signal at the PULSE EXT input is the falling slope.

Options: Option R&S SMA-K26

Manual operation: See "Trigger Slope - DME Modulation" on page 280

[:SOURce]:DME:WIDTh <Width>

Sets the pulse width (50% to 50% of peak voltage).

Parameters:

<Width> float

Range: 1 us to 100 us
Increment: 2 ns
*RST: 3.5 us

Example: `DME:WIDT 12us`
sets a pulse width of 12us

Options: Option R&S SMA-K26

Manual operation: See "Pulse Width - DME Modulation" on page 277

7.14.6 SOURce:FM Subsystem

The FM subsystem contains the commands for checking the frequency modulation.

The FM-specific characteristics of the internal modulation source are defined with commands `SOURce:FM:INTernal:....` 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 FM/PM EXT connector. Internal and external modulation source can be selected at the same time, thus enabling two-tone FM modulation.

For information about the required options, see Chapter 5.4.3, "Frequency Modulation (FM)", on page 250.

[:SOURce<hw>]:FM[:DEViation] <Deviation>

Sets the deviation of the frequency modulation signals in Hz. The maximum deviation depends on the set RF frequency and the selected modulation mode (see data sheet).

Parameters:

<Deviation> float

Range: 0 to dynamic
Increment: 0.01
*RST: 1000

Example: `FM 2E3`
sets a 2 kHz deviation to the modulation signal.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "FM Deviation" on page 252

[:SOURce<hw>]:FM:EXTernal:COUPling <Coupling>

Selects the coupling mode for the external frequency modulation signal.

Parameters:

<Coupling> AC | DC

AC
Uses only the AC signal component of the modulation signal.

DC
Uses the modulation signal as it is, with AC and DC.

*RST: AC

Example: `FM:EXT:COUP AC`
selects the coupling mode AC for the external frequency modulation signal.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "FM External Coupling" on page 254

[:SOURce<hw>]:FM:EXTernal:DEViation <Deviation>

Sets the deviation of the external frequency modulation signal in Hz. The maximum deviation depends on the set RF frequency and the selected modulation mode (see data sheet).

The sum of the deviations of all active frequency modulation signals may not exceed the total value set with command `[:SOURce<hw>]:FM[:DEViation]`.

Parameters:

<Deviation> float

Range: see data sheet
Increment: 0.01
*RST: 1000

Example: `FM:EXT:DEV 3kHz`
sets 3 kHz deviation to the frequency modulation signal.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "FM Deviation" on page 252

[:SOURce<hw>]:FM:EXTernal:DIGital:BFORmat <BFormat>

Selects the binary format for external digital frequency modulation.

Parameters:

<BFormat> DCODe | BOFFset

*RST: BOFFset

Example: `FM:EXT:DIG:BFOR BOFF`
selects binary format binary offset.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "Binary Format " on page 254

[:SOURce<hw>]:FM:INTernal<ch>:DEViation <Deviation>

Sets the deviation of the internal frequency modulation signals in Hz. The sum of the deviations of all active frequency modulation signals may not exceed the total value set with command `[:SOURce<hw>]:FM[:DEViation]`.

Suffix:

<ch> 1..2
determines the modulation signal channel.

Parameters:

<Deviation> float

Range: see data sheet
Increment: 0.01
*RST: LF1: 1 kHz, LF2: 0 kHz

Options: Option R&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24

Manual operation: See "Deviation 1/Deviation 2" on page 253

[:SOURce<hw>]:FM:INTernal:SOURce <Source>

Selects the internal modulation signal source. The available selection depends on the installed options. To configure the modulation signal, use the commands of the Chapter 7.14.10, "SOURce:LFOutput Subsystem", on page 566 subsystem.

Parameters:

<Source> LF1 | LF2 | LF12 | NOISe | LF1Noise | LF2Noise

*RST: LF1

Example: `FM:INT:SOUR LF2N`

uses the noise signal generated by the second LF generator for frequency modulation.

Options: OptionR&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24 for selections other than LF1

Manual operation: See "Internal Source" on page 253

[:SOURce<hw>]:FM:MODE <Mode>

Selects the mode for the frequency modulation.

Parameters:

<Mode> NORMal | LNOise

NORMal

Provides full setting range of modulation bandwidth and FM deviation.

LNOise

Provides phase noise and spurious characteristics close to CW. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

*RST: NORM

Example: `FM:MODE NORM`

selects normal mode for external frequency modulation.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "FM Mode" on page 252

[:SOURce<hw>]:FM:SENSitivity?

Queries the input sensitivity of the externally applied signal for frequency modulation. The returned value reports the sensitivity in Hz/V. It is assigned to the voltage value for full modulation of the input signal.

The sensitivity depends on the set `[:SOURce<hw>]:FM[:DEViation]`.

Return values:

<Sensitivity> float

Range: 0 to max
Increment: 0.01

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 5000 Hz/V.

Usage: Query only

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "FM Sensitivity" on page 254

[:SOURce<hw>]:FM:SOURce <Source>

Selects the modulation signal source for frequency modulation.

You can use both, the internal and an external modulation signal at a time.

Parameters:

<Source> INTernal | EXTernal | INT,EXT | EDIGital

INT
Uses the internally generated signal for modulation. To configure the frequency, use the commands of the Chapter 7.14.10, "SOURce:LFOutput Subsystem", on page 566 subsystem.
With command `[:SOURce<hw>]:FM:INTernal:SOURce` on page 538 you can select the internal signal source.

EXT
Uses an externally applied modulation signal.
The external analog signal is input at the FM/PM EXT connector.
The external digital signal is input at the AUX I/O connector (selection `EDIGital`).

INT,EXT
Uses both, the internal and external modulation signals.

EDIGital
Uses an externally applied digital modulation signal.

*RST: INT

Example: `FM:SOUR INT`
selects the internal modulation source.

Options: Option R&S SMA-B20 or -B22

Manual operation: See "FM Source" on page 251

[:SOURce<hw>]:FM:STATe <State>

Activates frequency modulation.

Note: Activation of FM deactivates phase modulation (PM).

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `FM:STAT ON`

Activates FM modulation.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "State" on page 251

7.14.7 SOURce:FREQuency Subsystem

This subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

[:SOURce<hw>]:FREQuency:CENTer <Center>

Sets the center frequency of the RF sweep range.

The range is defined by this center frequency and the specified `[:SOURce<hw>]:FREQuency:SPAN`, according to the formula:

f_{CENTer} - (f_{SPAN}/2) ... f_{CENTer} + (f_{SPAN}/2)

with:

$f_{SPAN} = f_{STOP} - f_{STARt}$

The center frequency directly relates to the span, and the start and stop frequencies. If you change one of these parameters, the center frequency changes accordingly.

$f_{CENTer} = (f_{STOP} + f_{STARt})/2$

Note: You can select any frequency within the setting range. The range is defined with the parameters `[:SOURce<hw>]:FREQuency:STARt` and `[:SOURce<hw>]:FREQuency:STOP`.

A defined offset and the multiplier factor affect the sweep frequency range and therefore all correlated parameters. The set frequencies are only absolute values, if the offset = 0 and the multiplication factor = 1. The multiplier multiplies the frequencies accordingly, and the offset ≠ 0 shifts the frequencies corresponding to the set value.

300 kHz * $f_{MULTiplier}$ + f_{OFFSet} ... f_{max} * $f_{MULTiplier}$ + f_{OFFSet}

Parameters:

<Center> float

	Range:	full frequency range
	Increment:	see the data sheet: RF characteristics > Resolution of setting
	*RST:	depends on model

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.

Manual operation: See "Center Freq - Frequency Sweep" on page 226

[:SOURce<hw>]:FREQuency[:CW|FIXed] <Fixed>

Sets the frequency of the RF output signal.

In CW mode, see FREQ:MODE CW|FIXed, the instrument operates at a fixed frequency.

In sweep mode FREQ:MODE SWE, the value applies to the sweep frequency and the instrument processes the frequency settings in defined sweep steps.

You can enter either a numerical frequency value, of decrease or increase the current frequency step by step with FREQ UP and FREQ DOWN. The frequency is then increased or decreased by the value `[:SOURce<hw>]:FREQuency:STEP[:INCRement]` in FREQ:STEP:MODE USER.

Note:

A defined offset and the multiplier factor affect the sweep range and therefore all correlated parameters. The set frequencies are only absolute values, if the offset = 0 and the multiplication factor = 1. The multiplier multiplies the frequencies accordingly, and the offset ≠ 0 shifts the frequencies corresponding to the set value.

The actual frequency at the RF output does not change, but rather the value queried with [:SOUR]:FREQ?, according to the formula:

$f_{FREQ} = f_{RFout} * f_{MULTiplier} + f_{OFFSet}$

Correlation: `FREQ` for `FREQ:MODE SWE` is linked to the sweep frequency.

Parameters:

<Fixed> float

Range: full frequency range

Increment: see the data sheet: RF characteristics > Resolution of setting

*RST: 100 MHz

Example: `FREQ 500kHz`

sets the frequency of RF output signal A to 500 kHz.

Manual operation: See "RF Freq" on page 141

[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL <Rcl>

Determines whether the RF frequency value is retained or taken from a loaded instrument configuration, when you recall instrument settings with the command `*RCL`.

Parameters:

<Rcl> INCLude | EXCLude

INCLude

Takes the frequency value of the loaded settings.

EXCLude

Retains the current frequency when an instrument configuration is loaded.

*RST: INCLude

Example: `FREQ:RCL INCL`

takes the frequency from the loaded instrument configuration.

Manual operation: See "Exclude Frequency" on page 133

[:SOURce<hw>]:FREQuency:MANual <Manual>

Determines the frequency and triggers a sweep step manually in SWE:MODE MAN.

Note: You can select any frequency within the setting range. The range is defined with the parameters `[:SOURce<hw>]:FREQuency:STARt` and `[:SOURce<hw>]:FREQuency:STOP`. A defined offset and the multiplier factor affect the sweep range and therefore all correlated parameters. The set frequencies are only absolute values, if the offset = 0 and the multiplication factor = 1. The multiplier multiplies the frequencies accordingly, and the offset ≠ 0 shifts the frequencies corresponding to the set value.

$f_{STARt} * f_{MULTiplier} + f_{OFFset} \dots f_{STOP} * f_{MULTiplier} + f_{OFFset}$

Parameters:

<Manual> float

Range: full frequency range

Increment: see the data sheet: RF characteristics > Resolution of setting

Example: `SWE:MODE MAN`

sets the `Step` sweep mode.

Example: `FREQ:MODE SWE`

sets the frequency sweep mode. The sweep start frequency is output.

`FREQ:MAN UP`

triggers the next higher sweep step.

`FREQ:MAN 500MHz`

outputs 500 MHz RF frequency (must e within the sweep frequency range).

`FREQ:MAN DOWN`

triggers the next lower sweep step relative to 500 MHz.

Manual operation: See "Current Freq - Frequency Sweep" on page 226

[:SOURce<hw>]:FREQuency:MODE <Mode>

Selects the frequency mode for the generating the RF output signal. The selected mode determines the parameters to be used for further frequency settings.

Parameters:

<Mode> CW | FIXed | SWEep | LIST

CW|FIXed

Sets the fixed frequency mode.

`CW` and `FIXed` are synonyms. The instrument operates at a defined frequency, set with command `[:SOURce<hw>]:FREQuency[:CW|FIXed]`..

SWEep

Sets the sweep mode. The instrument processes the frequency settings in defined sweep steps. To determine the corresponding frequency values, use the commands `[:SOURce<hw>]:FREQuency:STARt` and `[:SOURce<hw>]:FREQuency:STOP`, or `[:SOURce<hw>]:FREQuency:CENTer` and `[:SOURce<hw>]:FREQuency:SPAN` and `[:SOURce<hw>]:FREQuency:MANual`.

LIST

Sets the list mode. The instrument processes the frequency and level settings by means of values loaded from a list.

To configure the list mode settings use the commands of the SOURce:LIST Subsystem

*RST: CW

Example: `FREQ:MODE SWE`
sets the SWEep mode.

Manual operation: See "State - Frequency Sweep" on page 223

[:SOURce<hw>]:FREQuency:MULTiplier <Multiplier>

Sets the value for the multiplication factor of a subsequent downstream instrument.

Parameters:

<Multiplier> float

Range: 1 to dynamic
Increment: 0.001
*RST: 1

Example: `FREQ:MULT 1`
sets the multiplication factor to 1.

Manual operation: See "Multiplier" on page 143

[:SOURce<hw>]:FREQuency:OFFSet <Offset>

Sets the frequency offset of a downstream instrument, for example a mixer.

If you have specified an `OFFSet` and / or a `MULTiplier` factor, the actual frequency at the RF output does not change, but rather the value queried with [:SOUR]:FREQ?, according to the following formula:

$f_{FREQ} = f_{RFout} * f_{MULTiplier} + f_{OFFSet}$

Parameters:

<Offset> float

Increment: 0.01
*RST: 0

Example: `FREQ:OFFS 500kHz`
sets the frequency offset to 500 kHz.

Manual operation: See "Offset" on page 142

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:HIGH?

Queries the maximum frequency of the frequency range for phase continuous settings.

The maximum frequency of the frequency range depends on the mode selected with the command `SOURce:FREQuency:PHASe:CONTinuous:MODE`.

Return values:

<High> float

Range: 1E5 to 6E9
Increment: 0.01
*RST: 1E9

Example: `FREQ:PHAS:CONT:MODE NARR`
selects mode narrow.
`FREQ:PHAS:CONT:HIGH`
queries the max frequency.

Example: `Response: 1 003 720 930.23`

Usage: Query only

Options: R&S SMx-B22

Manual operation: See "Frequency Range in [Hz] - RF Signal" on page 151

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW?

Queries the minimum frequency of the frequency range for for phase continuous settings.

The minimum frequency of the frequency range depends on the mode selected with the command `SOURce:FREQuency:PHASe:CONTinuous:MODE`.

Return values:

<Low> float

Range: 1E5 to 6E9
Increment: 0.01
*RST: 1E9

Example: `FREQ:PHAS:CONT:MODE NARR`
selects mode narrow.
`FREQ:PHAS:CONT:LOW`
queries the max frequency.
`Response: 998 720 930.20`

Usage: Query only

Options: R&S SMx-B22

Manual operation: See "Frequency Range in [Hz] - RF Signal" on page 151

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:MODE <Mode>

Selects the mode for determining the frequency range for the phase continuous signal (see Chapter 5.3.3.2, "Phase Continuous Frequency", on page 146).

The minimum and maximum frequency (`SOUR:FREQ:PHAS:CONT:HIGH` and `SOUR:FREQ:PHAS:CONT:LOW`) of the frequency range depends on the mode selected with this command.

Parameters:

<Mode> NARRow | WIDE

NARRow
The available frequency range is smaller than with setting wide. It is asymmetrical around the RF frequency set at the point of activating the phase continuous settings.

WIDE
The wide mode provides a larger frequency range. The frequency range is symmetrical around the RF frequency set at the point of activating the phase continuous settings.

*RST: NARRow

Example: `FREQ:PHAS:CONT:MODE NARR`
selects narrow mode.
`FREQ:PHAS:CONT:LOW`
queries the max frequency.
`Response: -3 518 518.52`

Options: R&S SMx-B22

Manual operation: See "Frequency Range - RF Signal" on page 150

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:STATe <State>

Activates/deactivates phase continuous frequency settings. For a given RF frequency setting, phase continuous frequency changes are possible in a limited frequency range (see Chapter 5.3.3.2, "Phase Continuous Frequency", on page 146).

The output sinewave is phase continuous, i.e there will be no phase discontinuity or glitch when changing the frequency.

Note: Restricted structure of command line. As long as phase continuous mode is active, only one command in a command line is processed. A second command in the command line will be ignored.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `FREQ:PHAS:CONT:STAT ON`
activates phase continuous mode.

Manual operation: See "Phase Continuous Active" on page 149

[:SOURce<hw>]:FREQuency:PLL:MODE <Mode>

Sets the bandwidth of the main PLL (Phase Locked Loop).

Parameters:

<Mode> NORMal | NARRow | WIDE

*RST: NORMal

Options: R&S SMA-B22

Manual operation: See "Main Pll Bandwidth" on page 143

[:SOURce<hw>]:FREQuency:SPAN <Span>

Determines the extent of the frequency sweep range. This setting in combination with the center frequency setting (`[:SOURce<hw>]:FREQuency:CENTer`) defines the sweep range.

This parameter is related to the start and stop frequencies. If you change the frequency, the span changes accordingly.

$f_{SPAN} = f_{STOP} - f_{STARt}$

$f_{STARt} > f_{STOP}$ is permitted.

Parameters:

<Span> float

Range:	full frequency range
Increment:	see the data sheet: RF characteristics > Resolution of setting
*RST:	400E6

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.

Manual operation: See "Span - Frequency Sweep" on page 226

[:SOURce<hw>]:FREQuency:STARt <Start>

Sets the start frequency for the RF sweep.

This parameter relates to the center frequency and span. If you change the frequency, these parameters change accordingly.

$f_{STARt} > f_{STOP}$ is permitted.

$f_{STARt} = (f_{CENTer} - f_{SPAN}/2)$.

Note: A defined offset and the multiplier factor affect the sweep range and therefore all correlated parameters. The set frequencies are only absolute values, if the offset = 0 and the multiplication factor = 1. The multiplier multiplies the frequencies accordingly, and the offset ≠ 0 shifts the frequencies corresponding to the set value.

$f_{STARt} * f_{MULTiplier} + f_{OFFset} \ldots f_{STOP} * f_{MULTiplier} + f_{OFFset}$

Parameters:

<Start> float

Range:	full frequency range
Increment:	see the data sheet: RF characteristics > Resolution of setting
*RST:	100 MHz

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.

Manual operation: See "Start Freq - Frequency Sweep" on page 226

[:SOURce<hw>]:FREQuency:STOP <Stop>

Sets the stop frequency for the RF sweep.

This parameter is related to the center frequency and span. If you change the frequency, these parameters change accordingly.

$f_{STARt} > f_{STOP}$ is permitted.

$f_{STOP} = (f_{CENTer} + f_{SPAN}/2)$.

Note: A defined offset affects the sweep range and consequently all correlating parameters. The set frequencies are only absolute values, if the Offset = 0. Offset ≠ 0 shifts the frequencies according to the offset value.

$f_{STARt} * f_{MULTiplier} + f_{OFFSet} ... f_{STOP} * f_{MULTiplier} + f_{OFFSet}$

Parameters:

<Stop> float

Range:	full frequency range
Increment:	see the data sheet: RF characteristics > Resolution of setting
*RST:	500 MHz

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.

Manual operation: See "Stop Freq - Frequency Sweep" on page 226

[:SOURce<hw>]:FREQuency:STEP[:INCRement] <Increment>

Sets the step width for FREQ:STEP:MODE USER.

To adjust the frequency step by step with this step size, use the `FREQ:UP` and `FREQ:DOWN` commands.

Note: This value also applies to the step width of the rotary knob of the instrument and increases or decreases the frequency accordingly, when you work in user-defined step mode.

Parameters:

<Increment> float

Range: full frequency range

Increment: see the data sheet: RF characteristics > Resolution of setting

*RST: 1E6

Example: `FREQ:STEP 50 kHz`

sets the step width for the frequency setting to 50 kHz.

Manual operation: See "Variation Step" on page 144

[:SOURce<hw>]:FREQuency:STEP:MODE <Mode>

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).

Manual operation: See "Variation Active" on page 143

7.14.8 SOURce:ILS Subsystem

The ILS subsystem contains the commands for checking the ILS-GS and ILS-LOC modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:ILS:...` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The external signal is input at the AM EXT connector.

Commands `[SOURce:]ILS[:GS|GSLope]:SODepth`, `[SOURce:]ILS:LOCalizer:SODepth`, `[SOURce:]ILS:TYPE and [SOURce:]ILS:STATe` are implemented for reasons of compatibility to R&S SMT signal generator family.

[:SOURce]:ILS:LOCalizer:COMid:CODE <Code>

The command enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code (see Table 5-11). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (`ILS:LOC:COM:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`ILS:LOC:COM:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code> string

Example: `ILS:LOC:COM:CODE 'MUC'`
select COM/ID code for Munich airport.

Usage: SCPI confirmed

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Code - ILS-LOC Modulation" on page 309

[:SOURce]:ILS:LOCalizer:COMid:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 300 ms
Default unit: ms

Example: `ILS:LOC:COM:CODE 'MUC'`
selects code for Munich airport
`ILS:LOC:COM:TSCH USER`
selects user time schema
`ILS:LOC:COM:DOT 200ms`
sets a dot length of 200 ms.
`ILS:LOC:COM:DASH 400ms`
sets a dash length of 400 ms.
`ILS:LOC:COM:LETT 50ms`
sets a letter space of 50 ms.
`ILS:LOC:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Dash Length - ILS-LOC Modulation" on page 311

[:SOURce]:ILS:LOCalizer:COMid:DEPTh <Depth>

The command sets the frequency of the communication/identification signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 95
Default unit: PCT

Example: `ILS:LOC:COM:DEPT 10 PCT`
sets the AM depth of the communication/identification signal to the value of 10 PCT.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Depth - ILS-LOC Modulation" on page 310

[:SOURce]:ILS:LOCalizer:COMid:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 100 ms
Default unit: ms

Example: `ILS:LOC:COM:CODE 'MUC'`
selects code for Munich airport
`ILS:LOC:COM:DOT 200ms`
sets a dot length of 200 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Dot Length - ILS-LOC Modulation" on page 310

[:SOURce]:ILS:LOCalizer:COMid:FREQuency <Frequency>

Sets the frequency of the additional communication/identification signal.

Parameters:

<Frequency> float

Range: 0.1 to 20E3
Increment: 0.01
*RST: 1020
Default unit: Hz

Example: `ILS:LOC:COM:FREQ 1020`
sets the frequency of the COM/ID signal to the standard value of 1020 Hz.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Frequency - ILS-LOC Modulation" on page 310

[:SOURce]:ILS:LOCalizer:COMid:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available for user time schema only.

Parameters:

<Letter> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 300 ms
Default unit: ms

Example:
`ILS:LOC:COM:CODE 'MUC'`
selects code for Munich airport
`ILS:LOC:COM:TSCH USER`
selects user time schema
`ILS:LOC:COM:DOT 200ms`
sets a dot length of 200 ms.
`ILS:LOC:COM:DASH 400ms`
sets a dash length of 400 ms.
`ILS:LOC:COM:LETT 50ms`
sets a letter space of 50 ms.
`ILS:LOC:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Letter Space - ILS-LOC Modulation" on page 311

[:SOURce]:ILS:LOCalizer:COMid:PERiod <Period>

Enters the period of the COM/ID signal in seconds.

Parameters:

<Period> float

Range: 0 ms to 120 s
Increment: 1 ms
*RST: 9 s

Example:
ILS:LOC:COM:PER 888ms
sets a period of 888 ms for the COM/ID signal.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Period - ILS-LOC Modulation" on page 310

[:SOURce]:ILS:LOCalizer:COMid[:STATe] <State>

The command activates or deactivates the additional communication/identification signal.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: OFF

Example: `ILS:LOC:COM ON`
activates the COM/ID signal.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID State - ILS-LOC Modulation" on page 308

[:SOURce]:ILS:LOCalizer:COMid:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:
<Symbol> float
Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 100 ms
Default unit: ms

Example: `ILS:LOC:COM:CODE 'MUC'`
selects code for Munich airport
`ILS:LOC:COM:TSCH USER`
selects user time schema
`ILS:LOC:COM:DOT 200ms`
sets a dot length of 200 ms.
`ILS:LOC:COM:DASH 400ms`
sets a dash length of 400 ms.
`ILS:LOC:COM:LETT 50ms`
sets a letter space of 50 ms.
`ILS:LOC:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Symbol Space - ILS-LOC Modulation" on page 311

[:SOURce]:ILS:LOCalizer:COMid:TSCHema <TSchema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ID signal).

Parameters:
<TSchema> STD | USER
*RST: STD

Example: `ILS:LOC:COM:CODE 'MUC'`
selects code for Munich airport
`ILS:LOC:COM:TSCH STD`
selects standard time schema
`ILS:LOC:COM:DOT 200ms`
sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Time Schema - ILS-LOC Modulation" on page 310

[:SOURce]:ILS[:GS|GSLope]:DDM:COUPling <Coupling>
[:SOURce]:ILS:LOCalizer:DDM:COUPling <Coupling>

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see `[:SOURce]:ILS:LOCalizer:SDM` on page 563).

Parameters:

<Coupling> FIXed | SDM
*RST: FIXed

Example: `ILS:DDM:COUP SDM`
the absolute value of DDM changes with changes of the SDM value. The DDM value expressed in dB stays constant.

Options: Option R&S SMA-K25

Manual operation: See "DDM - SDM Coupling - ILS-LOC Modulation" on page 307

[:SOURce]:ILS[:GS|GSLope]:DDM:CURRent <Current>
[:SOURce]:ILS:LOCalizer:DDM:CURRent <LocCurrent>

The command enters the DDM value alternatively as a current by means of the ILS indicating instrument. The instrument current is calculated according to:

DDM uA = DDM × 857,1 uA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB

Parameters:

<LocCurrent> float
Range: -967.75 uA to 967.75 uA
Increment: 1E-7
*RST: 0 uA
Default unit: A

<GsCurrent> float
Range: -857.125 uA to 857.12 uA
*RST: 0 uA
Default unit: A

Example: `ILS:DDM:CURR?`
queries the instrument current (ILS-GS modulation).

Options: Option R&S SMA-K25

Manual operation: See "DDM Current - ILS-LOC Modulation" on page 306

[:SOURce]:ILS[:GS|GSLope]:DDM[:DEPTh] <Depth>
[:SOURce]:ILS:LOCalizer:DDM[:DEPTh] <Depth>

Sets the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone. The following applies:

`ILS:GS|LOC:DDM:DEPTh` = (AM(90Hz) - AM(150Hz))/100%

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

The setting range of DDM depends on the set `[:SOURce]:ILS:LOCalizer:SDM`.

Parameters:

<Depth> float

Range:	-SDM/100% to +SDM)/100%
Increment:	0.0001
*RST:	0

Example: `ILS:DDM 0.2`
sets the difference in depth of modulation to 20 percent between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz) in ILS-GS modulation.

Options: Option R&S SMA-K25

Manual operation: See "DDM Depth - ILS-LOC Modulation" on page 306

[:SOURce]:ILS[:GS|GSLope]:DDM:DIRection <Direction>
[:SOURce]:ILS:LOCalizer:DDM:DIRection <LocDirection>

Selects the simulation mode for the ILS-GS / ILS-LOC modulation signal.A change of the setting automatically changes the sign of the DDM value

Parameters:

<LocDirection> LEFT | RIGHt

LEFT
The 150-Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

RIGHT (ILS-LOC)
The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

*RST: LEFT

<GsDirection> UP | DOWN

UP
The 150-Hz modulation signal is predominant, the DDM value is negative (the airplane is too low, it must climb).

DOWN
The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too high, it must descend).

*RST: UP

Example: `ILS:DDM:DIR UP`
'The airplane is too low, it must climb.

Options: Option R&S SMA-K25

Manual operation: See "Fly - ILS-LOC Modulation" on page 306

[:SOURce]:ILS[:GS|GSLope]:DDM:LOGarithmic <Logarithmic>
[:SOURce]:ILS:LOCalizer:DDM:LOGarithmic <Logarithmic>

The command enters the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Parameters:

<Logarithmic> float

Range: -999.9 to 999.9
Increment: 1E-4
*RST: 0
Default unit: dB

Example: `ILS:DDM:LOG 1`
sets the difference in depth of modulation to 1 dB between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz) in ILS-GS modulation.

Options: Option R&S SMA-K25

Manual operation: See "DDM Logarithmic - ILS-LOC Modulation" on page 306

[:SOURce]:ILS[:GS|GSLope]:DDM:PCT <Pct>
[:SOURce]:ILS:LOCalizer:DDM:PCT <Pct>

The command enters the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone. The following is true for the percentage value:

`ILS:GS|LOC:DDM:DEPTh` = (AM(90Hz) - AM(150Hz))

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Parameters:

<Pct> float

Range: -80.0 to 80.0
Increment: 0.01
*RST: 0

Example: `ILS:DDM:PCT 20`
sets the difference in depth of modulation to 20 percent between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz) in ILS-GS modulation.

Manual operation: See "DDM Percent - ILS-LOC Modulation" on page 307

[:SOURce]:ILS[:GS|GSLope]:DDM:POLarity <Polarity>
[:SOURce]:ILS:LOCalizer:DDM:POLarity <Polarity>

The command enters the polarity for DDM calculation (see `[:SOURce]:ILS:LOCalizer:DDM[:DEPTh]` on page 556).

The DDM depth calculation depends on the selected polarity:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)] / 100%

Parameters:

<Polarity> P90_150 | P150_90

*RST: P90_150

Example: `ILS:DDM:POL P90_150`
selects polarity 90 Hz - 150 Hz

Options: Option R&S SMA-K25

Manual operation: See "DDM Polarity- ILS-LOC Modulation" on page 305

[:SOURce]:ILS[:GS|GSLope]:FREQuency:STEP <Step>
[:SOURce]:ILS:LOCalizer:FREQuency:STEP <Step>

The command selects the variation of the carrier frequency via the rotary knob.

Parameters:

<Step> DECimal | ICAO

DECimal
Decimal variation according to the current cursor position.

ICAO
Variation in predefined steps according to the standardized ILS-GS/LOC transmitting frequencies. The start value can be selected with command `ILS:GS|LOC:ICAO:CHANnel`. The selection of the ICAO channel is effective on both ILS modulations. A switch between the two modulations causes the RF frequency to be adapted to the associated value.

*RST: DECimal

Example: `ILS:FREQ:STEP DEC`
selects decimal variation (ILS-GS modulation).

Options: Option R&S SMA-K25

Manual operation: See "Carrier Frequency Step - ILS-LOC Modulation" on page 311

[:SOURce]:ILS[:GS|GSLope]:ICAO:CHANnel <Channel>
[:SOURce]:ILS:LOCalizer:ICAO:CHANnel <Channel>

The command selects the ICAO channel i.e., the ILS transmitting frequency. The RF-frequency is set to the value selected here. A variation of the carrier frequency by the rotary knob is performed in predefined steps according to the standardized ILS transmitting frequencies (see Table 5-12). The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

Parameters:

<Channel> CH18X | CH18Y | CH20X | CH20Y | CH22X | CH22Y | CH24X | CH24Y | CH26X | CH26Y | CH28X | CH28Y | CH30X | CH30Y | CH32X | CH32Y | CH34X | CH34Y | CH36X | CH36Y | CH38X | CH38Y | CH40X | CH40Y | CH42X | CH42Y | CH44X | CH44Y | CH46X | CH46Y | CH48X | CH48Y | CH50X | CH50Y | CH52X | CH52Y | CH54X | CH54Y | CH56X | CH56Y

*RST: 18X

Example: `ILS:ICAO:CHAN CH18X`
selects ICAO frequency channel 18X. This channel sets the RF frequency to 334.7 MHz for ILS-GS and 108.1 MHz for ILS-LOC.

Options: Option R&S SMA-K25

Manual operation: See "ICAO Channel - ILS-LOC Modulation" on page 312

[:SOURce]:ILS[:GS|GSLope]:LLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane.

Parameters:

<Frequency> float

Range: 100 to 200
Increment: 0.05
*RST: 150
Default unit: Hz

Example: `ILS:LLOB 150`
sets the frequency of the antenna lobe at the bottom of the air plane to the standard value 150 Hz (ILS-GS modulation).

Options: Option R&S SMA-K25

Manual operation: See "Down Frequency - ILS-GS Modulation" on page 301

[:SOURce]:ILS:LOCalizer:LLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane.

Parameters:

<Frequency> float

Range: 60 to 120
Increment: 0.03
*RST: 90
Default unit: Hz

Example: `ILS:LOC:LLOB 90`
sets the frequency of the antenna lobe to the left of the air plane to the standard value 90 Hz (ILS-LOC modulation).

Options: Option R&S SMA-K25

Manual operation: See "Left Frequency - ILS-LOC Modulation" on page 308

[:SOURce]:ILS[:GS|GSLope]:MODE <Mode>

Selects the operating mode for the ILS-GS modulation signal.

Parameters:

<Mode> NORM | ULOBe | LLOBe

NORM
ILS-GS modulation is active.

ULOBe
Amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the ILS-GS signal is active. The modulation depth of the 90Hz signal results from the settings of commands `SOURce:ILS:GS:SDM` and `SOURce:ILS:GS:DDM[:DEPTh]` according to (command `SOURce:ILS:GS:DDM:DIR UP`):
AM(90Hz) = 0.5 * (`ILS:GS:SDM` + `ILS:GS:DDM` * 100%)
and for `SOURce:ILS:GS:DDM:DIR DOWN` according to
AM(90Hz) = 0.5 * (`ILS:GS:SDM` - `ILS:GS:DDM` * 100%)

LLOBe
Amplitude modulation of the output signal with the lower lobe (150Hz) signal component of the ILS-GS signal is active. The modulation depth of the 150Hz signal results from the settings of commands `SOURce:ILS:GS:SDM` and `SOURce:ILS:GS:DDM[:DEPTh]` according to (command `SOURce:ILS:GS:DDM:DIR UP`):
AM(150Hz) = 0.5 * (`ILS:GS:SDM` + `ILS:GS:DDM` * 100%)
and for `SOURce:ILS:GS:DDM:DIR DOWN` according to
AM(150Hz) = 0.5 * (`ILS:GS:SDM` - `ILS:GS:DDM` * 100%)

*RST: NORM

Example: `ILS:MODE ULOB`
Activates amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the ILS-GS signal.

Options: Option R&S SMA-K25

Manual operation: See "Mode - ILS-GS Modulation" on page 301

[:SOURce]:ILS:LOCalizer:MODE <Mode>

Selects the operating mode for the ILS-LOC modulation signal.

Parameters:

<Mode> NORM | LLOBe | RLOBe

NORM
ILS-LOC modulation is active.

LLOBe
Amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS-LOC signal is active. The modulation depth of the 90Hz signal results from the settings of commands `SOURce:ILS:LOC:SDM` and `SOURce:ILS:LOC:DDM[:DEPTh]` according to (command `SOURce:ILS:LOC:DDM:DIR RIGHt`):
AM(90Hz) = 0.5 * (`ILS:LOC:SDM` + `ILS:LOC:DDM` * 100%)
and for `SOURce:ILS:GS:DDM:DIR LEFT` according to
AM(90Hz) = 0.5 * (`ILS:LOC:SDM` - `ILS:LOC:DDM` * 100%)

RLOBe
Amplitude modulation of the output signal with the right lobe (150Hz) signal component of the ILS-LOC signal is active. The modulation depth of the 150Hz signal results from the settings of commands `SOURce:ILS:LOC:SDM` and `SOURce:ILS:LOC:DDM[:DEPTh]` according to (command `SOURce:ILS:LOC:DDM:DIR RIGHt`):
AM(150Hz) = 0.5 * (`ILS:LOC:SDM` + `ILS:LOC:DDM` * 100%)
and for `SOURce:ILS:GS:DDM:DIR LEFT` according to
AM(150Hz) = 0.5 * (`ILS:LOC:SDM` - `ILS:LOC:DDM` * 100%)

*RST: NORM

Example: `ILS:LOC:MODE LLOB`
Activates amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS-LOC signal.

Options: Option R&S SMA-K25

Manual operation: See "Mode - ILS-LOC Modulation" on page 307

[:SOURce]:ILS[:GS|GSLope]:PHASe <Phase>
[:SOURce]:ILS:LOCalizer:PHASe <Phase>

The command enters the phase between the modulation signals of the upper/left and lower/right antenna lobe. The zero crossing of the lower/right lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the lower/right antenna lobe.

Parameters:

<Phase> float

Range: -60 to 120
Increment: 0.01
*RST: 0
Default unit: DEG

Example: `ILS:LOC:PHAS 30DEG`
sets the phase between the modulation signals of the left and right antenna lobe to 30 degrees (ILS-LOC modulation).

Options: Option R&S SMA-K25

Manual operation: See "Left/Right Phase - ILS-LOC Modulation" on page 308

[:SOURce]:ILS[:GS|GSLope]:PRESet
[:SOURce]:ILS:LOCalizer:PRESet

The commands activate the ILS-GS /ILS-LOC default setting.

Example: `ILS:LOC:PRES`
activates the ILS-LOC default settings for all `SOURCe:ILS:LOC:...` commands.

Usage: Event
SCPI confirmed

Options: Option R&S SMA-K25

Manual operation: See "Set to Default - ILS-LOC Modulation" on page 308

[:SOURce]:ILS:LOCalizer:RLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the right viewed from the air plane.

Parameters:
<Frequency> float

Range: 100 to 200
Increment: 0.05
*RST: 150
Default unit: Hz

Example: `ILS:LOC:RLOB 150`
sets the frequency of the antenna lobe at the right of the air plane to the standard value 150 Hz (ILS-LOC modulation).

Options: Option R&S SMA-K25

Manual operation: See "Right Frequency - ILS-LOC Modulation" on page 308

[:SOURce]:ILS[:GS|GSLope]:SDM <Sdm>
[:SOURce]:ILS:LOCalizer:SDM <Sdm>

The commands enter the arithmetic sum of the modulation depths of the upper/left lobe (90Hz) and lower/right lobe (150Hz) ILS-GS/ILS-LOC signal contents. The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Note:

Commands `[SOURce:]ILS[:GS|GSLope]:SODepth` and `[SOURce:]ILS:LOCalizer:SODepth` are implemented as alias commands.

Parameters:

<LocSdm> float

Range: 0 to 100
Increment: 0.1
*RST: 40
Default unit: PCT

<GsSdm> float

Range: 0 to 100
Increment: 0.1
*RST: 80
Default unit: PCT

Example: `ILS:SDM 80PCT`
sets a sum of modulation depths of 80 % for the upper lobe (90Hz) and lower lobe (150Hz) ILS-GS signal.

Options: Option R&S SMA-K25

Manual operation: See "Sum of Depth - ILS-LOC Modulation" on page 306

[:SOURce]:ILS[:GS|GSLope]:SOURce <Source>
[:SOURce]:ILS:LOCalizer:SOURce <Source>

The command selects the modulation source for ILS-GS and ILS-LOC modulation. INT is the internal modulation source. The external signal is input at the AM EXT connector. The external signal is added to the internal signal. Switching off the internal source is not possible.

Parameters:

<Source> INT | INT,EXT | EXT

*RST: INTernal

Example: `ILS:SOUR INT`
selects the internal modulation source.

Options: Option R&S SMA-K25

Manual operation: See "EXT AM - ILS-LOC Modulation" on page 313

[:SOURce]:ILS:GS|GSLope:STATe <State>
[:SOURce]:ILS:LOCalizer:STATe <State>

The commands activate/deactivate ILS-GS/ILS-LOC modulation.

Note: Commands `[SOURce:]ILS:STATe` and `[SOURce:]ILS:TYPE` are implemented for reasons of compatibility to R&S SMT(E) Signal Generator family.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `ILS:STAT ON`
activates ILS-GS modulation.
`ILS:LOC:STAT ON`
activates ILS-LOC modulation. The RF-frequency is automatically set to 190 kHz.

Options: Option R&S SMA-K25

Manual operation: See "State - ILS-LOC Modulation" on page 305

[:SOURce]:ILS[:GS|GSLope]:ULOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the top viewed from the air plane.

Parameters:
<Frequency> float

Range: 60 to 120
Increment: 0.03
*RST: 90
Default unit: Hz

Example: `ILS:ULOB 90`
sets the frequency of the antenna lobe at the top of the air plane to the standard value 90 Hz (ILS-GS modulation).

Options: Option R&S SMA-K25

Manual operation: See "Up Frequency - ILS-GS Modulation" on page 301

7.14.9 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 <Impedance>

Sets the impedance for an externally applied modulation signal.

Parameters:
<Impedance> HIGH | G50

HIGH
> 100 kOhm to ground

G50
50 Ohm to ground
(requires the extended synthesis assembly (SynEx))

*RST: HIGH

Example: `INP:MOD:IMP HIGH`
sets > 100 kOhm to ground.

Manual operation: See "Ext. Impedance" on page 254

[: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`
Activates the falling slope of the external trigger signal at the trigger input.

Manual operation: See "Ext. Trigger Input Slope" on page 228

7.14.10 SOURce:LFOutput Subsystem

The `SOURce:LFOutput` subsystem contains the commands for setting the LF signal source in CW and Sweep mode and for analog modulation.

An LF generator is always available in the instrument. A second LF generator is optional.

The suffix for `LFOutput<ch>` denotes the selected LF generator. The source for the LF sweep (LF generator 1 or 2) is selected with command `SOURce:LFOutput:SWEep:FREQuency:SOURce`.

Example

The following example shows how to set an LF sweep.

1. Set the sweep range.
   `LFOutput:FREQuency:STARt 4 kHz`
   `LFOutput:FREQuency:STOP 10 kHz`
2. Select linear or logarithmic sweep spacing.
   `LFOutput:SWEep[:FREQuency]:SPACing LIN`
3. Set the step width and dwell time.
   `LFOutput:SWEep[:FREQuency]:STEP[:LINear] 100 Hz`
   `LFOutput:SWEep[:FREQuency]:DWELl 20 ms`
4. Determine the sweep mode.
   `LFOutput:SWEep:MODE AUTO`
5. Determine the trigger.

```
TRIGger0:SOURce SINGle
```

6. Activate the sweep.
   `LFOutput:FREQuency:MODE SWEep`
7. Trigger the sweep (depending on the mode).
   `LFOutput:SWEep:EXECute`

[:SOURce]:LFOutput<ch>:FREQuency <Frequency>

Sets the frequency of the LF signal in LFO:FREQ:MODE CW|FIXed mode.

Note:

- If signal source "Internal" is set, the instrument performs the analog modulations (AM/FM/ϕM/PM) with this freqeuncy.
- In sweep mode (LFO:FREQ:MODE SWEep), the frequency is coupled with the sweep frequency.
- If you generate test signals for avionic systems (VOR/ILS modulation), the frequency is preset and cannot be modified.

Parameters:

<Frequency>	float	
	Range:	full frequency range
	Increment:	see the data sheet: Modulation sources > Resolution of frequency setting
	*RST:	1000

Example: `LFO2:FREQ 5kHz`
sets the frequency of the LF generator 2 signal to 5 kHz.

Options: Option R&S SMA-K24 is required for selection LFOutput2.

Manual operation: See "LF Gen 1/2 Freq" on page 249

[:SOURce<hw>]:LFOutput:FREQuency:MANual <Manual>

Determines the frequency and triggers the next sweep step manually in LFO:SWE[:FREQ]:MODE MAN, and LFO:SWE:[FREQ]:MODE STEP.

Note: You can select any frequency within the setting range. The range is defined with LFO:FREQ:STARt and LFO:FREQ:STOP.

Parameters:

<Manual>	float	
	Range:	full frequency range
	Increment:	see the data sheet: Modulation sources > Internal modulation generator > Resolution of frequency setting
	*RST:	1000

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.

Manual operation: See "Current Freq" on page 326

[:SOURce<hw>]:LFOutput:FREQuency:MODE <Mode>

Sets the instrument operating mode, and determines the commands to be used for frequency settings.

The source for the LF sweep is selected with command `[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource`.

Parameters:
<Mode> CW | FIXed | SWEep

CW|FIXed
Sets the CW frequency mode. `CW` and `FIXed` are synonyms.
The instrument operates at a fixed frequency. To set the LF output frequency, use the command `[:SOURce]:LFOutput<ch>:FREQuency`.

SWEep
Sets the sweep mode.
The instrument processes the frequency settings in defined sweep steps. To determine the corresponding frequency values, use the commands `[:SOURce<hw>]:LFOutput:FREQuency:STARt`, `[:SOURce<hw>]:LFOutput:FREQuency:STOP` or `[:SOURce<hw>]:LFOutput:FREQuency:MANual`.

*RST: CW

Example: `LFO:FREQ:MODE SWE`
sets the sweep mode.

Manual operation: See "State" on page 323

[:SOURce<hw>]:LFOutput:FREQuency:STARt <Start>

Sets the start frequency for the LF sweep.

Parameters:
<Start> float

Range: full frequency range
Increment: see the data sheet: Resolution of frequency setting
*RST: 1 KHz

Example:
```
RST*
```
activates all presettings.
```
LFO:SWE:MODE AUTO
TRIG0:SOUR SING
LFO:FREQ:STAR 1 kHz
LFO:FREQ:STOP 10 kHz
LFO:FREQ:MODE SWE
LFO:SWE:EXEC
```
the instrument generates a single sweep cycle from 1 kHz to 10 kHz automatically after a manual trigger event occurs (`:LFOutput:SWEep:EXECute` or `*TRG`). The step width is 1 kHz linear, with 15 ms dell time until the signal switches to the subsequent step.

Manual operation: See "Start Freq" on page 326

[:SOURce<hw>]:LFOutput:FREQuency:STOP <Stop>

Sets the stop frequency for the LF sweep.

Parameters:

<Stop> float

Range: full frequency range
Increment: see the data sheet: resolution of frequency setting
*RST: 100 KHz

Example: `LFO:FREQ:STOP 10 kHz`
sets the stop frequency for the LF sweep to 10 kHz.

Manual operation: See "Stop Freq" on page 326

[:SOURce]:LFOutput<ch>:INTernal:VOLTage <Voltage>

Sets the output voltage for the two LF generators. The sum of the two values must not exceed the overall output voltage set with command `SOURce:LFOutput:VOLTage`.

Parameters:

<Voltage> float

Range: 0 to 4
*RST: 0.5

Example: `LFO:INT:VOLT 0.5V`
sets the output voltage of the first LF generator to 0.5 volts

Options: Option R&S SMA-K24 is required for selection LFOutput2

Manual operation: See "Out Voltage 1/2" on page 330

[:SOURce]:LFOutput:OFFSet <Offset>

Sets a DC offset at the LF Output.

Parameters:

<Offset> float

Range: depends on lfo voltage to depends on lfo voltage
Increment: 0.001
*RST: 0

Example: `LFO:OFFS 2 V`
sets a DC OFFSet of 2 V

Manual operation: See "DC Offset" on page 331

[:SOURce]:LFOutput:SOURce <Source>

Selects the internal source to be used for the LF Output signal. The available selection depends on the options fitted.

If test signals for avionic systems are generated (VOR/ILS modulation), the sources are preset and cannot be changed.

Parameters:

<Source> LF1 | LF2 | LF12 | NOISe | LF1Noise | LF2Noise

*RST: LF1

Example: `LFO:SOUR NOIS`
selects the noise generator as source for the LF output signal.

Options: Option R&S SMA-K24 for selections other than LF1

[:SOURce]:LFOutput[:STATe] <State>

Activates/deactivates the LF output.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `LFO ON`
activates the LF output. The settings under `LFO:FREQ` and `LFO:SWE` become effective.

Manual operation: See "LF Output State" on page 329

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl <Dwell>

Sets the dwell time for each frequency step of the sweep.

Tip: It is recommended to switch off the "Display Update" for optimum sweep performance especially with short dwell times (SYSTem:DISPlay:UPDate OFF).

Parameters:

<Dwell> float

Range: see data sheet: Dwell time setting range
Increment: 100E-6
*RST: 15E-3

Example: `LFO:SWE:DWEL 20 ms`
sets a dwell time of 20 ms.

Manual operation: See "Dwell Time - LF Sweep" on page 328

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute

Immediately starts an LF frequency sweep in LFO:SWE:MODE SINGle.

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

Manual operation: See "Execute Single Sweep" on page 325

[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource <LfSource>

Selects the source for the LF sweep.

Parameters:

<LfSource> LF1 | LF2

*RST: LF1

Example: `LFO:SWE:LFS LF2`

selects LF generator 2 as the LF frequency sweep source.

Options: Option R&S SMA-K24

Manual operation: See "Sweep Source" on page 326

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE <Mode>

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 dialogs.

Parameters:

<Mode> AUTO | MANual | STEP

AUTO

Performs a complete sweep cycle from the start to the end value when a trigger event occurs.

The dwell time deterrmines the time period for the signal to switch to the next step.

MANual

Performs a single sweep step when a manual trigger event occurs.

The trigger system is not active. You can trigger each frequency step of the sweep individually with the command `[:SOURce<hw>]:LFOutput:FREQuency:MANual`. In manual mode, use the rotary knob for switching to the next step.

With each step, the frequency increases by the value specified with the command `[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]` or `[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic`, respectively. A frequency value, entered with `[:SOURce<hw>]:LFOutput:FREQuency:MANual` takes no effect.

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).

STEP

Each trigger triggers one sweep step only. The frequency increases by the value entered with `[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]` or `[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic`.

*RST: AUTO

Example: `LFO:SWE:MODE AUTO`

selects Auto mode.

Manual operation: See "Mode" on page 323

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:POINts <Points>

Determines the number of steps for the LF frequency sweep within the sweep range.

This parameter always applies to the currently set sweep spacing and correlates with the step size as follows:

- for linear sweeps and $f_{STARt} < f_{STOP}$
  freq_points = (f_{SPAN} / step_lin) + 1
  with $f_{SPAN} = f_{STOP} - f_{STARt}$
  To determine the step size, use the command SWE:STEP[:LIN].
- logarithmic sweeps and $f_{STARt} < f_{STOP}$

freq_points = ((log f_{STOP} - log f_{STARt}) / log step_log) + 1
To determine the logarithmic step size, use the command SWE:STEP:LOG.

If you change the number of sweep points, the step size changes accordingly. The sweep range remains the same.

Each sweep spacing mode has assigned the `POINts` setting separately. Thus, the command refers always to the particular set mode, see `[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing`.

Parameters:

<Points> integer

Range: 2...max

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<hw>]:LFOutput:SWEep[:FREQuency]:RETRace <State>

Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single".

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example:

`TRIG0:SWE:SOUR SING`
`LFO:SWE:MODE SWE`
`LFO:SWE:SHAP SAWT`
`LFO:SWE:RETR ON`
activates retrace function, that menas the frequency changes to the value at start frequency while waiting for the next trigger event.

Manual operation: See "Retrace - LF Frequency Sweep" on page 327

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RUNNing?

Queries the current status of the LF frequency sweep mode.

Return values:

<State> 0 | 1 | OFF | ON

Example: `LFO:SWE:RUNN?`
Response "1": the frequency sweep is running.

Usage: Query only

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe <Shape>

Sets the cycle mode for a sweep sequence (shape).

Parameters:
<Shape> SAWTooth | TRIangle

SAWTooth
A sweep runs from the start to the stop frequency. A subsequent sweep starts at the start frequency, that menas the shape of the sweep sequence resembles a sawtooth.

TRIangle
A sweep runs from the start to the stop frequency and back, thatnt menas the shape of the sweep resembles a triangle. A 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.

Manual operation: See "Shape" on page 327

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing <Spacing>

Selects the mode for the calculation of the frequency sweep intervals.The frequency increases or decreases by this value at each step.

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>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]` on page 576).

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>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic` on page 576).

*RST: LINear

Example: `LFO:SWE:SPAC LIN`
selects linear sweep spacing.

Manual operation: See "Spacing" on page 326

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step size for linear LF frequency sweep steps.

This parameter correlates with the number of steps `[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:POINts` within the sweep range as follows:

$f_{STARt} < f_{STOP}$

freq_points = ((f_{STARt} - f_{STOP}) / step_lin) + 1

If you change the step size, the number of steps changes accordingly. The sweep range remains the same.

Parameters:

<Linear> float

Range:	full frequency range
Increment:	see the data sheet: Modulation sources > Resolution of frequency setting
*RST:	1000

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.

Manual operation: See "Step Lin/Log - LF Sweep" on page 328

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

Sets the logarithmically determined sweep step size for the LF frequency sweep. It is expressed in percent and you must enter the *value* and the unit *PCT* with the command.

The frequency is increased by a logarithmically calculated fraction of the current frequency according to:

$step\_log_{step+1} = f_{step} + step\_log_{step} \times f_{step}$

$f_{step+1} = f_{step} + step\_log_{step+1}$

with $f_{STARt} < f_{STOP}$ and step = the current number of the sweep steps

This parameter correlates with the number of steps LFO:SWE[:FREQ]:POIN within the sweep range as follows:

freq_points = ((log f_{STOP} - log f_{STARt}) / log step_log) + 1

If you change the step size, the number of steps changes accordingly. The sweep range remains the same.

Parameters:

<Logarithmic> float

Range: 0.01 to 100
Increment: 0.01
*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.

Manual operation: See "Step Lin/Log - LF Sweep" on page 328

[:SOURce<hw>]:LFOutput<ch>:SHAPe <Shape>

Selects the shape of the LF signal.

Parameters:

<Shape> SINE | SQUare | TRIangle | TRAPeze

TRAPeze
For `TRAPeze` shapes, the instrument provides additional parameters for configuring the period of the single trapeze elements.

*RST: SINE

Example: `LFO:SHAP SQU`
selects a rectangular shape for the signal of the LF generator.

Options: Option R&S SMA-K24

Manual operation: See "LF Gen 2 Shape" on page 249

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL <Fall>

Selects the fall time for the trapeze shape of the second LF generator.

Parameters:

<Fall> float

Range: see data sheet
Increment: see data sheet
*RST: 10 µs

Example: `SOUR:LFO2:SHAP:TRAP:FALL 100ms`
selects a fall time of 100 ms for the trapezoidal signal of the LF generator 2.

Options:	Option R&S SMA-K24
Manual operation:	See "Trapeze Fall" on page 331

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH <High>

Selects the high time for the trapeze shape of the second LF generator.

Parameters:

<High> float

Range: see data sheet
Increment: see data sheet
*RST: 10 µs

Example: `SOUR:LFO2:SHAP:TRAP:HIGH 10ms`
selects a high time of 10 ms for the trapezoidal signal of the LF generator 2.

Options: Option R&S SMA-K24

Manual operation: See "Trapeze High" on page 331

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:LOW <Low>

Selects the low time for the trapezoidal signal of the second LF generator.

Parameters:

<Low> float

Range: 0 us to 10 s
Increment: 0.01 µs
*RST: 10 µs

Example: `SOUR:LFO2:SHAP:TRAP:LOW 5ms`
selects a low time of 5ms for the trapezoidal signal of the LF generator 2.

Options: Option R&S SMA-K24

Manual operation: See "Trapeze Low" on page 331

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE <Rise>

Selects the rise time for the trapeze shape of the second LF generator.

Parameters:

<Rise> float

Range: see data sheet
Increment: see data sheet
*RST: 10 µs

Example: `SOUR:LFO2:SHAP:TRAP:RISE 1ms`
selects a rise time of 1 ms for the trapezoidal signal of the LF generator 2.

Options: Option R&S SMA-K24

Manual operation: See "Trapeze Rise" on page 331

[:SOURce]:LFOutput:VOLTage <Voltage>

Sets the voltage of the LF output signal.

Parameters:

<Voltage> float

Range:	see the data sheet: Internal modulation generator > Output voltage range
Increment:	see the data sheet: resolution of output voltage setting
*RST:	1

Example: `LFO:VOLT 2 V`
sets the voltage of the LF output to 2 V.

Manual operation: See "Out Voltage" on page 330

7.14.11 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?

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/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 <Filename>

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:

<Filename>	string

Example:	`MMEM:CDIR '/var/Listmode'`
	selects the directory for the list mode files.
	`LIST:DEL 'LIST1'`
	deletes the list `list1`.

Usage:	Setting only
Manual operation:	See "List Mode Data... - List Mode" on page 240

[:SOURce<hw>]:LIST:DELete:ALL

Deletes all lists in the selected directory.

Note: The list mode must be previously disabled to make sure that no records are selected when you set the frequency mode (`[:SOURce<hw>]:FREQuency:MODE`).

The files are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. You can select the directory with the commands `:MMEMory:CDIRectory` or `[:SOURce<hw>]:LIST:CATalog?`.

`*RST` does not affect data lists.

Example: `MMEM:CDIR '/var/Listmode'`
selects the directory for the list mode files.
`FREQ:MODE SWE`
deactivates the list mode for RF output and activates the sweep mode.
`LIST:DEL:ALL`
deletes all list mode files in the selected directory.

Usage: Event

Manual operation: See "List Mode Data... - List Mode" on page 240

[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog?

Queries the available ASCII files for export or import of list mode data in the current or specified directory.

As response, you get a string containing the existing ASCII files `*.txt` or `*.csv`, separated by commas.

Return values:
<Catalog> string

Example: `MMEM:CDIR '/var/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`LIST:DEXC:AFIL:EXT TXT`
determines the extension `*.txt` for the query.
`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>

Determines the extension of the ASCII file for import or export, or to query existing files.

Parameters:
<Extension> TXT | CSV
*RST: TXT

Example: `MMEM:CDIR '/var/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`LIST:DEXC:AFIL:EXT TXT`
selects ASCII files with the extension `*.txt` for the query.
`LIST:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response: `'list1,list2'`
the ASCII files `list1.txt` and `list2.txt` exist.

Manual operation: See "Extension - List Mode" on page 242

[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

Parameters:
<Filename> <ascii_file_name>

Example: `LIST:DEXC:MODE IMP`
determines that ASCII files with frequency and level value pairs are imported into list mode lists.
`LIST:DEXC:AFIL:EXT TXT`
determines the extension `*.txt` for the query.
`LIST:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response: `'list1,list2'`
the ASCII files `list1.txt` and `list2.txt` exist.
`LIST:DEXC:AFIL:SEL '/var/list.csv'`
selects `list.csv` for import.
`LIST:DEXC:SEL '/var/list_imp'`
determines the destination file `list_imp`.
`LIST:DEXC:EXEC`
imports the ASCII file data into the list file.

Manual operation: See "Select ASCII Source / Destination - List Mode" on page 243

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn <Column>

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 is exported into an ASCII file.
`LIST:DEXC:AFIL:SEL '/var/list.csv'`
determines ASCII file list.csv as destination for the list mode list data.
`LIST:DEXC:AFIL:SEP:COL TAB`
defines a tabulator to separate the frequency and level values pairs.
`LIST:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`LIST:DEXC:SEL '/var/list_imp'`
determines the source file list_imp for export into the ASCII file `list.csv`.
`LIST:DEXC:EXEC`
exports the list file data into the ASCII file.

Manual operation: See "Column Separator- List Mode" on page 243

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal <Decimal>

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

Parameters:
<Decimal> DOT | COMMa
*RST: DOT

Example: see `[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn` on page 583

Manual operation: See "Decimal Point - List Mode" on page 243

[:SOURce<hw>]:LIST:DEXChange:EXECute

Executes the import or export of the selected list file, according to the previously set transfer direction with command `[:SOURce<hw>]:LIST:DEXChange:MODE`.

Example: `LIST:DEXC:MODE IMP`
determines that ASCII files with frequency and level value pairs are imported into list mode lists.
`LIST:DEXC:AFIL:SEL '/var/list.csv'`
selects the ASCII file `list.csv` for import.
`LIST:DEXC:SEL '/var/list_imp'`
determines the destination file `list_imp`.
`LIST:DEXC:EXEC`
imports the ASCII file data into the list mode file.

Usage: Event

Manual operation: See "Import / Export - List Mode" on page 243

[:SOURce<hw>]:LIST:DEXChange:MODE <Mode>

Selects if list mode lists should be imported or exported. Depending on the selection here, the file select command defines 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/list.csv'`

selects that ASCII file `list.csv` is imported.

`LIST:DEXC:SEL '/var/list_imp'`

selects that the ASCII file `list.csv` is imported into list mode list `list_imp`.

Manual operation: See "Mode - List Mode" on page 242

[:SOURce<hw>]:LIST:DEXChange:SELect <Filename>

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:

<Filename> <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/list.csv'`

selects that ASCII file `list.csv` is imported.

`LIST:DEXC:SEL '/var/list_imp'`

selects that the ASCII file `list.csv` is imported into list mode list `list_imp`.

Manual operation: See "Select Destination / Source - List Mode" on page 243

[:SOURce<hw>]:LIST:DWELl <Dwell>

Sets the dwell time. The R&S SMA generates the signal with the frequency / power value pairs of each list entry for that particular period.

Parameters:

<Dwell> float

Range: 7E-4 to 100
Increment: 1E-4
*RST: 15E-3

Example: `LIST:DWEL 15`
each setting in the list is retained for 15 ms.

Manual operation: See "Dwell Time - List Mode" on page 239

[:SOURce<hw>]:LIST:FREE?

Queries on the free storage space for list mode lists.

Return values:

<Free> integer

Range: 0 to INT_MAX
*RST: 0

Example: `LIST:FREE?`

Usage: Query only

Response: `2147483647;1`

[:SOURce<hw>]:LIST:FREQuency <Frequency>

Fills the `FREQuency` column 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 bytes are always interpreted as a floating-point number with double accuracy (see `:FORMat[:DATA]` on page 409).

Range: 300 kHz to RFmax

Example: `LIST:SEL '/var/list3'`
selects `list3` for editing. The R&S SMA generates a new file automatically, if it does not exist yet.
`SOUR:LIST:FREQ 1.4GHz, 1.3GHz, 1.2GHz,...`
specifies the frequency values in list3. If the list already contains data, it is overwritten.

Manual operation: See "Edit List Mode Data... - List Mode" on page 240

[:SOURce<hw>]:LIST:FREQuency:POINts?

The command queries the length (in points) of the `FREQuency` component of the selected list.

Return values:

<Points>	integer Range: 0 to INT_MAX *RST: 0

Example:	`LIST:SEL '/var/list3'`
	selects `list3` for editing. The R&S SMA creates a new file automatically, if it does not exist yet.
	`LIST:FREQ:POIN?`
	queries the number of frequency values in the list
	`Response: 327`

Usage:	Query only

[:SOURce<hw>]:LIST:INDex <Index>

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>	integer *RST: 0

Example:	`LIST:SEL '/var/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.

Manual operation:	See "Current Index - List Mode" on page 239

[:SOURce<hw>]:LIST:INDex:STARt <Start>

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> integer

Range: 0 to list length

*RST: 0

Example: `LIST:SEL '/var/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.

Manual operation: See "List Range In - List Mode" on page 241

[:SOURce<hw>]:LIST:INDex:STOP <Stop>

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> integer

Range: 0 to list length

*RST: 0

Example: see `[:SOURce<hw>]:LIST:INDex:STARt` on page 587

Manual operation: See "List Range In - List Mode" on page 241

[:SOURce<hw>]:LIST:LEARn

Learns the selected list to determine the hardware setting for all list entries. The results are saved with the list. When the list is activated the first time, these settings are calculated automatically.

Example: `LIST:SEL '/var/list3'`

selects list file. The file is created if it does not yet exist.

`LIST:LEAR`

starts learning of the hardware setting for `list3` and stores the setting.

Usage: Event

Manual operation: See "Learn List Mode Data... - List Mode" on page 240

[:SOURce<hw>]:LIST:MODE <Mode>

Selects 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.
The external trigger has to be used (setting `:LIST:TRIGger:SOURce EXT`).

*RST: AUTO

Example: `LIST:MODE STEP`
selects step-by-step processing of the list.

Manual operation: See "Mode - List Mode" on page 238

[:SOURce<hw>]:LIST:POWer <Power>

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 bytes are always interpreted as a floating-point number with double accuracy (see `:FORMat[:DATA]` on page 409).

Range: Minimum level to Maximum level
Default unit: dBm

Example: `LIST:SEL '/var/list3'`
selects `list3` for editing. The R&S SMA generates a new file automatically, if it does not exist yet.
`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.

Manual operation: See "Edit List Mode Data... - List Mode" on page 240

[:SOURce<hw>]:LIST:POWer:AMODe <AMode>

Selects the ranges of level settings for the list mode. The level settings are either performed in the low level or in the high level ranges.

Parameters:

<AMode> NORMal | HPOWer

NORMal
The level settings are made in the range of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made in the range of the option. Only the high level range is available.

*RST: NORMal

Example: `LIST:POW:AMOD HPOW`
selects the high level ranges for List Mode.

Manual operation: See "Attenuator Mode – List Mode with High Power Option" on page 237

[:SOURce<hw>]:LIST:POWer:POINts?

Queries the length (in points) of the LEVel part of the selected list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: `LIST:SEL '/var/list3'`
selects `list3` for editing. The R&S SMA generates a new file automatically, if it does not exist yet.
`LIST:POW:POIN?`
queries the number of levels in the list file
Response: `327`

Usage: Query only

[:SOURce<hw>]:LIST:RESet

Resets the list to the starting point.

Example: `LIST:RES`
resets the list to the starting point.

Usage: Event

Manual operation: See "Reset - List Mode" on page 239

[:SOURce<hw>]:LIST:SELect <Filename>

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 which case the list mode file in the specified directory is selected.

`*RST` does not affect data lists.

Parameters:

<Filename> '<list name>'

Example: `LIST:SEL '/var/list3'`
selects `list3` for editing.

Manual operation: See "List Mode Data... - List Mode" on page 240

[:SOURce<hw>]:LIST:TRIGger:EXECute

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

Manual operation: See "Execute Single - List Mode" on page 239

[:SOURce<hw>]:LIST:TRIGger:SOURce <Source>

Selects the trigger source processing lists.

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 | HOP | DHOP

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.

HOP
Index-by-index cycle. The processed list index is determined by the external control signals provided via the serial FHOP bus. Processing of the frequency and level settings associated with selected index is triggered externally via the INST TRIG connector.

DHOP
Index-by-index cycle. The processed list index is determined by the external control signals provided via the serial FHOP bus. Processing of the frequency and level settings associated with selected index is automatically started at the end of data transmission.

*RST: AUTO

Example: `LIST:TRIG:SOUR EXT`
selects triggering by means of the external trigger.

Manual operation: See "Mode - List Mode" on page 238

7.14.12 SOURce:MBEacon Subsystem

The MBEacon subsystem contains the commands for checking the Marker Beacon modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:MBEacon:...` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The signal is output at the LF OUT connector.

[:SOURce]:MBEacon:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see Table 5-14). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (`MBE:COM:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`MBE:COM:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code>	string

Example: `MBE:COM:CODE 'MUC'`
select COM/ID code for Munich airport.

Usage: SCPI confirmed

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Code - Marker Beacon Modulation" on page 315

[:SOURce]:MBEacon:COMid:DASH <Dash>

Sets the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3
Default unit: s

Example: `MBE:COM:CODE 'MUC'`
selects code for Munich airport
`MBE:COM:TSCH USER`
selects user time schema
`MBE:COM:DOT 200ms`
sets a dot length of 200 ms.
`MBE:COM:DASH 400ms`
sets a dash length of 400 ms.
`MBE:COM:LETT 50ms`
sets a letter space of 50 ms.
`MBE:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Dash Length - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid:DEPTh <Depth>

Sets the AM modulation depth of of the COM/ID signal.

Parameters:

<Depth> float

Range: 0 PCT to 100 PCT
Increment: 0.1 PCT
*RST: 5 PCT
Default unit: PCT

Example: `MBE:COM:DEPT 80`
sets 80 % modulation depth.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Depth - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid:DOT <Dot>

Sets the length of a morse dot by means of seconds. The length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1
Default unit: s

Example: `MBE:COM:CODE 'MUC'`
selects code for Munich airport
`MBE:COM:DOT 200ms`
sets a dot length of 200 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Dot Length - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid:FREQuency <Frequency>

Sets the frequency of the communication/identification signal.

Parameters:

<Frequency> float

Range: 0.1 to 20E3
Increment: 0.01
*RST: 1020
Default unit: Hz

Example: `MBE:COM:FREQ 11KHz`
sets the frequency to 11 kHz.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Frequency - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid:LETTer <Letter>

Sets the length of a letter space by means of seconds. This command is available user time schema only.

Parameters:

<Letter> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3
Default unit: s

Example: `MBE:COM:CODE 'MUC'`
selects code for Munich airport
`MBE:COM:TSCH USER`
selects user time schema
`MBE:COM:DOT 200ms`
sets a dot length of 200 ms.
`MBE:COM:DASH 400ms`
sets a dash length of 400 ms.
`MBE:COM:LETT 50ms`
sets a letter space of 50 ms.
`MBE:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Letter Space - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid:PERiod <Period>

Sets the period of the COM/ID signal in seconds.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9
Default unit: s

Example: MBEA:COM:PER 17s
sets a period of 17 s for the COM/ID signal.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Period - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid:SYMBol <Symbol>

Set the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1
Default unit: s

Example: `MBE:COM:CODE 'MUC'`
selects code for Munich airport
`MBE:COM:TSCH USER`
selects user time schema
`MBE:COM:DOT 200ms`
sets a dot length of 200 ms.
`MBE:COM:DASH 400ms`
sets a dash length of 400 ms.
`MBE:COM:LETT 50ms`
sets a letter space of 50 ms.
`MBE:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Symbol Space - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid:TSCHema <Tschema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ID signal).

Parameters:

<Tschema> STD | USER

*RST: USER

Example: `MBE:COM:CODE 'MUC'`
selects code for Munich airport
`MBE:COM:TSCH STD`
selects standard time schema
`MBE:COM:DOT 200ms`
sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Time Schema - Marker Beacon Modulation" on page 317

[:SOURce]:MBEacon:COMid[:STATe] <State>

Activates the additional communication/identification signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `MBE:COM ON`
activates the COM/ID signal.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID State - Marker Beacon Modulation" on page 315

[:SOURce]:MBEacon:PRESet

Activates the Marker Beacon default setting. The command also sets the RF frequency to 75 MHz.

Example: `ILS:MBE:PRES`
activates the default settings for all SOURCe:MBE:... commands, and sets the RF frequency to 75 MHz.

Usage: Event
SCPI confirmed

Options: Option R&S SMA-K25

Manual operation: See "Set To Default - Marker Beacon Modulation" on page 318

[:SOURce]:MBEacon:STATe <State>

Activates Marker Beacon modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `MBE:STAT ON`

Options: Option R&S SMA-K25

Manual operation: See "State - Marker Beacon Modulation" on page 314

[:SOURce]:MBEacon[:MARKer]:DEPTh <Depth>

Sets the modulation depth of the marker signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 95
Default unit: PCT

Example: `MBE:DEPT 30PCT`
sets 30 percent modulation depth for the marker signal.

Options: Option R&S SMA-K25

Manual operation: See "Marker Depth - Marker Beacon Modulation" on page 314

[:SOURce]:MBEacon[:MARKer]:FREQuency <Frequency>

Sets the modulation frequency of the marker signal.

Parameters:

<Frequency> 400Hz | 1300Hz | 3000Hz

Range: 400 to 3000
Increment: 0.1 Hz
*RST: 400 Hz

Example: `MBE:FREQ 400`
sets a frequency of 400 Hz for the marker.

Options: Option R&S SMA-K25

Manual operation: See "Marker Frequency - Marker Beacon Modulation" on page 314

[:SOURce]:MBEacon[:MARKer]:PULSed <Pulsed>

The commands activate the pulsed marker.

Parameters:

<Pulsed> 0 | 1 | OFF | ON

OFF
The markers are output uncoded (key down).

ON
The markers are output with the following on/off ratio:
Outer Marker (400 Hz): 375 ms on, 125 ms off…
Middle Marker (1300 Hz) 375 ms on, 125 ms off, 83 ms on, 83 ms off…
Inner Marker (3000 Hz) 83 ms on, 83 ms off (6dots/sec)

*RST: OFF

Example: `MBE:PULS`
activates the pulsed marker

Options: Option R&S SMA-K25

Manual operation: See "Pulsed Marker - Marker Beacon Modulation" on page 315

7.14.13 SOURce:MODulation Subsystem

This subsystem contains the command for switching on/off all modulations.

[:SOURce<hw>]:MODulation[:ALL][:STATe] <State>

Activates/deactivates the modulations.

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

*RST: 1

Example: `MOD:STAT OFF`
switches off all modulations.

Manual operation: See "MOD ON/OFF" on page 246

7.14.14 SOURce:NOISe Subsystem

The `SOURce:NOISe` subsystem contains the commands for setting the noise modulation signal. The noise generator is optional.

[:SOURce<hw>]:NOISe:BANDwidth|BWIDth <BWidth>

Sets the noise level in the system bandwidth for enabled bandwidth limitation. Distinct bandwidth settings between 10 kHz and 10 MHz in 100 kHz steps (range 100 .. 1 MHz), 1 MHz (range 1 MHz .. 5 MHz) and 5 MHz (5 MHz … 10 MHz) are possible.

Parameters:

<BWidth> float

Range: 100E3 to 10E6
Increment: 100E3
*RST: 100E3

Example: `NOIS:BWID:STAT ON`
enables bandwidth limitation.
`NOIS:BWID 1 MHz`
sets a system bandwidth of 1 MHz.

Options: R&S SMA-K24

Manual operation: See "Bandwidth " on page 332

[:SOURce<hw>]:NOISe:BWIDth:STATe <State>

Enables /disables bandwidth limitation of noise.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `NOIS:BWID:STAT ON`
enables bandwidth limitation.

Options: R&S SMA-K24

Manual operation: See "Bandwidth Limitation" on page 332

[:SOURce<hw>]:NOISe:DISTribution <Distribution>

Selects the noise power density distribution of the noise.

Parameters:

<Distribution> GAUSs | EQUal

*RST: GAUSs

Example: `NOIS:DIST GAUS`
selects Gaussian distribution.

Options: R&S SMA-K24

Manual operation: See "Distribution - Noise" on page 332

[:SOURce<hw>]:NOISe:LEVel:RELative?

This command queries the level of the noise signal per Hz in the total bandwidth.

Return values:

<Relative>	float	
	Range:	-149.18 to -52.67
	Increment:	0.1
	*RST:	-69.84

Example: `NOIS:LEV:REL?`
queries the noise level

Usage: Query only

Options: R&S SMA-K24

Manual operation: See "Noise Level - Noise" on page 332

[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?

Queries the level of the noise signal in the system bandwidth for enabled bandwidth limitation.

Return values:

<Absolute>	float	
	*RST:	3.84 MHz

Example: `NOIS:BWID:STAT ON`
enables bandwidth limitation.
`NOIS:BWID 10 MHz`
sets a system bandwidth of 1 MHz.
`NOIS:LEV:ABS`
queries the noise level in the system bandwidth

Usage: Query only

Options: R&S SMA-K24

Manual operation: See "Noise Level (System Bandwidth)" on page 333

7.14.15 SOURce:PGEN Subsystem

This subsystem contains the commands for setting the pulse generator.

[:SOURce<hw>]:PGENerator:STATe <State>

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: 0

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`.

Manual operation: See "Video Sync Signal State - Pulse Generator" on page 333

7.14.16 SOURce:PHASe Subsystem

This subsystem contains the commands for adjusting the phase of the RF output signal relative to a reference signal of the same frequency.

[:SOURce<hw>]:PHASe <Phase>

Sets the phase variation relative to the current phase. The variation is specified in RADians.

Parameters:

<Phase> float

Range: -720 to 720
Increment: 0.1
*RST: 0

Example: `PHAS 0.1 RAD`
changes the phase by 0.1 RAD relative to the current phase.
`PHAS:REF`
adopts the set phase as the current phase.

Manual operation: See "Delta Phase" on page 146

[:SOURce<hw>]:PHASe:REFerence

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

Manual operation: See "Reset Delta Phase Display" on page 146

7.14.17 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 on the required options, see Chapter 5.4.4, "Phase Modulation (PhiM)", on page 256.

[:SOURce<hw>]:PM[:DEViation] <Deviation>

Sets the deviation of the phase modulation signals in RAD. The maximum deviation depends on the set RF frequency and the selected modulation mode (see data sheet).

Parameters:

<Deviation> float

Range: see data sheet
Increment: 1E-6

Example: `PM 2`
sets 2 RAD deviation to the phase modulation signal.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "ϕM Deviation" on page 258

[:SOURce<hw>]:PM:EXTernal:COUPling <Coupling>

Selects the coupling mode for the external phase modulation signal.

Parameters:

<Coupling> AC | DC

AC
Uses only the AC signal component of the modulation signal.

DC
Uses the modulation signal as it is, with AC and DC.

*RST: AC

Example: `PM:EXT:COUP AC`
selects the coupling mode AC for the external phase modulation signal.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "PhiM Ext Coupling" on page 259

[:SOURce<hw>]:PM:EXTernal:DEViation <Deviation>

Sets the modulation deviation of the external phase modulation signal in RAD. The maximum value depends on the set RF frequency and the selected modulation mode (see data sheet).

Parameters:

<Deviation> float

Range: 0 to 20
*RST: 1

Example: `PM 5`
sets 5 RAD deviation for the external phase modulation signal.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "ϕM Deviation" on page 258

[:SOURce<hw>]:PM:EXTernal:DIGital:BFORmat <BFormat>

Selects the binary format for external digital phase modulation.

Parameters:

<BFormat> DCODe | BOFFset

*RST: BOFFset

Example: `PM:EXT:DIG:BFOR BOFF`
selects binary format binary offset.

Options: Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:INTernal<ch>:DEViation <Deviation>

Sets the modulation deviation of the external phase modulation signal in RAD. The maximum value depends on the set RF frequency and the selected modulation mode (see data sheet).

The sum of the deviations of all active frequency modulation signals may not exceed the total value set with command `[:SOURce<hw>]:PM[:DEViation]`.

The command selects the deviation for the two phase modulation signals. The sum of the two values must not exceed the overall modulation deviation set with command `SOURce:PM:DEViation`.

Suffix:

<ch> 1..2
determines the modulation signal channel.

Parameters:

<Deviation> float

Range: 0 to 20
*RST: 0.5 RAD

Example: `PM:INT1:DEV 10RAD`
selects a deviation of 10 RAD for LF generator 1.

Options: Option R&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24

Manual operation: See "Deviation 1/Deviation 2" on page 259

[:SOURce<hw>]:PM:INTernal:SOURce <Source>

Selects the internal modulation signal source. The available selection depends on the installed options. To configure the modulation signal, use the commands of the Chapter 7.14.10, "SOURce:LFOutput Subsystem", on page 566 subsystem.

Parameters:

<Source> LF1 | LF2 | LF12 | NOISe | LF1Noise | LF2Noise

*RST: LF1

Example: `PM:INT:SOUR LF2N`
uses the noise signal generated by the second LF generator for phase frequency modulation.

Options: Option R&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24 for selections other than LF1

Manual operation: See "Internal Source" on page 258

[:SOURce<hw>]:PM:MODE <Mode>

Selects the mode for the phase modulation.

Parameters:

<Mode>	HDEViation | HBANdwidth | LNOise **HDEViation** Provides full setting range of PhiM deviation. The range of modulation frequency is limited (see data sheet). Recommended for low modulation frequencies and/or high PhiM deviation. **HBANdwidth** Provides maximum range of modulation bandwidth. Recommended for high modulation frequencies. **LNOise** Provides modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and PhiM deviation is limited (see data sheet) *RST: HBANdwidth

Example: `PM:MODE LNO`
selects Low Noise mode for external phase modulation.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "ϕM Mode" on page 257

[:SOURce<hw>]:PM:SENSitivity?

Queries the input sensitivity of the externally applied signal for phase modulation. The returned value reports the sensitivity in RAD/V. It 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 external modulation input.
`Response: 1`
since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 1RAD/V.

Usage: Query only

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "ϕM Sensitivity" on page 259

[:SOURce<hw>]:PM:SOURce <Source>

Selects the modulation signal source for phase modulation.

You can use both, the internal and an external modulation signal at a time.

Parameters:

<Source> INTernal | EXTernal | INT,EXT | EDIGital

INTernal
Uses the internally generated signal for modulation. To configure the LF signal, use the commands of the SOURce:LFOutput Subsystem subsystem.
With command `[:SOURce<hw>]:PM:INTernal:SOURce` you can select the internal signal source.

EXTernal
Uses an externally applied modulation signal.

INT,EXT
Uses both, the internal and external modulation signals.

EDIGital
Uses an externally applied digital modulatioin signal.

*RST: INT

Example: `PM:SOUR INT`
selects the internal modulation source.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "ϕM Source" on page 257

[:SOURce<hw>]:PM:STATe <State>

Activates phase modulation.

Note: Activation of PM deactivates frequency modulation (FM).

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `PM:STAT ON`
activates PM.

Options: Option R&S SMA-B20 or R&S SMA-B22

Manual operation: See "State" on page 257

7.14.18 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 <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

Temporarily 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

Manual operation: See "Search Once - ALC" on page 163

[:SOURce<hw>]:POWer:ALC[:STATe] <State>

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.

Manual operation: See "State - ALC" on page 163

[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE <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.

Parameters:

<Mode> UNCHanged | FATTenuation

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, it provides fast and wear-free operation of the relay-switched high power bypass.
Furthermore, on instruments equipped with a high power option, it provides fast and wear-free operation of the relay-switched high power bypass.

FATTenuation
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: depends on instrument hardware

Example: `SOUR:POW:ATT:RFOF:MODE FATT`
sets the RF OFF attenuator to maximum.

Manual operation: See "RF OFF Mode" on page 160

[:SOURce<hw>]:POWer:EMF:STATe <State>

Displays the signal level as voltage of the EMF. The displayed value represents the voltage over a 50 Ohm load.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `POW:EMF:STAT 1`
activates voltage level display.

Manual operation: See "Display Level as Voltage of EMF - RF Level" on page 161

[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

Sets the RF level applied to the DUT.

Notes:

If specified, a level offset `[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet` is included according to the formula:

`Minimum level + OFFSet ... Maximum level + OFFSet`

In addition to numerical values, you can increase or decrease the values step by step with the `UP` and `DOWN` according to the step width defined with `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

The RF output is activated with `:OUTPut<hw>[:STATe]` on page 429 (RF ON / RF OFF).

Parameters:

<Amplitude> Minimum level ... Maximum level

Determines the RF output level.

Range: Minimum level to Maximum level
*RST: -30

Example: The keywords of this command are largely optional. Therefore, both the long and short form of the command are shown.
`SOUR:POW:LEV:IMM:AMPL 15`
or
`:POW 15`
sets the RF level at output A to 15 dBm.

Manual operation: See "RF Level" on page 157

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Note: The level offset is also effective for level sweeps!

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 "RF level vs. RF output level" on page 156.

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 to 100
Increment: 0.01
*RST: 0

Example: `SOURce:POWer:LEVel:IMMediate:OFFSet -10`
or
`POW:OFFS 10`
sets the RF level offset to 10 dB

Manual operation: See "Offset (Level)" on page 158

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL <Rcl>

Determines whether the RF level is retained or taken from a loaded instrument configuration, when you recall instrument settings with the command `*RCL`.

Parameters:

<Rcl> INCLude | EXCLude

INCLude
Takes the level value of the loaded settings.

EXCLude
Retains the current level when an instrument configuration is loaded.

*RST: INCLude

Example: `POW:RCL INCL`
takes the level value from an instrument configuration loaded with command `*RCL`.

Manual operation: See "Exclude Level" on page 133

[:SOURce<hw>]:POWer:LIMit[:AMPLitude] <Amplitude>

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
*RST: 30

Example: `SOURce:POWer:LIMit:AMPLitude 10`
or
`:POW:LIM 10`
limits the RF level to maximum +10 dBm.

Manual operation: See "Limit - RF Level" on page 158

[:SOURce]:POWer:WIGNore <State>

Ignores level range warnings.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `POW:WIGN ON`
suppresses the level range warnings.

Manual operation: See "Ignore Level Range Warnings" on page 159

[: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
*RST: -30

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.

Manual operation: See "Current Level - Level Sweep" on page 232

[:SOURce<hw>]:POWer:MODE <Mode>

Sets the instrument operating mode and therefore also the commands used to set the output level.

Parameters:

<Mode> CW | FIXed | SWEep

CW|FIXed
Operates at a constant level.
`CW` and `FIXed` are synonyms. To set the output level value, use the command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]`.

SWEep
Operates in power sweep mode.
Set the range and current level with the commands `[:SOURce<hw>]:POWer:STARt`, `[:SOURce<hw>]:POWer:STOP` and `[:SOURce<hw>]:POWer:MANual`.

*RST: CW

Example: `POW:MODE SWEep`
selects the SWEep mode using the `POW:STAR; POW:STOP; POW:MAN` settings.

Manual operation: See "State - Level Sweep" on page 229

[: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 "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
*RST: -30

Example: `SOUR:POW:POW 15`
sets the RF level at output to 15 dBm.

Manual operation: See "Amplitude" on page 158

[:SOURce<hw>]:POWer:SPC:CRANge <PowCntrlCRange>

Defines the capture range of the power control system.

Within the range:

Target Level +/- Catch Range

the power control locks and tries to achieve the target level. Readings outside the range are not considered.

Parameters:

<PowCntrlCRange> float

Range: 0 to 50
Increment: 0.01
*RST: 30
Default unit: dB

Example: `POW:SPC:CRAN 15`
sets the capture range to +/- 15 dB.

Manual operation: See "Catch Range +/-" on page 166

[:SOURce<hw>]:POWer:SPC:DELay <PowCntrlDelay>

Defines a waiting period between the level adjustment of the generator and the next measurement of the power sensor.

Parameters:

<PowCntrlDelay> integer

Range: 0 to 1000
*RST: 0

Example: `:POW:SPC:DEL 2 ms`
the sensor starts the next reading 2 ms after the level adjustment.

Manual operation: See "Delay Time" on page 167

[:SOURce<hw>]:POWer:SPC:PEAK <PowCntrlPeak>

Activates power control by means of the peak power values, provided the power sensor supports this function.

Parameters:
<PowCntrlPeak> 0 | 1 | OFF | ON
*RST: 0

Example: `POW:SPC:PEAK ON`
uses the measured peak power for power control.

Manual operation: See "Use Peak Power" on page 167

[:SOURce<hw>]:POWer:SPC:SELect <PowCntrlSelect>

Defines the currently selected sensor to be used for power control.

Parameters:
<PowCntrlSelect> SENS1 | SENS2 | SENS3 | SENS4
*RST: SENS1

Example: `POW:SPC:SEL SENS2`
selects the sensor connected to a second USB interface for power control.

Manual operation: See "Sensor" on page 165

[:SOURce<hw>]:POWer:SPC:STATe <PowCntrlState>

Activates power control using the selected sensor. The control loop periodically adjusts the generator output. After switching off, the running loop is completed.

Parameters:
<PowCntrlState> 0 | 1 | OFF | ON
*RST: 0

Example: `POW:SPC:STAT ON`
activates power control.

Manual operation: See "State" on page 165

[:SOURce<hw>]:POWer:SPC:TARGet <PowCntrlTarget>

Sets the nominal level expected at the input of the sensor. To define the unit of the power value, use command `:SENSe<ch>:UNIT[:POWer]` on page 477.

Parameters:

<PowCntrlTarget>	float Range: -50 to 30 Increment: 0.01 *RST: -10

Example: `SENS:UNIT dBm`
selects unit dBm for setting the target level value.
`POW:SPC:TARG -10`
sets -10 dBm target level.

Manual operation: See "Target Level" on page 166

[:SOURce<hw>]:POWer:STARt <Start>

Sets the start level for the RF sweep.

Note: You can select any level within the setting range. The range is defined by this start value and the `[:SOURce<hw>]:POWer:STOP` value.

A defined offset (`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`) affects the level values according to the formula:

`Minimum level + OFFSet ... Maximum level + OFFSet`

Parameters:

<Start>	float Determines the first level value of the sweep setting range. Range: full specified level range Increment: see the data sheet: Level sweep > Step size setting resolution *RST: -30

Example: `POW:STAR -20 dBm`
sets the start level for the level sweep to -15 dBm for RF output A.

Manual operation: See "Start Level - Level Sweep" on page 232

[:SOURce<hw>]:POWer:STEP[:INCRement] <Increment>

Sets the step width for POW:STEP:MODE USER.

To adjust the level step by step with this step size, use the `POW:UP` and `POW:UP` commands.

Note: This value also applies to the step width of the rotary knob of the instrument and increases or decreases the level accordingly, when you work in user-defined step mode.

Parameters:

<Increment> float

Range: full specified level range
Increment: see the data sheet: Level sweep > Step size setting resolution
*RST: 1

Example: `POW:STEP 2`
sets the step width for entering the RF level to 2 dB.

Manual operation: See "Variation Step" on page 160

[:SOURce<hw>]:POWer:STEP:MODE <Mode>

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).

Manual operation: See "Variation Active" on page 160

[:SOURce<hw>]:POWer:STOP <Stop>

Sets the stop level for the RF sweep.

Note: You can select any level within the setting range. The range is defined by the `[:SOURce<hw>]:POWer:STARt` value and this stop value.

A defined offset (`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`) affects the level values according to the formula:

`Minimum level + OFFSet ... Maximum level + OFFSet`

Parameters:

<Stop> float

Determines the last level value of the sweep setting range.

Range: full specified level range
Increment: see the data sheet: Level sweep > Step size setting resolution
*RST: -10

Example: `POW:STOP 3`
sets the stop level for the level sweep to 3 dBm for RF output A.

Manual operation: See "Stop Level - Level Sweep" on page 232

7.14.19 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.

Programming Examples

Example: Performing pulse modulation

This example shows a command sequence to perform pulse modulation.

```
// ******************************************************************
// Reset the instrument to start from an initial state
// ******************************************************************
*RST; *CLS

// ******************************************************************
// Set the RF signal frequency and level
// ******************************************************************
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// ******************************************************************
// Configure the pulse modulation settings
// ******************************************************************
// Select the internal modulation generator
SOURce:PULM:SOURce INT
// Set trigger mode
SOURce:PULM:TRIGger:MODE AUTO
// Select pulse mode
SOURce:PULM:MODE DOUB

// ******************************************************************
// Alternatively configure the pulse modulation settings for
// external modulation source
// ******************************************************************
// Select the external modulation source
SOURce:PULM:SOURce EXT
```

```
// Set the polarity of the externally applied modulation signal.
SOURce:PULM:POLarity NORMal
// Select the impedance for the external pulse modulation trigger input
SOURce:PULM:TRIGger:EXTernal:IMPedance G10K

// ******************************************************************
// Configure the pulse generator settings
// ******************************************************************
// Set pulse period
SOURce:PULM:PERiod 10 us
// Set pulse width
SOURce:PULM:WIDth 8 us
// Set double pulse width
SOURce:PULM:DOUBle:WIDTh 0.0000012
// Set double pulse delay
SOURce:PULM:DOUBle:DELay 0.0000045

// ******************************************************************
// Activate the signal output
// ******************************************************************
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1
```

Example: Generating a pulse train signal

This example shows a command sequence to create a pulse train signal.

Prior to the selection of the pulse train mode make sure that you have generated and selected a pulse train data list. Otherwise, the instrument generates an error.

```
// ******************************************************************
// Reset the instrument to start from an initial state
// ******************************************************************
*RST; *CLS

// ******************************************************************
// Set the RF signal frequency and level
// ******************************************************************
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// ******************************************************************
// Create a pulse train data list
// ******************************************************************
// Select the directory
MMEM:CDIR '/var/user/Lists/'
// Create and/or select the pulse train data file
```

```
SOURce:PULM:TRAin:SEL 'P_FIVE'
// Enter the pulse train data
SOURce:PULM:TRAin:ONTime 10ns,30ns,40ns,20ns,10ns
SOURce:PULM:TRAin:OFFTime 30ns,40ns,50ns,40ns,30ns
SOURce:PULM:TRAin:REPetition 10,1,3,10,6

// ******************************************************************
// Select pulse train mode
// ******************************************************************
// Select the internal modulation generator and the pulse mode
SOURce:PULM:SOURce INTernal
SOURce:PULM:MODE PTRain

// ******************************************************************
// Activate the signal output
// ******************************************************************
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1
```

[:SOURce<hw>]:PULM:DELay <Delay>

Sets the pulse delay.

Parameters:

<Delay> float

Range: 10 ns to 100 s
Increment: 5 ns
*RST: 10 ns

Example: `PULM:DEL 13 us`
13 us elapse after a trigger before the first pulse is generated.

Options: R&S R&S SMA-K23 (Pulse Generator)

Manual operation: See "Pulse Delay - Pulse Generator" on page 334

[:SOURce<hw>]:PULM:DOUBle:DELay <Delay>

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: 5 ns
*RST: 3 us

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 SMA-K23 (Pulse Generator)

Manual operation: See "Double Pulse Delay - Pulse Generator" on page 334

[:SOURce<hw>]:PULM:DOUBle:STATe <State>

Enables/disables double pulse generation. The two pulses are generated in one pulse period.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `PULM:DOUB:STAT ON`
double-pulse mode is enabled.

Options: R&S SMA-K23 (Pulse Generator)

[:SOURce<hw>]:PULM:DOUBle:WIDTh <Width>

Sets the width of the second pulse in case of double pulse generation.

Parameters:

<Width> float

Range: 5 ns to 100 s
Increment: 5 ns
*RST: 3 us

Example: `PULM:DOUB:WIDT 33 us`
sets a width of 33 us for the second pulse.

Options: R&S SMA-K23 (Pulse Generator)

Manual operation: See "Double Pulse Width - Pulse Generator" on page 334

[: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.

Manual operation: See "Pulse Mode - Pulse Generator" on page 333

[:SOURce<hw>]:PULM:PERiod <Period>

Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period> float

Range: 5 us | 20 ns to 100 s
Increment: 1us | 5 ns
*RST: 10 us

Example: `PULM:PER 220 us`
the pulse period is 220 us.

Options: R&S SMA-K23 (Pulse Generator)

Manual operation: See "Pulse Period - Pulse Generator" on page 334

[:SOURce<hw>]:PULM:POLarity <Polarity>

Sets the polarity between modulating and modulated signal. This command is effective only 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.

Manual operation: See "Polarity" on page 263

[:SOURce<hw>]:PULM:SOURce <Source>

Selects the source for the pulse modulation signal.

Parameters:

<Source> INTernal | EXTernal

INTernal
Without option R&S SMA-K23:
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.
With option R&S SMA-K23:
If option R&S SMA-K23 is installed, the characteristics of the generated pulse can be set in a wide range, and double pulse generation is possible.

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.
`PULM:STAT ON`
activates the pulse modulation.

Usage: SCPI confirmed

Manual operation: See "Source" on page 263

[:SOURce<hw>]:PULM:STATe <State>

Activates the pulse modulation.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0
Example:	`PULM:STAT ON` activates pulse modulation.
Manual operation:	See "State" on page 263

[:SOURce<hw>]:PULM:TRAin:CATalog?

Queries 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/user/Lists'`
	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 SMA-K27 (Pulse Train)
Manual operation:	See "Pulse Train Data – Pulse Generator" on page 340

[:SOURce<hw>]:PULM:TRAin:DELete <Filename>

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:

<Filename>	<list file name>

Example: `MMEM:CDIR '/var/user/Lists'`
selects the directory for the pulse train files.
`PULM:TRA:DEL 'P_FIVE'`
deletes the list `P_FIVE`

Usage: Setting only

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Pulse Train Data – Pulse Generator" on page 340

[:SOURce<hw>]:PULM:TRAin:OFFTime <OffTime>

Fills the Off-time 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 2047 values.

Example: `MMEM:CDIR '/var/user/Lists'`
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,30ns,40ns,...`
specifies the off-time values in `P_INCR`. If the list already contains data, it is overwritten.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Edit Pulse Train Data" on page 341

[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts?

Queries the length (in points) of the off-time component of the selected list.

Return values:

<Points> integer

Range: 0 to 2047
*RST: 0

Example: `MMEM:CDIR '/var/user/Lists'`
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 off-time entries.

Usage: Query only

Options: R&S SMA-K27 (Pulse Train)

[:SOURce<hw>]:PULM:TRAin:ONTime <OnTime>

Fills the On-time part of the selected file with data.

Parameters:

<OnTime> Ontime#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 2047 values.

Example: `MMEM:CDIR '/var/user/Lists'`
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,30ns,40ns,...`
specifies the on-time values in `P_INCR`. If the list already contains data, it is overwritten.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Edit Pulse Train Data" on page 341

[:SOURce<hw>]:PULM:TRAin:ONTime:POINts?

Queries the length (in points) of the ontime component of the selected list.

Return values:

<Points> integer

Range: 0 to 2047
*RST: 0

Example: `MMEM:CDIR '/var/user/Lists'`
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 SMA-K27 (Pulse Train)

[:SOURce<hw>]:PULM:TRAin:REPetition <Repetition>

Sets the number of repetitions for each ontime/offtime value pair.

*RST does not affect data lists.

Tip:"0" ignores the corresponding value pair in the pulse train. Thus, you can individually omit value pairs without deleting them from the table.

Parameters:
<Repetition> Repetition#1{, Repetition#2, ...}
Range: 0...65535

Example: `MMEM:CDIR '/var/user/Lists'`
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,30ns,40ns,...`
specifies the ontime values in `P_INCR`. If the list already contains data, it is overwritten.
`PULM:TRA:OFFT 10ns,30ns,40ns,...`
specifies the offtime values in `P_INCR`. If the list already contains data, it is overwritten.
`PULM:TRA:REP 1,8,3,...`
specifies the number of repetitions for each value pair.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Edit Pulse Train Data" on page 341

[:SOURce<hw>]:PULM:TRAin:REPetition:POINts?

Queries the length (in points) of the repetition component of the selected list.

Return values:
<Points> integer
Range: 0 to INT_MAX
*RST: 0

Example: `MMEM:CDIR '/var/user/Lists'`
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 SMA-K27 (Pulse Train)

[:SOURce<hw>]:PULM:TRAin:SELect <Filename>

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:
<Filename> string

Example: `MMEM:CDIR '/var/user/Lists'`
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 SMA-K27 (Pulse Train)

Manual operation: See "Pulse Train Data – Pulse Generator" on page 340

[: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:GATE:POL NORM`
The pulse signal is generated while the gate signal is high.

Options: R&S SMA-K23 (Pulse Generator)

Manual operation: See "Gate Input Polarity - Pulse Generator" on page 339

[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance <Impedance>

Selects the impedance for external pulse trigger.

Parameters:

<Impedance> G50 | G10K

*RST: G50

Example: `SOUR:PULM:TRIG:EXT:IMP G50`
selects 50 Ohm as the trigger impedance for the external pulse trigger.

Manual operation: See "External Impedance" on page 339

[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe <Slope>

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

Parameters:

<Slope> NEGative | POSitive

*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 SMA-K23 (Pulse Generator)

Manual operation: See "External Trigger Input Slope - Pulse Generator" on page 338

[:SOURce<hw>]:PULM:TRIGger:MODE <Mode>

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.

Options: Option R&S SMA-K23 (Pulse Generator); (AUTO by default without this option)

Manual operation: See "Trigger Mode - Pulse Generator" on page 334

[: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/user/Lists/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

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Select ASCII Source / Destination - Import/Export Pulse Train Files" on page 343

[: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/user/Lists/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.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Extension – ASCII File Settings" on page 343

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect <Filename>

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:

<Filename> string

Example:
`MMEM:CDIR '/var/user/Lists/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`.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Select ASCII Source / Destination - Import/Export Pulse Train Files" on page 343

[: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/user/Lists/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`.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Column Separator- ASCII File Settings" on page 343

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal <Decimal>

Select 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/user/Lists/import'`
selects the directory for the ASCII files with on-time/off-time/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`.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Decimal Point - ASCII File Settings" on page 343

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute

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/user/Lists/import'`
selects the directory for the ASCII files with on-time/off-time/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

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Import / Export - Import/Export Pulse Train Files" on page 343

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE <Mode>

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/user/Lists/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`.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Mode – Import/Export Pulse Train Files" on page 343

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect <Filename>

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:

<Filename>	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/user/Lists/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`.

Options: R&S SMA-K27 (Pulse Train)

Manual operation: See "Select Destination / Source - Import/Export Pulse Train Files" on page 343

[:SOURce<hw>]:PULM:WIDTh <Width>

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:	2 us | 5 ns to 100 s
Increment:	1us | 5 ns
*RST:	2 us

Example:
`PULM:WIDT 33 us`
sets a width of 33 us for the pulse.

Options: The enhanced features require option R&S SMA-K23 (Pulse Generator)

Manual operation: See "Pulse Width - Pulse Generator" on page 334

7.14.20 SOURce:ROSCillator Subsystem

This subsystem contains the commands for setting the external and internal reference frequency.

The settings of the reference oscillator are not affected by an instrument reset (`*RST` on page 394). They are only reset to factory state by the factory-preset (`:SYSTem:FPReset` on page 397).

[:SOURce]:ROSCillator:EXTernal:FREQuency <Frequency>

Selects the external reference frequency.

Parameters:

<Frequency> 5MHZ | 10MHZ | 13MHZ

*RST: 10MHZ

Example: `ROSC:SOUR EXT`

Selects the external source. The reference must be input at the REF IN connector.

`ROSC:EXT:FREQ 5MHz`

Selects 5 MHz external reference frequency.

Manual operation: See "External Reference Frequency" on page 154

[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] <State>

Activates that RF output is automatically switched off, when in external source mode no reference signal is supplied.

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 instrument generates the message "RF output deactivated'.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: --

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.

Manual operation: See "Deactivate RF Output (if external reference is missing)" on page 154

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <SBandwidth>

Sets the synchronization bandwidth for an external reference signal.

Parameters:

<SBandwidth> WIDE | NARRow

NARRow
The synchronization bandwidth depends on the configuration of the instrument:
If the R&S SMA is equipped with the option R&S SMA-B22, the synchronization bandwidth is a few Hz. The internal 10-MHz OCXO is synchronized to the external signal. This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.
Without option SMA-B22, the synchronization bandwidth is approx. 20 Hz.

WIDE
The synchronization bandwidth depends on the configuration of the instrument:
If the R&S SMA is equipped with the option R&S SMA-B22, the synchronization bandwidth is approximately 100 Hz. This mode is recommended for precise reference sources of high spectral purity. The internal 10-MHz OCXO is bypassed and the external signal synchronizes a 100-MHz reference oscillator directly.
Without R&S SMA-B22: Synchronization the bandwidth is approx. 750 Hz.
Without option R&S SMA-B22, the synchronization bandwidth is approx. 750 Hz. This mode is the standard mode. It is provided for using precise reference sources of high spectral purity.

Example:

`ROSC:SOUR EXT`
Selects the external source.
`ROSC:EXT:FREQ 10 MHz`
Informs the instrument that the external reference has a frequency of 10 MHz.
`ROSC:EXT:SBAN WID`
Selects wideband setting for synchronization bandwidth.

Manual operation: See "Synchronization Bandwidth" on page 154

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue <Value>

Specifies the frequency correction value (adjustment value).

Parameters:

<Value> integer

Range: 0 to maximum value (see data sheet)
Increment: see data sheet
*RST: ---

Example: `ROSC:ADJ:VAL 456`
Sets the adjustment value to 456.

Manual operation: See "Adjustment DAC Value" on page 155

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] <State>

Determines whether the calibrated (`OFF`) or a user-defined (`ON`) adjustment value is used for fine adjustment of the frequency.

If user-defined values are used, the instrument is no longer in the calibrated state. However, the calibration value is not changed and the instrument resumes the calibrated state after sending the command `:SOURce:ROSCillator:INTernal:ADJust:STATe OFF`.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: -

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.

Manual operation: See "Adjustment Active" on page 155

[:SOURce]:ROSCillator:SOURce <Source>

Selects the reference frequency source.

Parameters:
<Source> INTernal | EXTernal | ELOop

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`.
*RST: ---

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.

Manual operation: See "Source" on page 154

7.14.21 SOURce:SWEep Subsystem

The `SOURce:` subsystem contains the commands for configuring RF sweep signals.

- The keyword `[:FREQuency]` can be ommitted, then the commands are SCPI-compliant.
- To activate a RF sweep mode, use the following commands:
  - RF frequency sweep: `SOURce:FREQuency:MODE SWEep` (`SOURce:FREQuency:MODE CW` (off))
  - RF level sweep: `SOURce:POWer:MODE SWEep` (`SOURce:POWer:MODE CW` (off))
- All sweeps, including the LF sweep, can be set independently from 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 that you switch off the "Start/Stop Display Update" for optimum sweep performance, especially with short dwell times (`SYSTem:DISPlay:UPDate OFF`).

[:SOURce<hw>]:SWEep[:FREQuency]:DWELl <Dwell>

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 "Display Update" for optimum sweep performance especially with short dwell times (SYSTem:DISPlay:UPDate OFF).

Parameters:

<Dwell> float

Range: 2E-3 to 100
Increment: 100E-6
*RST: 15E-3

Example: `SWE:DWEL 12 ms`
sets a dwell time of 12 ms for a frequency sweep at the RF output.

Manual operation: See "Dwell Time - Frequency Sweep" on page 228

[:SOURce<hw>]:SWEep[:FREQuency]:EXECute

Starts an RF frequency sweep cycle manually.

The command is only effective in single mode.

Example:

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

triggers a frequency sweep at the RF output.

Usage: Event

Manual operation: See "Execute Single Sweep - Frequency Sweep" on page 225

[:SOURce<hw>]:SWEep[:FREQuency]:MODE <Mode>

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 trigger 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.

Manual operation: See "Mode - RF Frequency Sweep" on page 223

[:SOURce<hw>]:SWEep[:FREQuency]:POINts <Points>

Determines the number of steps for the RF frequency sweep within the sweep range.

This parameter always applies to the currently set sweep spacing and correlates with the step size as follows:

- for linear sweeps
  freq_points = (f_{SPAN} / step_lin) + 1
  To determine the step size, use the command SWE:STEP[:LIN].
- logarithmic sweeps and $f_{STARt} < f_{STOP}$
  freqq_points = ((log f_{STOP} - log f_{STARt}) / log step_log) + 1
  To determine the logarithmic step size, use the command SWE:STEP:LOG.

If you change the number of sweep points, the step size changes accordingly. The sweep range remains the same.

Parameters:

<Points> integer

Range: 2..max

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]:RETRace <State>

Activates that the signal changes to the start frequency value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single".

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `TRIG0:SWE:SOUR SING`
`FREQ:MODE SWE`
`SWE:SHAP SAWT`
`SWE:RETR ON`
activates retrace function, i.e. the frequency changes to the value at start frequency while waiting for the next trigger event.

Manual operation: See "Retrace - RF Frequency Sweep" on page 227

[:SOURce<hw>]:SWEep[:FREQuency]:RUNNing?

Queries the current state of the frequency sweep mode.

Return values:

<State> 0 | 1 | OFF | ON

Example: `SWE:RUNN?`
Response "`1`": signal generation in level sweep active.

Usage: Query only

[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe <Shape>

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.

Manual operation: See "Shape - RF Frequency Sweep" on page 227

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing <Spacing>

Selects the mode for the calculation of the frequency sweep intervals. The frequency increases or decreases by this value at each step.

The keyword `[:FREQuency]` can be omitted. Then the command is 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 642).

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 643).

*RST: LINear

Example: `SWE:SPAC LIN`
selects linear sweep spacing for a frequency sweep at the RF output.

Manual operation: See "Spacing - Frequency Sweep" on page 226

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step size for linear RF frequency sweep steps.

This parameter is related to the number of steps ([:SOURce<hw>]:SWEep[:FREQuency]:POINts) within the sweep range as follows:

$f_{STARt} < f_{STOP}$

freq_points = (f_{SPAN} / step_lin) + 1

If you change the step size, the number of steps changes accordingly. The sweep range remains the same.

The keywords `[:FREQuency]` and `[:LINear]` can be omitted. The command is then SCPI-compliant.

Parameters:

<Linear> float

Range: full frequency range
Increment: see the data sheet: RF characteristics > Resolution of setting

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.

Manual operation: See "Step Lin/Log - Frequency Sweep" on page 227

[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

Sets a logarithmically determined sweep step size for the RF frequency sweep. It is expressed in percent and you must enter the *value* and the unit *PCT* with the command.

The frequency is increased by a logarithmically calculated fraction of the current frequency according to:

$step\_log_{n+1} = f_n + step\_log_n \times f_n$

$f_{n+1} = f_n + step\_log_{n+1}$

with $f_{STARt} < f_{STOP}$ and n = number of sweep steps

This parameter correlates with the number of steps SWE:FREQ:POIN within the sweep range as follows:

freq_points = ((log f_{STOP} - log f_{STARt}) / log step_log) + 1

If you change the step size, the number of steps changes accordingly. The sweep range remains the same.

Parameters:

<Logarithmic> float

Range: 0.01 to 100
Increment: 1E-3
*RST: 1

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).

Manual operation: See "Step Lin/Log - Frequency Sweep" on page 227

[:SOURce<hw>]:SWEep:POWer:AMODe <AMode>

Selects the ranges of level settings for the level sweep. The sweep is either performed in the low level or in the high level ranges.

Parameters:

<AMode> AUTO | FIXed | NORMal | HPOWer | MANual

NORMal
The level settings are made in the range of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made in the high level range.

*RST: NORMal(HighPower)|AUTO

Example:
`SWE:POW:AMOD HPOW`
selects the high level ranges for level sweep.

Manual operation: See "Attenuator Mode - Level Sweep with High Power Option" on page 234

[:SOURce<hw>]:SWEep:POWer:DWELl <Dwell>

Sets the time taken for each level step of the sweep.

Tip: It is recommended to switch off the "Display Update" for optimum sweep performance especially with short dwell times (SYSTem:DISPlay:UPDate OFF).

Parameters:

<Dwell> float

Range: 1E-3 to 100
Increment: 100E-6
*RST: 15E-3

Example: `SWE:POW:DWEL 12 ms`
sets a dwell time of 12 ms for a level sweep at the RF output.

Manual operation: See "Dwell Time - Level Sweep" on page 233

[:SOURce<hw>]:SWEep:POWer:EXECute

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

Manual operation: See "Execute Single Sweep - Level Sweep" on page 232

[:SOURce<hw>]:SWEep:POWer:MODE <Mode>

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.

Manual operation: See "Mode - Level Sweep" on page 229

[:SOURce<hw>]:SWEep:POWer:POINts <Points>

Determines the number of steps for the RF level sweep within the sweep range.

This parameter always applies to the currently set sweep spacing and correlates with the step size as follows:

pow_points = (f_{STOP} - f_{STARt} / step_log) + 1

To determine the step size use the command SWE:POW:STEP[:LOG].

If you change the number of sweep points, the step size changes accordingly. The sweep range remains the same.

Parameters:

<Points> integer

Range: 2...max

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:RETRace <State>

Activates that the signal changes to the start level value while it is waiting for the next trigger event.

You can enable this feature, when you are working with sawtooth shapes in sweep mode "Single" or "External Single".

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example:

```
TRIG0:SWE:SOUR SING
POW:MODE SWE
SWE:POW:SHAP SAWT
SWE:POW:RETR ON
```
activates retrace function, i.e. the level changes to the value at start level while waiting for the next trigger event.

Manual operation: See "Retrace - RF Level Sweep" on page 232

[:SOURce<hw>]:SWEep:POWer:RUNNing?

Queries the current state of the level sweep mode.

Return values:

<State> 0 | 1 | OFF | ON

Example: `SWE:POW:RUNN?`
Response `"1"`: signal generation in level sweep active.

Usage: Query only

[:SOURce<hw>]:SWEep:POWer:SHAPe <Shape>

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.

Manual operation: See "Shape - RF Level Sweep" on page 232

[:SOURce<hw>]:SWEep:POWer:SPACing:MODE?

Queries the sweep spacing mode. The sweep spacing for level sweeps is always linear.

Return values:

<Mode> LINear

*RST: 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>

Sets a logarithmically determined sweep step size for the RF level sweep. It is expressed in decibels and you must enter the *value* and the unit *dB* with the command.

The level is increased by a logarithmically calculated fraction of the current level according to:

$step\_size_{n+1} = Level_n + step\_size_n \times Level_n$

$Level_{n+1} = Level_n + step\_size_{n+1}$

with $Level_{STARt} < level_{STOP}$, step_size = `SWE:POW:STEP[:LOG]` and n = number of sweep steps

This parameter correlates with the number of steps SWE:POW:POIN within the sweep range as follows:

$level\_points = ((Level_{STOP} - Level_{STARt}) / step\_size) + 1)$

If you change the step size, the number of steps changes accordingly. The sweep range remains the same.

Parameters:

<Logarithmic> float

Increment: 0.01

*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).

Manual operation: See "Step - Level Sweep" on page 233

[:SOURce<hw>]:SWEep:RESet[:ALL]

Resets all active sweeps to the starting point.

Example: `SWE:RES`

resets all active sweeps to the starting point.

Usage: Event

Manual operation: See "Reset Sweep - Frequency Sweep" on page 226

7.14.22 SOURce:VOR Subsystem

The VOR subsystem contains the commands for checking the VOR modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:VOR:...` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The external signal is input at the AM EXT connector.

[:SOURce]:VOR:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal). The COM/ID tone is sent according to the selected code (see Table 5-8). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (`VOR:COM:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`VOR:COM:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code> string

Example: `VOR:COM:CODE 'MUC'`
select COM/ID code for Munich airport.

Usage: SCPI confirmed

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Code - VOR Modulation" on page 294

[:SOURce]:VOR:COMid:DASH <Dash>

Sets the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Example:
`VOR:COM:CODE 'MUC'`
selects code for Munich airport
`VOR:COM:TSCH USER`
selects user time schema
`VOR:COM:DOT 200ms`
sets a dot length of 200 ms.
`VOR:COM:DASH 400ms`
sets a dash length of 400 ms.
`VOR:COM:LETT 50ms`
sets a letter space of 50 ms.
`VOR:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Dash Length - VOR Modulation" on page 296

[:SOURce]:VOR:COMid:DEPTh <Depth>

Sets the AM modulation depth of the additional communication/identification signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 10
Default unit: PCT

Example:
`VOR:COM:FREQ 1020`
sets the frequency of the COM/ID signal to the standard value of 1020Hz

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Depth - VOR Modulation" on page 295

[:SOURce]:VOR:COMid:DOT <Dot>

Sets the length of a morse dot by means of seconds. The length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> float

Range: 50 ms to 1 s
Increment: 0.1 ms
*RST: 100 ms
Default unit: ms

Example:
`VOR:COM:CODE 'MUC'`
selects code for Munich airport
`VOR:COM:DOT 200ms`
sets a dot length of 200 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Dot Length - VOR Modulation" on page 296

[:SOURce]:VOR:COMid:FREQuency <Frequency>

Sets the frequency of the communication/identification signal.

Parameters:

<Frequency> float

Range: 0.1 to 20E3
Increment: 0.01
*RST: 1020
Default unit: Hz

Example: `VOR:COM:FREQ 1020`
sets the frequency of the COM/ID signal to the standard value of 1020Hz.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Frequency - VOR Modulation" on page 295

[:SOURce]:VOR:COMid:LETTer <Letter>

Sets the length of a letter space by means of seconds. This command is available user time schema only.

Parameters:

<Letter> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Example: `VOR:COM:CODE 'MUC'`
selects code for Munich airport
`VOR:COM:TSCH USER`
selects user time schema
`VOR:COM:DOT 200ms`
sets a dot length of 200 ms.
`VOR:COM:DASH 400ms`
sets a dash length of 400 ms.
`VOR:COM:LETT 50ms`
sets a letter space of 50 ms.
`VOR:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Letter Space - VOR Modulation" on page 296

[:SOURce]:VOR:COMid:PERiod <Period>

Sets the period of the COM/ID signal in seconds.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9
Default unit: s

Example: VOR:COM:PER 33s
sets a period of 33 s for the COM/ID signal.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Period - VOR Modulation" on page 295

[:SOURce]:VOR:COMid:SYMBol <Symbol>

Sets the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1
Default unit: s

Example:

```
VOR:COM:CODE 'MUC'
```
selects code for Munich airport
```
VOR:COM:TSCH USER
```
selects user time schema
```
VOR:COM:DOT 200ms
```
sets a dot length of 200 ms.
```
VOR:COM:DASH 400ms
```
sets a dash length of 400 ms.
```
VOR:COM:LETT 50ms
```
sets a letter space of 50 ms.
```
VOR:COM:SYMB 10ms
```
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Symbol Space - VOR Modulation" on page 296

[:SOURce]:VOR:COMid:TSCHema <Tschema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ID signal).

Parameters:

<Tschema>	STD | USER *RST: STD

Example: `VOR:COM:CODE 'MUC'`
selects code for Munich airport
`VOR:COM:TSCH STD`
selects standard time schema
`VOR:COM:DOT 200ms`
sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.

Options: Option R&S SMA-K25

Manual operation: See "COM/ID Time Schema - VOR Modulation" on page 296

[:SOURce]:VOR:COMid[:STATe] <State>

Activates the additional communication/identification signal.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0

Example: `VOR:COM ON`

Options: Option R&S SMA-K25

Manual operation: See "COM/ID State - VOR Modulation" on page 294

[:SOURce]:VOR:FREQuency:STEP <Step>

Selects the variation of the carrier frequency via the rotary knob.

Parameters:

<Step> DECimal | ICAO

DECimal
Decimal variation according to the current cursor position.

ICAO
Variation in predefined steps according to the standardized VOR transmitting frequencies, see Table 5-9.

*RST: DECimal

Example: `VOR:FREQ:STEP DEC`
varies the frequency in decimal steps.

Manual operation: See "Carrier Freq. Knob Step - VOR Modulation" on page 296

[:SOURce]:VOR:ICAO:CHANnel <Channel>

Selects the ICAO channel, that menas the the VOR transmitting frequency. The RF-frequency is set to the value selected here.

Parameters:

<Channel>
CH17X | CH17Y | CH19X | CH19Y | CH21X | CH21Y | CH23X | CH23Y | CH25X | CH25Y | CH27X | CH27Y | CH29X | CH29Y | CH31X | CH31Y | CH33X | CH33Y | CH35X | CH35Y | CH37X | CH37Y | CH39X | CH39Y | CH41X | CH41Y | CH43X | CH43Y | CH45X | CH45Y | CH47X | CH47Y | CH49X | CH49Y | CH51X | CH51Y | CH53X | CH53Y | CH55X | CH55Y | CH57X | CH57Y | CH58X | CH58Y | CH59X | CH59Y | CH70X | CH70Y | CH71X | CH71Y | CH72X | CH72Y | CH73X | CH73Y | CH74X | CH74Y | CH75X | CH75Y | CH76X | CH76Y | CH77X | CH77Y | CH78X | CH78Y | CH79X | CH79Y | CH80X | CH80Y | CH81X | CH81Y | CH82X | CH82Y | CH83X | CH83Y | CH84X | CH84Y | CH85X | CH85Y | CH86X | CH86Y | CH87X | CH87Y | CH88X | CH88Y | CH89X | CH89Y | CH90X | CH90Y | CH91X | CH91Y | CH92X | CH92Y | CH93X | CH93Y | CH94X | CH94Y | CH95X | CH95Y | CH96X | CH96Y | CH97X | CH97Y | CH98X | CH98Y | CH99X | CH99Y | CH100X | CH100Y | CH101X | CH101Y | CH102X | CH102Y | CH103X | CH103Y | CH104X | CH104Y | CH105X | CH105Y | CH106X | CH106Y | CH107X | CH107Y | CH108X | CH108Y | CH109X | CH109Y | CH110X | CH110Y | CH111X | CH111Y | CH112X | CH112Y | CH113X | CH113Y | CH114X | CH114Y | CH115X | CH115Y | CH116X | CH116Y | CH117X | CH117Y | CH118X | CH118Y | CH119X | CH119Y | CH120X | CH120Y | CH121X | CH121Y | CH122X | CH122Y | CH123X | CH123Y | CH124X | CH124Y | CH125X | CH125Y | CH126X | CH126Y

*RST: CH17X

Example:
`VOR:ICAO:CHAN CH19X`
selects ICAO frequency channel 19X. This channel sets the RF frequency to 108.2 MHz.

Options: Option R&S SMA-K25

Manual operation: See "ICAO Channel - VOR Modulation" on page 296

[:SOURce]:VOR:MODE <Mode>

Selects the operating mode for the VOR modulation signal.

Parameters:
<Mode> NORM | VAR | SUBCarrier | FMSubcarrier

NORM
VOR modulation is active.

VAR
Amplitude modulation of the output signal with the variable signal component (30Hz signal content) of the VOR signal. The modulation depth of the 30 Hz signal corresponds to the value set with command `SOURce:VOR:VAR:DEPTh`.

SUBCarrier
Amplitude modulation of the output signal with the unmodulated FM carrier (9960Hz) of the VOR signal. The modulation depth corresponds to the value set with command `SOURce:VOR:SUBCarrier:DEPTh`.

FMSubcarrier
Amplitude modulation of the output signal with the frequency-modulated FM carrier (9960Hz) of the VOR signal. The frequency deviation corresponds to the value set with command `SOURce:VOR:REFerence:DEViation`, the modulation depth corresponds to the value set with command `SOURce:VOR:SUBCarrier:DEPTh`.

*RST: NORM

Example: `VOR:MODE VAR`
Activates amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the VOR signal.

Options: Option R&S SMA-K25

Manual operation: See "Mode - VOR Modulation" on page 292

[:SOURce]:VOR:PRESet

Sets the VOR default settings.

Example: `VOR:PRES`
sets all `SOURce:VOR:...` parameters to default.

Usage: Event

Options: Option R&S SMA-K25

Manual operation: See "Set to Default - VOR Modulation" on page 293

[:SOURce]:VOR:REFerence[:DEViation] <Deviation>

Sets the frequency deviation of the reference signal on the FM carrier.

Parameters:

<Deviation>	integer Range: 0 to 960 Increment: 1 *RST: 480 Default unit: Hz

Example: `VOR:REF 480`
sets the frequency deviation of the reference signal on the FM carrier to 480 Hz.

Options: Option R&S SMA-K25

Manual operation: See "REF Deviation - VOR Modulation" on page 293

[:SOURce]:VOR:SOURce <Source>

Selects the modulation source for VOR modulation. `INT` is the internal modulation source. The external signal is input at the AM EXT connector. The external signal is added to the internal signal. Switching off the internal source is not possible.

Parameters:

<Source>	INT | INT,EXT | EXT *RST: INT

Example: `VOR:SOUR INT`
selects the internal modulation source.

Options: Option R&S SMA-K25

Manual operation: See "EXT AM - VOR Modulation" on page 297

[:SOURce]:VOR:STATe <State>

Activates VOR modulation.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0

Example: `VOR:STAT ON`

Options: Option R&S SMA-K25

Manual operation: See "State - VOR Modulation" on page 291

[:SOURce]:VOR:SUBCarrier:DEPTh <Depth>

Sets the AM modulation depth of the FM carrier.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 30

Example: `VOR:SUBC:DEPT 30PCT`
sets 30 percent modulation depth for the subcarrier.

Options: Option R&S SMA-K25

Manual operation: See "Subcarrier Depth - VOR Modulation" on page 293

[:SOURce]:VOR:SUBCarrier[:FREQuency] <Frequency>

Sets the frequency of the FM carrier.

Parameters:

<Frequency> float

Range: 5E3 to 15E3
Increment: 0.01
*RST: 9.96E3
Default unit: Hz

Example: `VOR:SUBC 9960`
sets the standard frequency of 9960 Hz for the FM sub carrier.

Options: Option R&S SMA-K25

Manual operation: See "Subcarrier Frequency - VOR Modulation" on page 293

[:SOURce]:VOR:VAR:FREQuency <Frequency>

Sets the frequency of the variable and the reference signal. As the two signals must have the same frequency, the setting is applies to both signals.

Parameters:

<Frequency> float

Range: 10 to 60
Increment: 0.01
*RST: 30

Example: `VOR:VAR:FREQ 30`
sets 30 Hz frequency for the variable and reference signal.

Options: Option R&S SMA-K25

Manual operation: See "VAR/REF Frequency - VOR Modulation" on page 292

[:SOURce]:VOR:VAR[:DEPTh] <Depth>

Sets the AM modulation depth of the 30Hz variable signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 30
Default unit: PCT

Example: `VOR:VAR 30PCT`
sets 30 percent modulation depth for the variable signal.

Options: Option R&S SMA-K25

Manual operation: See "VAR Depth - VOR Modulation" on page 293

[:SOURce]:VOR[:BANGle] <BAngle>

sets the Bearing ANGle between the VAR signal and the reference signal. The orientation of the angle depends on the setting under `SOURce:VOR:BANGle:DIRection`.

Parameters:

<BAngle> float

Range: 0 to 360
Increment: 0.01
*RST: 0
Default unit: deg

Example: `VOR 20DEG`
sets a phase angle of 20 degrees between the variable signal and the reference signal

Options: Option R&S SMA-K25

Manual operation: See "Bearing Angle - VOR Modulation" on page 292

[:SOURce]:VOR[:BANGle]:DIRection <Direction>

Sets the reference position of the phase information.

Parameters:

<Direction> FROM | TO

FROM
The bearing angle is measured between the geographic north and the connection line from beacon to airplane.

TO
The bearing angle is measured between the geographic north and the connection line from airplane to beacon.

*RST: FROM

Example: `VOR:DIR FROM`
selects the beacon as a reference position. The angle corresponds to the angle between the geographic north and the connection line from beacon to airplane.

Options: Option R&S SMA-K25

Manual operation: See "Direction - VOR Modulation" on page 292

7.15 STATus Subsystem

This system contains the commands for the status reporting system. See also Chapter 6.5, "Status Reporting System", on page 381 for detailed information.

`*RST` on page 394 has no effect on the status registers.

Value ranges

- Queries return the current value of the respective register, which permits a check of the device status.
  Return values: A decimal value in the range 0 to 32767 (=2^{15}-1)
- The configuration commands set the respective register thus determining which status changes of the R&S SMA cause the status registers to be changed.
  Setting values: A decimal value in the range 0 to 32767 (=2^{15}-1)

:STATus:OPERation:CONDition <Condition>

Sets 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 because it indicates the current hardware status.

Parameters:

<Condition> string

Example: `:STATus:OPERation:CONDition?`
queries the Status:Operation:Condition register.

:STATus:OPERation:ENABle <Enable>

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.

:STATus:OPERation[:EVENt] <Event>

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.

:STATus:OPERation:NTRansition <Ntransition>

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, for example 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.

:STATus:OPERation:PTRansition <Ptransition>

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, for example 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.

:STATus:PRESet <Preset>

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.

:STATus:QUEStionable:CONDition <Condition>

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: `:STATus:QUEStionable:CONDition?`
queries the Status:Questionable:Condition register.

:STATus:QUEStionable:ENABle <Enable>

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.

:STATus:QUEStionable[:EVENt] <Event>

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.

:STATus:QUEStionable:NTRansition <Ntransition>

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

:STATus:QUEStionable:PTRansition <PTransition>

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

:STATus:QUEue[:NEXT]?

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[:NEXT]?` on page 665.

Return values:

<Next>	string

Example: `:STATus:QUEue?`
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

Manual operation: See "History" on page 73

7.16 SYSTem Subsystem

The `SYSTem` subsystem contains a series of commands for general functions which do not directly affect signal generation.

:SYSTem:ERRor:ALL?

Queries the error/event queue for all unread items and removes them from the queue. The response is a comma separated list of error number and a short description of the error in FIFO order.

Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Return values:

<All> string

List of: Error/event_number,"Error/event_description>[;Device-dependent info]"
If the queue is empty, the response is `0,"No error"`

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?

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]?

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?

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]?

Queries the error/event queue for the oldest item and removes it from the queue. The response consists of an error number and a short description of the error.

Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Return values:

<Next> string

Error/event_number,"Error/event_description>[;Device-dependent info]"
If the queue is empty, the response is `0,"No error"`

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

Manual operation: See "History" on page 73

: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:
<StaticErrors> string

Example: `SYSTem:SERRor?`
queries all errors existing in the error queue.
`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:DLOCk <DispLockStat>

Disables the display, or enables it again (OFF).

The command disables also the front panel keyboard of the instrument including the LOCAL key.

Parameters:
<DispLockStat> 0 | 1 | OFF | ON
*RST: 0

Example: `SYST:DLOC ON`
locks the display. To unlock the display `SYST:DLOC OFF`.

Manual operation: See "User Interface" on page 121

:SYSTem:KLOCk <State>

Keyboard **LOC**k disables the front panel keyboard of the instrument including the LOCAL key, or enables it again (OFF).

The command disables also the front panel keyboard of the instrument including the LOCAL key.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `SYST:KLOC ON`
locks the front panel and external controls. To enable the controls, set `SYST:KLOC OFF`.

Manual operation: See "User Interface" on page 121

:SYSTem:ULOCk <Mode>

Locks or unlocks the user interface of the instrument.

Parameters:

<Mode> ENABled | DONLy | DISabled

ENABled
Unlocks the display and all controls for the manual operation.

DONLy
Locks the controls for the rmanual operation of the instrument. The display shows the current settings.

DISabled
Locks the controls for the rmanual operation, and enables remote operation over VNC. The display shows the current settings.

*RST: ENABled

Example: `SYST:ULOC ON`
activates the user interface lock.

Manual operation: See "User Interface" on page 121

:SYSTem:COMMunicate:GPIB:LTERminator <LTerminator>

Sets the terminator recognition for remote control via GPIB 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: `SYSTem:COMMunicate:GPIB:LTERminator EOI`
only a character which is sent simultaneously with the line message EOI is accepted as the terminator.

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

Sets the GPIB address.

Parameters:

<Address> integer

Range: 1 to 30

*RST: 28

Example: `SYSTem:COMMunicate:GPIB:SELF:ADDRess 28`

sets GPIB address.

Manual operation: See "GPIB channel address" on page 112

:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain <Domain>

Sets the primary suffix, that is the DNS name without the host name part.

Parameters:

<Domain> string

Example: `SYSTem:COMMunicate:NETWork:COMMon:DOMain 'ABC.DE'`

sets the domain of the network.

Manual operation: See "DNS Suffix" on page 110

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

Sets the individual host name of the R&S SMA.

Note: it is recommended that you do not change the host name in order to avoid problems with the networdk connection. However, if you change the host name be sure to use an unique name.

The host name is a protected parameter, To change it, first disable protection level 1 with command `:SYSTem:PROTect<ch>[:STATe]` on page 674.

Parameters:

<Hostname> string

Example:
```
SYSTem:PROTect1:STATe OFF,123456
SYSTem:COMMunicate:NETWork:HOSTname 'SIGGEN'
```
sets the individual computer name of the R&S SMA.

Manual operation: See "Hostname" on page 109

:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup <Workgroup>

Sets the individual workgroup name of the instrument.

Parameters:

<Workgroup> string

Example: `SYSTem:COMMunicate:NETWork:COMMon:WORKgroup 'TEST_09'`
sets the workgroup name

Manual operation: See "Workgroup" on page 109

:SYSTem:COMMunicate:NETWork[:IPADdress]:DNS <DNS>

Determines the net DNS server to resolve the name.

Parameters:

<DNS> string

Example: SYST:COMM:NETW:IPAD:DNS 123.456.0.1

Manual operation: See "DNS Server" on page 110

:SYSTem:COMMunicate:NETWork:IPADdress:MODE <Mode>

Selects manual or automatic setting of the IP address.

Parameters:

<Mode> AUTO | STATic

*RST: AUTO

Example: `SYSTem:COMMunicate:NETWork:IPADdress:MODE AUTO`
the IP address is assigned automatically (DHCP)

Manual operation: See "Address Mode" on page 109

:SYSTem:COMMunicate:NETWork:IPADdress <IpAddress>

Sets the IP address.

Parameters:

<IpAddress> string

Range: 0.0.0.0. to ff.ff.ff.ff

Example: `SYSTem:COMMunicate:NETWork:IPADdress '7.8.9.10'`
sets the IP address of the instrument.

Manual operation: See "IP Address" on page 109

:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway <Gateway>

Sets the IP address of the default gateway.

Parameters:

<Gateway> string

Range: 0.0.0.0 to ff.ff.ff.ff

Example: `SYSTem:COMMunicate:NETWork:IPADdress:GATeway '1.2.3.4'`
sets the IP address of the default gateway.

Manual operation: See "Default Gateway" on page 110

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

Sets the subnet mask.

Parameters:

<Mask> string

Example: `SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK '255.255.0.0'`
determines the subnet mask.

Manual operation: See "Subnet Mask" on page 110

:SYSTem:COMMunicate:NETWork:MACaddress <MacAddress>

Queries the MAC address of the network adapter.

Parameters:

<MacAddress> string

Example: `SYST:COMM:NETW:MAC`
queries the MAC address.

Manual operation: See "MAC Address" on page 110

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Return values:

<State> 0 | 1 | OFF | ON

Usage: Query only

Manual operation: See "Network Status" on page 108

:SYSTem:COMMunicate:NETWork:RESTart

Restarts the network connection to the instrument, terminates the connection and sets it up again.

Example: `SYSTem:COMMunicate:NETWork:RESTart`

Usage: Event

Manual operation: See "Restart Network" on page 110

:SYSTem:COMMunicate:GPIB:RESource?

Queries the visa resource string for remote control via the GPIB interface.

To change the GPIB address, use the command :SYSTem:COMMunicate:GPIB[:SELF]:ADDRess.

Return values:
<Resource> string

Example: `SYSTem:COMMunicate:GPIB:RESource?`
queries the VISA resource string.
Response: "`GPIB::28::INSTR`"

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 113

:SYSTem:COMMunicate:NETWork:RESource?

Queries the VISA resource string, used for remote control of the instrument with VXI-11 protocol.

Return values:
<Resource> string

Example: `SYSTem:COMMunicate:NETWork:RESource?`
Response: "`TCPIP::192.1.2.3::INSTR`"

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 113

:SYSTem:COMMunicate:HISLip:RESource?

Queries the VISA resource string, used for remote control of the instrument with HiSLIP protocol.

Return values:
<Resource> string

Example: `SYSTem:COMMunicate:HISLip:RESource?`
Response: "`TCPIP::192.1.2.3::hislip0::INSTR`"

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 113

:SYSTem:COMMunicate:USB:RESource?

Queries the visa resource string for remote control via the USB interface.

Return values:
<Resource> string

Example: `SYSTem:COMMunicate:USB:RESource?`
queries the VISA resource string for remote control via the USB interface.
Response: `"USB::72::000000::INSTR"`

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 113

:SYSTem:COMMunicate:SERial:RESource?

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: `SYSTem:COMMunicate:SERial:RESource?`
queries the VISA resource string.
Response: `"ASRL1::INSTR"`

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 113

:SYSTem:COMMunicate:SERial:BAUD <Baud>

Sets the baudrate for the serial remote control interface.

Parameters:

<Baud> 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200

*RST: 115200

Example: `SYSTem:COMMunicate:SERial:BAUD 115200`
determines 115200 baudrate.

Manual operation: See "Baud Rate" on page 112

:SYSTem:COMMunicate:SERial:PARity <Parity>

Sets the parity for the serial remote control interface.

Parameters:

<Parity> NONE | ODD | EVEN

*RST: NONE

Example: `SYST:COMM:SER:PAR NONE`
selects parity NONE.

Manual operation: See "Parity" on page 113

:SYSTem:COMMunicate:SERial:SBITs <SBits>

Sets 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.
Manual operation:	See "Stop Bits" on page 113

:SYSTem:COMMunicate:SOCKet:RESource?

Queries the visa resource string for remote control via LAN interface, using TCP/IP socket protocol.

Return values:

<Resource>	string
Example:	`SYSTem:COMMunicate:SOCKet:RESource?` Response: `"TCPIP::10.113.1.150::5025::SOCKET"`
Usage:	Query only
Manual operation:	See "Visa Resource Strings" on page 113

:SYSTem:IDENtification <Identification>

Selects the mode the instrument identification is performed.

Parameters:

<Identification>	AUTO | USER **AUTO** The "IDN String" and the "OPT String" are set automatically. **USER** Enables the selection of user definable "IDN String" and "OPT String". *RST: AUTO
Example:	`SYST:IDEN USER` selects the user defined identification string.
Manual operation:	See "Mode" on page 114

:SYSTem:LANGuage <Language>

Sets the remote control command set.

The instrument can also be remote controlled via the command set of several other generators, for example HP generator. See the Application Note 1GP71 at the download area of the product site on the Internet.

Note: While working in a emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command `SYSTem:LANGuage` will be discarded.

The return to the SCPI command set of the R&S SMA 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'`).

Parameters:

<Language> string

Example: `SYSTem:LANGuage "SCPI"`
sets the SCPI command set.

Manual operation: See "Language" on page 114

:SYSTem:PROTect<ch>[:STATe] <State>[, <Key>]

Activates/deactivates the specified protection level.

Parameters:

<State> select

*RST: 1

Setting parameters:

<Key> integer

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: `SYSTem:PROTect1:STATe ON`
activates protection level 1. Internal adjustments are only possible after deactivating the lock-out.
`SYSTem:PROTect1:STATe OFF,123456`
deactivates protection level 1. Internal adjustments are enabled again.

Manual operation: See "Protection Level/Password" on page 117

:SYSTem:REBoot

Restarts the firmwware and the operating system.

Usage: Event

:SYSTem:RESTart

Restarts the firmware. The operating system remains active.

Usage: Event

:SYSTem:SHUTdown

Shuts down the instrument.

Usage: Event

:SYSTem:STARtup:COMPlete?

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:DISPlay:UPDate <Update>

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.

Manual operation: See "Display Update is On/Off" on page 104

:SYSTem:DATE <Year>, <Month>, <Day>

Queries or 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 674.

Parameters:

<Year> <year>,<month>,<day>

<Month> integer

Range: 1 to 12

<Day> integer

Range: 1 to 31

Example: `SYST:DATE?`
Response: `"2011,05,01"`
it is the 1st of May, 2011.

Manual operation: See "Date" on page 107

:SYSTem:HCLear

Clears the history.

Example: `SYST:HCL`
Deletes the history entries.

Usage: Event

:SYSTem:TIME <Hour>, <Minute>, <Second>

Queries or 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 674.

Parameters:

<Hour> 0...23,0...59,0...59
Range: 0 to 23

<Minute> integer
Range: 0 to 59

<Second> integer
Range: 0 to 59

Example: `SYSTem:TIME?`
Response: `"12,0,0"` it is precisely 12 pm.

Manual operation: See "Time" on page 107

:SYSTem:TIME:ZONE <TimeZone>

Sets the time zone. You can query the list of the available time zones with `:SYSTem:TIME:ZONE:CATalog?`.

Parameters:

<TimeZone> string

Manual operation: See "Time Zone" on page 107

:SYSTem:TIME:ZONE:CATalog?

Querys the list of available time zones.

Return values:
<Catalog>

Usage: Query only

Manual operation: See "Time Zone" on page 107

:SYSTem:VERSion?

Queries the SCPI version the instrument's command set complies with.

Return values:
<Version> string

Example: `SYST:VERS`
queries the SCPI version.
Response: "`1996`"
The instrument complies with the SCPI version from 1996.

Usage: Query only

:SYSTem:OSYStem?

Queries the operating system of the instrument.

Return values:
<OperSystem> string

Example: `SYSTem:OSYStem?`
Response: "`Linux`"

Usage: Query only

:SYSTem:MMEMory:PATH:USER?

Queries the user directory, that means the directory the instrument stores user files on.

Return values:
<PathUser> string

Example: `SYSTem:MMEMory:PATH:USER?`
Response: "/var/user/""

Usage: Query only

:SYSTem:WAIT <TimeMs>

Delays the execution of the subsequent remote command by the specified time.

This function is useful, for example to execute an SCPI sequence automatically but with a defined time delay between some commands.

Setting parameters:

<TimeMs> integer

Wait time in ms

Range: 0 to 10000
*RST: 0

Example:
```
:SYSTem:WAIT 10000
// waits 10s before resetting the instrument
*RST
```

Usage: Setting only

7.17 TEST Subsystem

The TEST system contains the commands for performing selftest routines, and for direct adjustment 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 can destroy the assembly

The respective hardware assembly responds directly to the `:TEST:DIRect` command; any safety mechanisms are bypassed. The command is intended for servicing purposes and should be used only by the Rohde & Schwarz service personnel.

:TEST<hw>:ALL:STARt

Starts a self-test on all installed hardware options.

To query the result, use the command `:TEST<hw>:ALL:RESult?` on page 678.

Example: See `:TEST<hw>:ALL:RESult?` on page 678

Usage: Event

Manual operation: See "Start Selftest" on page 104

:TEST<hw>:ALL:RESult?

Queries the result of the performed self-test (command `:TEST<hw>:ALL:STARt` on page 678).

Return values:

<Result> 0 | 1 | RUNning | STOPped

0
Success

1
Fail

*RST: STOPped

Example: `TEST:ALL:STAR`
Starts the self-test
`TEST:ALL:RES?`

Usage: Query only

Manual operation: See "Start Selftest" on page 104

: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`

7.18 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 SMA 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 SMA 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. Use command `LFO:SWEep:MODE` to select between the two sweep modes.
EAUTo	-	"Ext Start/Stop" mode.

:TRIGger<hw>:FSWeep:SOURce <Source>

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: AUTO

Example: `TRIG:FSW:SOUR EXT`
selects triggering with an external trigger.

Manual operation: See "Mode - RF Frequency Sweep" on page 223

:TRIGger<hw>:FSWeep[:IMMediate]

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

Manual operation: See "Execute Single Sweep - Frequency Sweep" on page 225

:TRIGger<hw>:LFFSweep

Usage: Event

Manual operation: See "Execute Single Sweep" on page 325

Immediately starts an LF frequency sweep.

The command is effective in sweep mode "Single" (`LFO:SWE:MODE AUTO` in combination with `TRIG:LFFS:SOUR SING`).

:TRIGger<hw>:LFFSweep:SOURce <Source>

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<hw>]:LFOutput:SWEep[:FREQuency]:EXECute` or `*TRG`.
The mode has to be set to `AUTO` (`[:SOURce<hw>]: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: AUTO

Example: `TRIG:LFFS:SOUR EXT`
selects triggering with an external trigger.

:TRIGger<hw>:LFFSweep:IMMediate

Immediately starts an LF frequency sweep.

The command is effective in sweep mode "Single" (LFO:SWE:MODE AUTO in combination with TRIG:LFFS:SOUR SING).

Usage: Event

Manual operation: See "Execute Single Sweep" on page 325

:TRIGger<hw>:PSWeep:SOURce <Source>

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: AUTO

Example: TRIG:PSW:SOUR EXT
selects triggering with an external trigger.

Manual operation: See "Mode - Level Sweep" on page 229

:TRIGger<hw>:PSWeep[:IMMediate]

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 SING`
sets the single trigger mode, i.e. a trigger starts a single sweep.
`TRIG:PSW`
starts a single RF level sweep.

Usage: Event

Manual operation: See "Execute Single Sweep - Level Sweep" on page 232

: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.

Setting 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: AUTO

Example: `TRIG0:SOUR EXT`
selects triggering with an external trigger. The trigger is input via the INST TRIG connector.

Usage: Setting only

Manual operation: See "Mode" on page 323

:TRIGger<hw>[:SWEep][:IMMediate]

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

Manual operation: See "Execute Single Sweep - Frequency Sweep" on page 225

:TRIGger<hw>[:IMMediate]

The command immediately starts the activated sweep.

The command performs a single sweep and therefore applies to sweep mode AUTO with sweep source SINGle. Use the commands `TRIG:FSW|LFFS|PSW|[:SWE]:SOUR SING`, and `SOUR:SWE:FREQ|POW:MODE`, or `SOUR:LFO:SWE:[FREQ:]MODE` to set the respective sinlge sweep. You can alternatively use an `IMMediate` command instead of the respective `SWEep:[FREQ:]|POW:EXECute` command.

Example: `TRIG`
starts all active sweeps.

Usage: Event

Manual operation: See "Execute Single Sweep" on page 325

7.19 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>

Defines the default unit for the phase modulation angle. It is not valid for commands which determine angle values, e.g. RF phase. It does not influence the manual control parameter unit and the display.

Parameters:

<Angle> DEGRee | RADian

*RST: RADian

Example: `UNIT:ANGL DEG`
sets DEG as a default unit for all commands which determine angle values.

:UNIT:POWer <Power>

Defines the default unit for power parameters. This setting affects the GUI, as well as all remote control commands that determine power values.

Parameters:

<Power> V | DBUV | DBM

*RST: DBM

Example: `UNIT:POW V`
sets V as a default unit for all commands which determine power values.

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. For example, cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

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 Status Information, Error Messages and Troubleshooting

The R&S SMA distinguishes between a variety of different messages such as status messages, error messages, warnings, or information that are displayed in the "Info" line on the screen, and also entered in the error/event queue of the status reporting system.

This section describes the information and status messages concerning the operating status of the instrument and the types of error messages and warnings. 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. The status reporting system is described in detail in Chapter 6.5, "Status Reporting System", on page 381.

Section Chapter 9.5, "Resolving Network Connection Failures", on page 694 provides recommended solutions for network connection errors, and helps you to collect the information required for quick and efficient support.

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 section 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 section gives an overview of the status messages displayed to the left of the Info line.

REMOTE
Indicates that the instrument is in remote control mode.

The keys on the front panel are usable, but all parameters are in read only mode.

To return to manual control, use the LOCAL key or the command `&GTL`. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

REM-LLO
Indicates that the instrument is in remote control mode with local lockout enabled.

The LOCAL key is locked. To set the local lockout, use the command `&LLO` (local lockout).

The keys on the front panel are usable, but all parameters are in read only mode.

To return to manual operation or to "REMOTE" state, use one of the following commands:
- `&LOCS`
  swichtes directly from "REM-LLO" to manual operation.
- `&REMS`
  changes the remote control state from "REM-LLO" to "REMOTE".
- `CALL IBLOC (generator%)` (Visual Basic command)
  switches from remote control state to manual operation.

LOC-LLO
For the direct operation the state has been changed from remote control to manual operation (local state). The LOCAL key was disabled with the command `LLO` (local lockout).

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 section 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. • 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. 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 5.2.3.2, "Internal Adjustments", on page 96.
182	Adjustment data missing	Adjustment data are missing.	The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the instrument.
183	Adjustment data invalid	Adjustment data are invalid and must be restored.	The adjustment data have to be generated again by an internal or external adjustment or to be loaded into the instrument.
200	Cannot access hardware	The data transmission to a module was unsuccessful.	The module is not installed, not properly installed or missing.
201	Hardware revision out of date	A later version of certain parts of the instrument is necessary to execute the function selected.	The driver does not support the installed version of a module.
202	Cannot access the EEPROM	A error occurs when writing or reading a EEPROM.	The EEPROM might be defect and has to be replaced.
203	Invalid EEPROM data	Reading a EEPROM is possible, however the data are inconsistent.	
204	Driver initialization failed	Initialization of a driver fails when booting the instrument firmware.	The driver is not compatible with the hardware or software configuration of the instrument.
241	No current list	There is no list selected. To execute the required operation, a list has to be selected in the related menu.	If no list is available, a new list must be created.
242	Unknown list type specified	The list type selected is not valid for the required operation. For 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.

Error Code	Error	Description	Remedy
460	Cannot open file	The selected file can not be opened.	Check the path and file name.
461	Cannot write file	The file can not be written.	Check if the file is read-only.
462	Cannot read file	The file can not be read.	Check if the file contents are compatible with the file type.
463	Filename missing	The required operation cannot be executed because the file name is not specified.	A file name has to be entered when creating a new list.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extension. 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. The file extension determines the data that is valid for this file type. If the file extension is changed the lists are no longer recognized and the data are therefore invalid. Example: the extension of a waveform file (= `*.wv`) was changed to `*.txt`	Check the file extension.

9.5 Resolving Network Connection Failures

Several issues may cause failures in the network connection to the instrument. This section lists the most likely reasons and the recommended solutions.

Common reasons for network connection failures

- Network connecting cables and cable connectors of poor quality
- Incompatibility between the network interface of the R&S SMA and certain switches or routers available on the market
- An invalid IP address assigned to the instrument

Possible solutions

NOTICE

Risk of connection errors

Before configuring the network, changing IP addresses or exchanging hardware, consult your network administrator.

Connection errors can affect the entire network.

- Check the network infrastructure. Exchange connecting cables if obvious damage is visible.
- Observe the link status LED on the connected network device. The link status LED is located next to the LAN connector.
  If a link failure is detected, connect the instrument to a different device port or to a different network device.
- Check whether the LAN interface and the required LAN services are enabled.
  See "LAN Services" on page 120.
- Check whether the IP address of the instrument is within the network's address range.
  See Chapter 5.2.3.13, "Network Settings ", on page 108.
  Check whether IP addresses that were set manually or obtained via the Zeroconf (APIPA) protocol are valid.

9.6 Obtaining Technical Support

If problems occur, the instrument generates error messages which in most cases will be sufficient for you to detect the cause of an error and find a remedy. Error message types are described in Chapter 9, "Status Information, Error Messages and Trouble-shooting", on page 688.

In addition, our customer support centers are there to assist you in solving any problems that you may encounter with your R&S SMA. We will find solutions more quickly and efficiently if you provide us with the information listed below.

- The following dialog boxes in the "Setup > System" menu provide useful information:
  - **Hardware Configuration:** hardware assemblies
  - **Software/Options:** the status of all software and hardware options installed on your instrument
- **System Messages:** displayed in the "Info" line and provide information on any errors that may have occurred

Collect the error information and send an e-mail in which you describe the problem to the customer support address for your region as listed at the beginning of the R&S SMA Getting Started manual.

To remove sensitive data

► For information on how to handle or remove the sensitive data from your instrument, refer to the description "Resolving Security Issues when working with R&S SMA", provided at the product homepage.

Packing and transporting the instrument

If the instrument needs to be transported or shipped, e.g. due to damage during delivery, observe the notes described in Chapter 2.3.2, "Unpacking and Checking the Instrument", on page 27.

Annex

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 347.

All other interfaces are described in Chapter 2.1, "Front Panel Tour", on page 16 and Chapter 2.2, "Rear Panel Tour", on page 23.

For specifications refer to the data sheet.

A.1 GPIB Bus Interface

Pin assignment

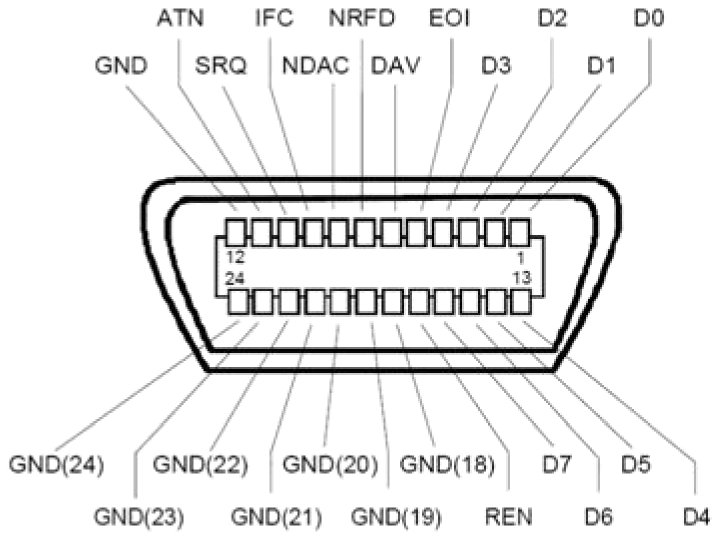


Figure A-1: Pin assignment of GPIB bus interface

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 SMA are listed in the following table.

Table A-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

A.2 AUX I/O Connector

Table A-2: Pin assignment of the AUX I/O Connector connector

Pin	Signal	Description
1	FHOP_DATA	Data input for Fast Hopping list mode. See Chapter 5.3.7.4, "List Mode", on page 234
2	Ground ⊥	Ground

Pin	Signal	Description
3	FHOP_CLK	Clock input for Fast Hopping list mode. See Chapter 5.3.7.4, "List Mode", on page 234
4	FHOP_STRB	Strobe input for Fast Hopping list mode. See Chapter 5.3.7.4, "List Mode", on page 234
5	RF OFF	Input for fast switching of the RF output. Active High (1) switches the RF output off. A subsequent Active Low (0) switches the RF output on again. Switching is performed very fast (10us). However, the attenuation of the switched off output is considerably less than after regular switch-off, because the attenuator is not set to maximum attenuation.
6	INST TRIG	Input for external triggering of the analog modulations, sweeps and List mode. HOP input for controlling the frequency hop mode with external source in List mode.
7	BLANK	Output for blank signal. This signal marks the blank times (invalid level indication). The signal is generated automatically.
8	OPC	Output for Operation Complete line. Active High signals that all remote control commands have been executed. The output is always active.
9 .. 10	Ground ⊥	Ground
11 .. 26	FM_DAT	Parallel data input with 16-bit word width for digital FM modulation data. The FM-Data bus is directly connected to the DDS of the synthesizer module. Thus, very fast frequency hop (settling times of 10 us) is possible for frequency bandwidth up to 80 MHz. See Chapter 5.4.3, "Frequency Modulation (FM)", on page 250

List of Commands

Index

Symbols

A

D

M

Q

R