R&S®SMA100B
RF Signal Generator
User Manual

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User Manual

ROHDE&SCHWARZ

This document describes the R&S®SMA100B, stock no. 1419.8888.02 and its options:

- R&S®SMAB-B1H
- R&S®SMAB-B29
- R&S®SMAB-B32/-B34
- R&S®SMAB-B80/-B85
- R&S®SMAB-B81
- R&S®SMAB-B86
- R&S®SMAB-B92/-B93
- R&S®SMAB-B103/-B106/-B112/-B120
- R&S®SMAB-B710(N)/-B711(N)
- R&S®SMAB-K22/-K23/-K24/-K27
- R&S®SMAB-K31/-K33
- R&S®SMAB-K703
- R&S®SMAB-K704
- R&S®SMAB-K720
- R&S®SMAB-K722

This manual describes firmware version FW 4.15.010.xx and later of the R&S®SMA100B.

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Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®SMA100B is indicated as R&S SMAB. Linux® is abbreviated as Linux.

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.

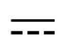
Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are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

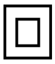
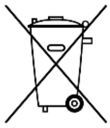
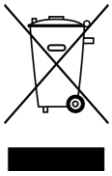
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. 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.
8. Follow the transport stipulations of the carrier (IATA-DGR, IMDG-Code, ADR, RID) when returning lithium batteries to Rohde & Schwarz subsidiaries.

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.

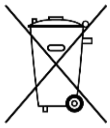
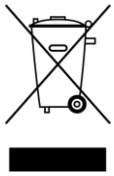
Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto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

Símbolo	Significado	Símbolo	Significado
	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.
	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.

8. En caso de devolver baterías de litio a las filiales de Rohde & Schwarz, debe cumplirse las normativas sobre los modos de transporte (IATA-DGR, código IMDG, ADR, RID).

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.

Europe, Africa, Middle East	Phone +49 89 4129 12345 customersupport@rohde-schwarz.com
North America	Phone 1-888-TEST-RSA (1-888-837-8772) customer.support@rsa.rohde-schwarz.com
Latin America	Phone +1-410-910-7988 customersupport.la@rohde-schwarz.com
Asia/Pacific	Phone +65 65 13 04 88 customersupport.asia@rohde-schwarz.com
China	Phone +86-800-810-8228 / +86-400-650-5896 customersupport.china@rohde-schwarz.com

ROHDE&SCHWARZ

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Contents

1 Preface

The R&S SMA100B is a new high-performance signal generator developed to meet demanding customer requirements. Offering excellent signal characteristic and straightforward and intuitive operation, the signal generator makes signal generation fast and easy.

1.1 Key Features

Outstanding key features of the R&S SMA100B are:

- Frequency range from 8 kHz to up to 20 GHz
- Excellent signal quality
- Excellent single sideband (SSB) phase noise
- Nearly no wideband noise
- Very high output power
- Low harmonics
- Unique pulse train generation
- High-stability reference oscillator
- Intuitive operation via touchscreen with the tile diagram as key element

For more information, see data sheet.

1.2 For Your Safety

The R&S SMA100B is designated for the development, production and verification of electronic components and devices in industrial and laboratory environments. Use the R&S SMA100B only for its designated purpose. Observe the operating conditions and performance limits stated in the data sheet.

The product documentation helps you to use the R&S SMA100B safely and efficiently. Keep the product documentation in a safe place and pass it on to the subsequent users.

Safety information is part of the product documentation. It warns you about the potential dangers and gives instructions how to prevent personal injury or damage caused by dangerous situations. Safety information is provided as follows:

- In the "Basic Safety Instructions", safety issues are grouped according to subjects. For example, one subject is electrical safety. The "Basic Safety Instructions" are delivered with the R&S SMA100B in different languages in print.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation. Always read the safety instructions carefully. Make sure to comply fully with them. Do not take risks and do not underestimate the potential danger of small details such as a damaged power cable.

1.3 About this Manual

This user manual describes general instrument functions, the manual operation of the instrument and remote control.

The main focus of this manual is on the signal generation capabilities of the instrument and the tasks required to achieve them. The following topics are included:

- **Welcome to the R&S SMA100B**
  Introduction to and getting familiar with the instrument, including introduction to the signal generation principles.
- **Getting Started**
  Information that you have received as a printed book together with your instrument
- **Configuration of the RF Signal**
  Descriptions of the individual operation modes, including configuration settings and task descriptions
- **File and Data Management**
  Description of general functions to handle data files and work with the file system of the instrument
- **System and General Instrument Configuration**
  Description of the general instrument settings and functions
- **Network and Remote Control Operation**
  Information on setting up the instrument in a network and operating it remotely.
- **Remote Commands**
  Remote commands required to configure and perform measurements in a remote environment, sorted by tasks.
  Remote commands required to set up the environment and to perform common tasks on the instrument, sorted by tasks.
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes.
- **Maintenance**
  Information on tasks required to maintain the operability of the instrument
- **Troubleshooting and Error Messages**
  Hints and tips on how to handle errors
- **Appendix**
  Extensive reference information on remote control, hardware interfaces, etc.
- **Glossary**
  List of often used terms and abbreviations
- **List of Commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

Contents and scope

This help system describes the full functionality of an R&S SMA100B. Depending on your model and the installed options, some of the functions may not be available on your instrument.

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 usage scenarios.

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.

1.4 Documentation Overview

This section provides an overview of the R&S SMA100B user documentation. Unless specified otherwise, you find the documents on the R&S SMA100B product page at:

www.rohde-schwarz.com/manual/sma100b

1.4.1 Getting Started Manual

Introduces the R&S SMA100B 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.

1.4.2 User Manuals and Help

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 getting started manual.

The contents of the user manuals are available as help in the R&S SMA100B. The help offers quick, context-sensitive access to the complete information.

All user manuals are also available for download or for immediate display on the Internet.

1.4.3 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).

1.4.4 Instrument Security Procedures

Deals with security issues when working with the R&S SMA100B in secure areas. It is available for download on the Internet.

1.4.5 Basic Safety Instructions

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

1.4.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S SMA100B. 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.

See www.rohde-schwarz.com/brochure-datasheet/sma100b

1.4.7 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 www.rohde-schwarz.com/firmware/sma100b

1.4.8 Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/sma100b

2 Getting Started

This section contains the information you have received as a printed book together with your instrument. The information is provided again to enable you to search throughout the complete description. If you are already familiar with the described topics, consider the provided information as not relevant.

2.1 Preparing for Use

2.1.1 Putting into Operation

This section describes the basic steps to be taken when setting up the R&S SMA100B for the first time.

WARNING

Risk of injury due to disregarding safety information

Observe the information on appropriate operating conditions provided in the data sheet to prevent personal injury or damage to the instrument. Read and observe the basic safety instructions provided with the instrument, in addition to the safety instructions in the following sections. In particular:

- Do not open the instrument casing.

NOTICE

Risk of instrument damage due to inappropriate operating conditions

Specific operating conditions are required to ensure accurate measurements and to avoid damage to the instrument. Observe the information on appropriate operating conditions provided in the basic safety instructions and the instrument's data sheet.

NOTICE

Instrument damage caused by electrostatic discharge

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

NOTICE

Risk of instrument damage due to inappropriate operating conditions

An unsuitable operating site or test setup can damage the instrument and connected devices. Before switching on the instrument, observe the information on appropriate operating conditions provided in the data sheet. In particular, ensure the following:

- 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 connected correctly and are not overloaded.

2.1.1.1 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

2.1.1.2 Unpacking and Checking the Instrument

Unpack the R&S SMA100B carefully and check the contents of the package.

- Check if all items listed on the delivery note, including this getting started manual, are included in the delivery.
- Check the R&S SMA100B for any damage.
  If the contents are damaged, immediately contact the carrier who delivered the package.

Packing material

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

⚠ WARNING

Risk of injury during transportation

The carrying handles at the front and side of the casing are designed to lift or carry the instrument. Do not apply excessive force to the handles. If a handle is ripped off, the falling instrument can cause injury.

2.1.1.3 Accessory List

The instrument comes with the following accessories:

- Power cable
- Getting Started printed manual

2.1.1.4 Placing or Mounting the Instrument

The R&S SMA100B is designed for use under laboratory conditions, either on a bench top or in a rack using the standard rackmount kit.

Bench top operation

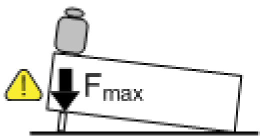
If the R&S SMA100B is operated on a bench top, the surface must be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

⚠ WARNING

Risk of injury if feet are folded out

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

- Fold the feet completely in or 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.



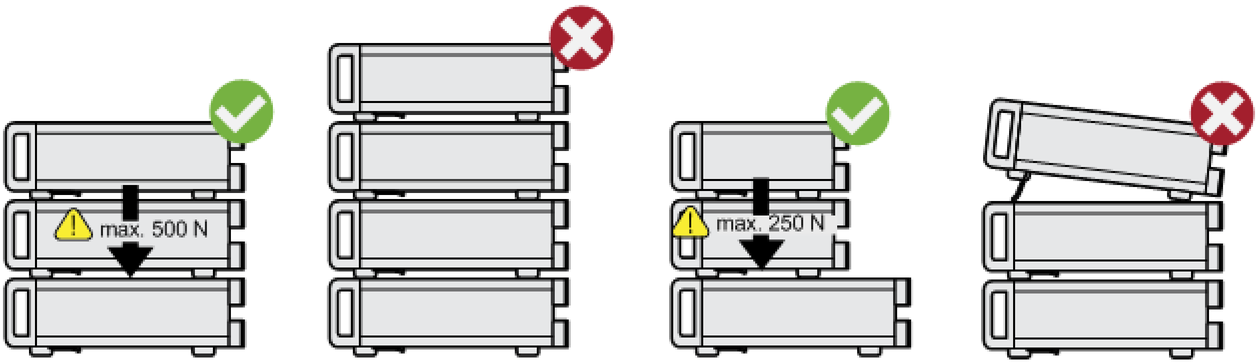
⚠ WARNING

Risk of injury if stacking heavy instruments

A stack of instruments can tilt over and cause injury if not stacked correctly. Furthermore, the instruments at the bottom of the stack can 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. 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.
- It is best if all instruments 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.



Correct | Too many instruments | Different dimensions | Feet folded out

Mounting in a rack

The R&S SMA100B 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 due to insufficient airflow in a rack

If the instrument is run with insufficient airflow for a longer period, the instrument overheats, which can 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.

2.1.1.5 Connecting AC Power

The R&S SMA100B is equipped with an AC power supply connector, that can be operated with different AC power voltages. Once it is connected, the instrument automatically adjusts to the given voltage. Refer to the data sheet for the requirements of voltage and frequency. 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.

To connect the AC supply

► Connect the R&S SMA100B to the AC power source using the supplied power cable.

Note: Since the instrument is designed in compliance with standard EN 61010-1 safety class I, it must only be connected to an outlet that has a ground contact.

Characteristics of the AC power supply:
- 100 V to 240 V AC
- 50 Hz to 60 Hz; 400 Hz
- 3.5 to 1.6 A, 2HU height unit (R&S SMAB-B92)
- 7.3 to 4.6 A, 3HU height unit (R&S SMAB-B92)

2.1.1.6 Turning the Instrument On and Off

To turn on the R&S SMA100B

1. Connect the instrument to the AC supply.
2. Turn on the main AC power switch at the rear panel of the R&S SMA100B (position "I" (on)).

   The instrument is supplied with AC power.

Warm-up time for OCXO
When the instrument is switched on, the OCXO requires an extended warm-up time (see data sheet).

To start the R&S SMA100B

Starting the R&S SMA100B requires that it is connected and turned on.

► At the front panel, press the ON/STANDBY key briefly.

The instrument boots the operating system and starts the instrument firmware.

After booting, the instrument is in the state before the last power off (standby or ready), indicated by the ON/STANDBY illumination:
- Green: the R&S SMA100B is running and ready for operation.
  All modules are power-supplied.
- Orange: the R&S SMA100B is in standby mode (main AC power switch is in position "I").
  The standby power mode keeps the power switch circuits and the oven-controlled crystal oscillator OCXO active. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.

To switch between standby and ready state, briefly press the ON/STANDBY key.

If a previous session was terminated regularly, the instrument uses the last setup with the relevant instrument settings.

► To set up a new configuration, press the PRESET key to return the instrument to its defined reset/preset state.

To shut down and turn off the R&S SMA100B

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 can be lost.

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

1. Press the ON/STANDBY key.

   The current setup is saved, the operating system shuts down and sets the instrument to standby state.
   The ON/STANDBY LED must be orange.

2. Turn off the main AC power switch at the rear panel of the R&S SMA100B (position "0" (off)).

   The instrument is no longer supplied with AC power.

Turning off the AC power

You can leave the AC power on permanently. Switching off is required only if the instrument must be disconnected from all power supplies.

2.1.1.7 Functional Check

When the instrument is switched on, it automatically monitors the main functions.

A detected fault is indicated by an "Error" message displayed in the "Info" line of the instrument together with a brief error description. For an in-depth identification of the error, press the "Info" button. In response, a description of the errors is displayed. For more information, refer to the "Troubleshooting and Error Messages" section in the user manual.

Apart from the automatic monitoring, the R&S SMA100B provides internal adjustments to check correct functioning. See the corresponding sections under "Maintenance" in the user manual.

2.1.1.8 Checking the Supplied Options and Licenses

The instrument can be equipped with both, hardware and firmware options. To check whether the installed options correspond to the options indicated on the delivery note, proceed as follows:

1. Press the SETUP key.
2. Select "Instrument Assembly > Hardware Config" and "Software / Options".

   A list with hardware and firmware information is displayed.
3. Check the availability of the hardware options as indicated in the delivery note. For an overview of the available options, refer to the data sheet.

See also Chapter 13.3.5, "Requesting Instrument Configuration and Specifications", on page 493.

2.1.2 Connecting USB Devices

The USB interfaces of the R&S SMA100B allow you to connect USB devices, including USB hubs directly to the instrument. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S SMA100B.

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)
- Keyboard or mouse to simplify the entry of data, comments, filenames, etc.
- Power sensors of the R&S NRP families

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

Connecting a USB storage device

When a USB storage device like a memory stick, a CD-ROM drive, or a hard disk is connected, it is detected automatically. The device is made available as a new drive (`/usb`). The name of the drive is manufacturer-dependent.

Connecting a keyboard

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

Use the "Setup > User Interface > USB Keyboard Settings" dialog to configure the keyboard properties (see Chapter 2.1.4.2, "Setting the Keyboard Language", on page 30).

Connecting a mouse

A mouse is detected automatically when it is connected.

2.1.3 Setting Up a Network (LAN) Connection

The R&S SMA100B 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, the interface can be used, for example:

- To transfer data between a controller and the instrument, for example to run a remote control program.
  See Chapter 11, "Network Operation and Remote Control", on page 243.
- To access or operate the instrument from a remote computer using the Ultr@VNC program (or a similar tool, like another VNC client or any Web browser supporting Java).
- To transfer data from a remote computer and back, for example using network folders.
- To transfer data between R&S NRP power sensors and the instrument.

This section describes how to configure the LAN interface.

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.

2.1.3.1 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

For addressing, both the instrument and the computer require an IP address. The address information is usually assigned to the devices automatically, depending on the network capabilities.

If the IP address is not assigned automatically, see Chapter 2.1.3.3, "Assigning the IP Address", on page 28 for information on how to assign the address manually.

To set up a network (LAN) connection

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses
- Exchanging hardware

Errors can 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 to obtain the whole address information automatically.

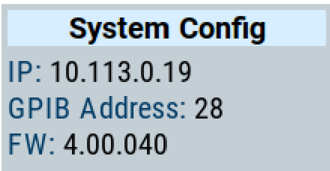
Risk of network connection failure

Network cables and cable connectors of poor quality, or failures in the autonegotiation process, can 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 "Troubleshooting and Error Messages".

When connected, the R&S SMA100B displays the address information on the screen.



2.1.3.2 Using Computer Names (Hostnames)

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

Each instrument is delivered with an assigned computer name, that remains permanent as long as it is not explicitly changed.

The default computer name follows the syntax `<INST>-<Serial Number>` (previous syntax: `rs<inst><Serial Number>`), where:

- `<INST>` is the short name of your instrument, as stated on the front panel.
- `<Serial Number>` is the individual serial number of the instrument.
  You can find the serial number at the rear panel of instrument. It is the third part of the device ID printed on the barcode sticker .

Example:

The default hostname of an R&S SMA100B with a serial number 102030 is `SMA100B-102030`.

To query and change a computer name

1. Press the SETUP key.
2. Select "Remote Access > Network".
   The "Network Settings" dialog opens.
   The computer name is displayed under "Hostname".
3. Press the SETUP key.
4. Select "Security > Protection".
5. Enable the "Protection Level 1".
   The default password is *123456*.
   The parameter "Hostname" in the "Network Settings" dialog is now enabled for configuration.
6. Change the "Hostname".

2.1.3.3 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 DHCP (Dynamic Host Configuration Protocol), the address information is 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.

Since the dynamic TCP/IP configuration assigns the address information automatically, it is safe to establish a physical connection to the LAN without any previous instrument configuration.

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses
- Exchanging hardware

Errors can affect the entire network.

To assign the IP address manually on the instrument

Use computer names to identify the instrument

In networks using a DHCP server, we recommend that you address the instrument by its unambiguous computer name, see Chapter 2.1.3.2, "Using Computer Names (Hostnames)", on page 27.

1. Press the SETUP key.
2. Select "Remote Access > Network".

   The "Network Settings" dialog opens.
3. Select "Address Mode > Static".
4. Select the "IP Address".
5. 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.
6. 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.

To assign the IP address manually on the computer

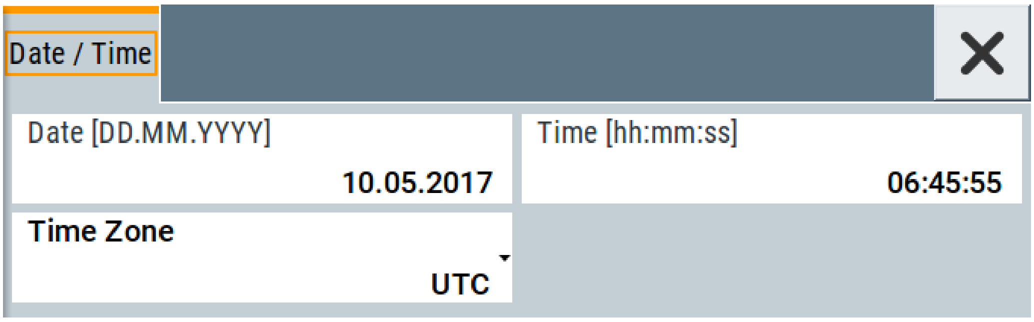
► Obtain the necessary information from your network administrator. If you use more than one LAN connector, you need separate address information for each connector.
For information on how to perform the configurations, refer to the documentation of the operating system the computer uses.

2.1.4 Configuring the Initial Instrument Settings

This section describes how to set up the R&S SMA100B initially.

2.1.4.1 Setting the Date and Time

The R&S SMA100B uses an internal real-time clock to determine the date and time. By default, the instrument is set to the UTC timezone, but you can select the timezone according to your location.



To select the timezone

1. Press the SETUP key.
2. Select "Maintenance > Timezone".
3. Select continent and city of your location.
   Tip: By typing the first letter, you can quickly navigate through the lists to find the desired destination.
4. Close the dialogs.

   The instrument adjusts the time according to the selected location.

To set the date and time

1. Press the SETUP key.
2. Select "Security > Protection".
3. Enable the "Protection Level 1".
   The default password is *123456*.
4. Select "Setup > Maintenance > Date / Time".
5. Adjust the settings.
6. Close the dialogs.

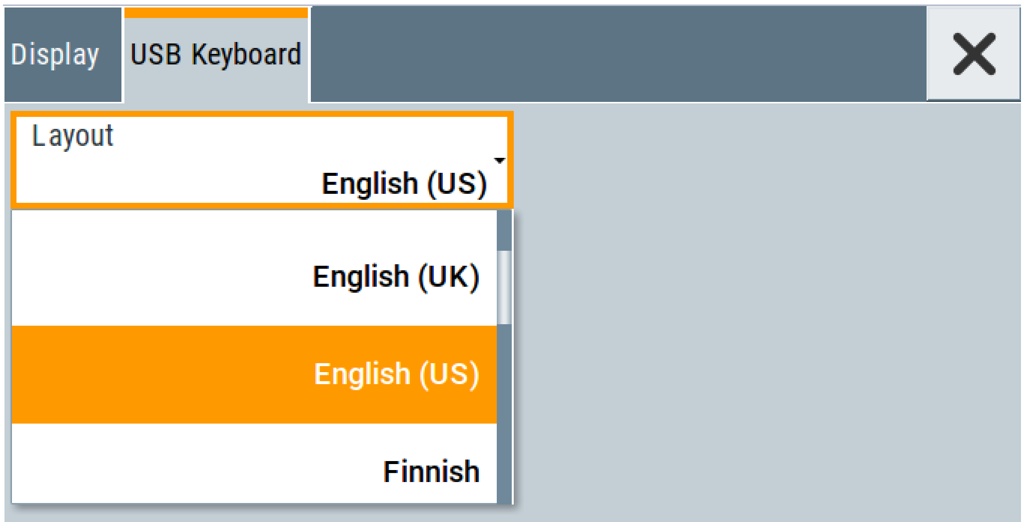
   The instrument adopts the new date and time.

2.1.4.2 Setting the Keyboard Language

You can select the language of the external keyboard connected to the instrument.

To adjust the keyboard settings

1. Press the SETUP key.
2. Select "User Interface > USB Keyboard".



3. Select the "Layout".

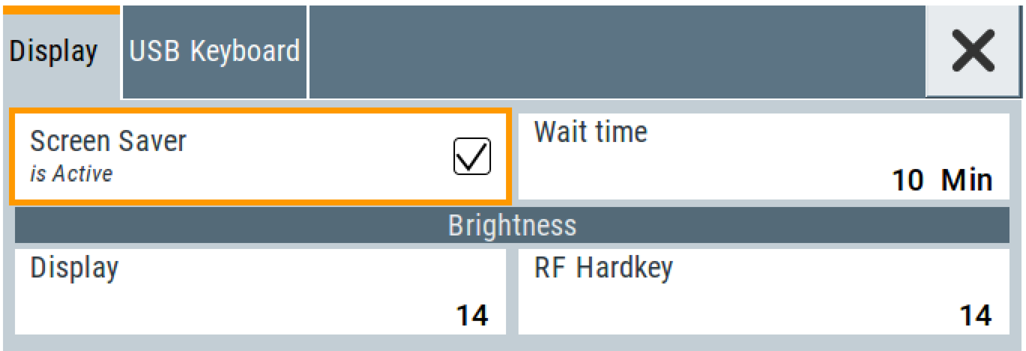
   The dialog closes and the changes take effect immediately.

2.1.4.3 Setting the Screen Saver

You can enable a screen saver that automatically turns off the display after a user-defined period of time. The screen saver is activated if no settings are made on the touch screen, or via keys or the rotary knob during the selected wait time.

To activate the screen saver

1. Press the SETUP key.
2. Select "User Interface > Display"
3. Activate the "Screen Saver".



4. Define the "Wait Time" in minutes.

The instrument turns off the display after the defined period of time.

5. To reactivate the display, tap the screen or press any key on the front panel.

To deactivate the screen saver

1. Press the SETUP key.
2. Select "User Interface > Display"
3. Disable the "Screen Saver" state.

2.2 Instrument Tour

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

- Chapter 2.2.1, "Front Panel Tour", on page 32
- Chapter 2.2.2, "Rear Panel Tour", on page 39

This section explains the control elements and the connectors of the R&S SMA100B with the aid of the front and rear views. For specifications of the interfaces, refer to the data sheet.

2.2.1 Front Panel Tour

This section provides an overview of the control elements at the front panel of the R&S SMA100B. Most of the connectors are at the rear panel and are described in Chapter 2.2.2, "Rear Panel Tour", on page 39.

Figure 2-1: Front panel view of the R&S SMA100B RF Signal Generator with height unit 2HU (option R&S SMAB-B92)

1 = Touchscreen
2 = Utility keys
3 = ON/STANDBY
4 = Function keys
5 = Keypad
6 = Navigation controls
7 = Display keys
8 = USB connector

9 = SD card slot
10 = SENSOR connector
11 = RF output connector

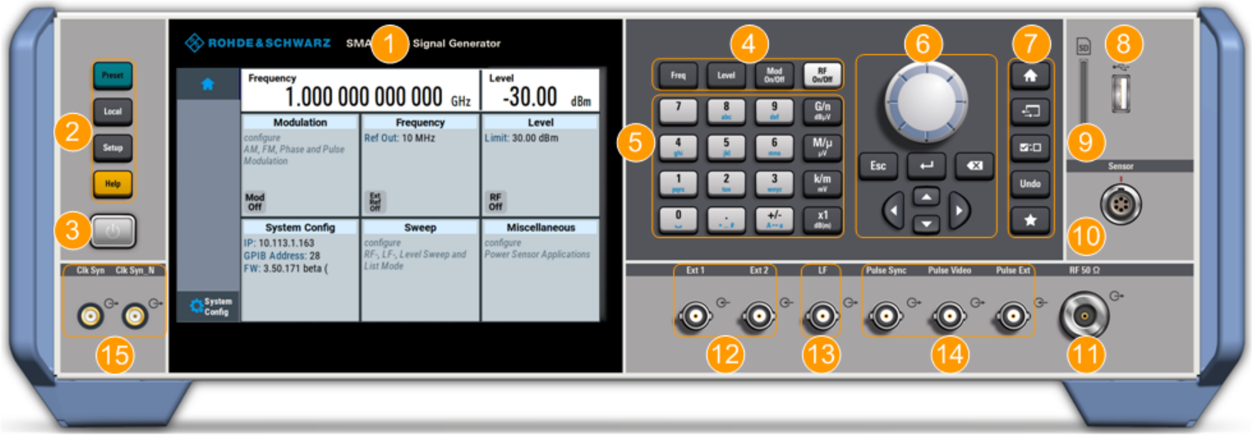


Figure 2-2: Front panel view of the R&S SMA100B RF Signal Generator with height unit 3HU (option R&S SMAB-B93)

1 = Touchscreen
2 = Utility keys
3 = ON/STANDBY
4 = Function keys
5 = Keypad
6 = Navigation controls
7 = Display keys
8 = USB connector
9 = SD card slot
10 = SENSOR connector
11 = RF output connector
12 = EXT1/2 input connectors
13 = LF output connector
14 = Pulse signal input and output connectors
15 = CLK SYNC and CLK SYNC N output connectors (SMA)

2.2.1.1 Touchscreen

The screen at the front panel is the graphical user interface. It shows the settings dialogs and parameters, and the current configuration at a glance, see Chapter 2.4.3, "Understanding the Display Information", on page 53.

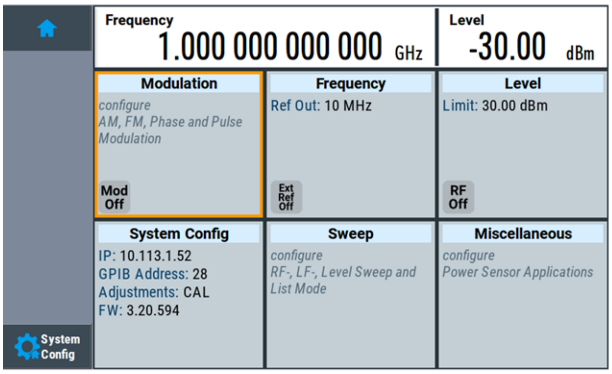


Figure 2-3: Touchscreen

The touch-sensitive panel provides an alternative means of user interaction for quick and easy handling of the instrument, see Chapter 2.4.2, "Means of Manual Interaction", on page 52.

NOTICE

Risk of touchscreen damage

Inappropriate tools or excessive force can damage the touchscreen.

Observe the following instructions when operating the touchscreen:

- Never touch the screen with ball point pens or other sharp objects, use your fingers instead.
  As an alternative, you can use a stylus pen with a smooth soft tip.
- Never apply excessive force to the screen. Touch it gently.
- Never scratch the screen surface, for example with a finger nail.
- Never rub the screen surface strongly, for example with a dust cloth.
  For instructions on cleaning the screen, see Chapter 13.1, "Cleaning", on page 484.

2.2.1.2 Utility Keys

The utility keys set the R&S SMA100B to a defined state, and provide access to basic settings and information on assistance.

Table 2-1: Utility keys

Utility Key	Assigned functions
PRESET	Sets the instrument to a defined state
LOCAL	Switches from remote control to local (manual) control
SETUP	Accesses the general instrument settings
HELP	Displays context-sensitive help text

2.2.1.3 ON/STANDBY

The ON/STANDBY key starts up and shuts down the instrument, and switches between the standby and the ready state.

- In the ready state, ON/STANDBY key lights green. The instrument is ready for operation.
- In the standby state, the ON/STANDBY key lights orange. The standby power mode keeps the power switch circuits and the oven-controlled crystal oscillator OCXO active. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.

2.2.1.4 Function Keys

Function keys provide access to the most common generator settings and functions. You can find a detailed description of the corresponding functions in the user manual.

Table 2-2: Function keys

Function key	Assigned functions
FREQ	Activates frequency entry.
LEVEL	Activates level entry.
MOD ON/OFF	Switches the modulation on and off.
RF ON/OFF	Switches the RF output on and off.

2.2.1.5 Keypad

The keypad enables you to enter alphanumeric parameters, including the corresponding units. It contains the following keys:

Table 2-3: Keys on the keypad

Type of key	Description
Alphanumeric keys	Enter numbers and (special) characters in edit dialog boxes.
Decimal point	Inserts a decimal point "." at the cursor position.
Sign key	Changes the sign of a numeric parameter. In the case of an alphanumeric parameter, inserts a "-" at the cursor position.
Unit keys (G/n dBµV, M/µ µV, k/m mV and x1 dB(m))	These keys add the selected unit to the entered numeric value and complete the entry. In the case of level entries (e.g. in dB) or dimensionless values, all units have the value "1" as multiplying factor. Thus, they have the same function as an ENTER key.

2.2.1.6 Navigation Controls

The navigation controls include a rotary knob, navigation keys, and the display keys. They allow you to navigate within the display or within dialog boxes.

Rotary Knob

The rotary knob has several functions:

- Increments (clockwise direction) or decrements (counterclockwise direction) the instrument parameter at a defined step width in the case of a numeric entry.
- Moves the selection, e.g. to a function block in the block diagram
- Shifts the selection bar within focused areas (e.g. lists).
- Acts like the ENTER key, when it is pressed.

Editing Keys

Editing keys enable you to confirm an entry, delete individual characters, or exit the current operation.

Table 2-4: Editing keys

Type of key	Description
ESC key	Closes all kinds of dialog boxes, if the edit mode is not active. Quits the edit mode, if the edit mode is active. In dialog boxes that contain a "Cancel" button it activates that button. For "Edit" dialog boxes the following mechanism is used: • If data entry has been started, it retains the original value and closes the dialog box. • If data entry has not been started or has been completed, it closes the dialog box.
ENTER key	Has the same effect as pressing the rotary knob • Concludes the entry of dimensionless entries. The new value is accepted. • With other entries, this key can be used instead of the default unit key. • In a dialog box, selects the default or focused element. • Calls the next dialog level. • Confirms and closes open input windows.
BACKSPACE key	Delets the character to the left of the cursor in editing mode.

Navigation Keys

As an alternative to the rotary knob or the touchscreen, you can use the navigation keys to navigate through dialog boxes, diagrams, or tables.

Table 2-5: Navigation keys

Type of key	Description
UP/DOWN Key	The UP and the DOWN key does the following: ● In a numeric edit dialog box, increase or decrease the instrument parameter. ● In a list, scroll forward and backward through the list entries. ● In a table, move the selection bar vertically. ● In windows or dialog boxes with vertical scrollbar, move the scroll-bar.
LEFT/RIGHT Key	The LEFT and the RIGHT key does the following: ● In an alphanumeric edit dialog box, move the cursor. ● In a list, scroll forward and backward through the list entries. ● In a table, move the selection bar horizontally. ● In windows or dialog boxes with horizontal scrollbar, move the scrollbar.

2.2.1.7 Display Keys

The display keys arrange different windows on the display.

Table 2-6: Display keys

Display key	Assigned functions
HOME	Returns to the initial feature screen.
NEXT WINDOW	Toggles between the entry fields in the taskbar.
ON/OFF	● 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.
UNDO	Reverts the last operation.
USER	Adds a parameter to the user menu for quick access.

2.2.1.8 USB Connector

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

Further USB interface type A (host USB) and a USB interface type B (USB IN) are available on the rear panel.

2.2.1.9 SD card slot

Slot for removable mass storage (option R&S SMAB-B85).

2.2.1.10 SENSOR

Connector for R&S NRP sensors.

The R&S SMA100B supports the use of R&S NRP power sensors in various ways including the use as a power viewer.

A power sensor is connected to the R&S SMA100B by inserting the male connector. To disconnect, pull the connector by its sleeve. You cannot disconnect the sensor simply by pulling at the cable or the rear part of the connector.

2.2.1.11 RF 50 Ω

Output of the 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 6.1.2, "Reverse Power Protection", on page 145. Nevertheless, the maximum permissible reverse power is specified in the data sheet.

The connector type depends on the installed frequency option.

Table 2-7: Overview of RF connector types depending on the frequency range

Required option	Connector type
RF: R&S SMAB-B103	N female
RF: R&S SMAB-B106	N female
RF: R&S SMAB-B112	Test port adapter, PC 3.5 mm female
RF: R&S SMAB-B120	Test port adapter, PC 3.5 mm female

NOTICE

Risk of RF connector and cable damage

If you tighten the connectors too strongly, you can damage the cables and connectors. If you do not tighten the connectors enough, the measurement results can be inaccurate.

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 SMA100B data sheet or product brochure.

2.2.1.12 Pulse Signal Connectors

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

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

See Chapter 4.4.1, "Pulse Modulation", on page 77.

PULSE EXT
Input for an external pulse modulation signal or an external trigger/gate signal for the pulse generator.

2.2.1.13 LF Modulation Connectors

LF
Output for internal LF generator signal.

See also data sheet and user manual, section "Analog Modulation".

EXT 1/2
Inputs for external analog modulation signal, and an external detector voltage.

See Chapter 4, "Analog Modulations", on page 74.

2.2.1.14 Clock Synthesizer Connectors

CLK SYNC/CLK SYNC N
Connectors for output of the clock synthesizer signal, or the inverted signal.

2.2.2 Rear Panel Tour

This section provides an overview of the connectors at the rear panel of the instrument. For technical data of the connectors, refer to the data sheet.

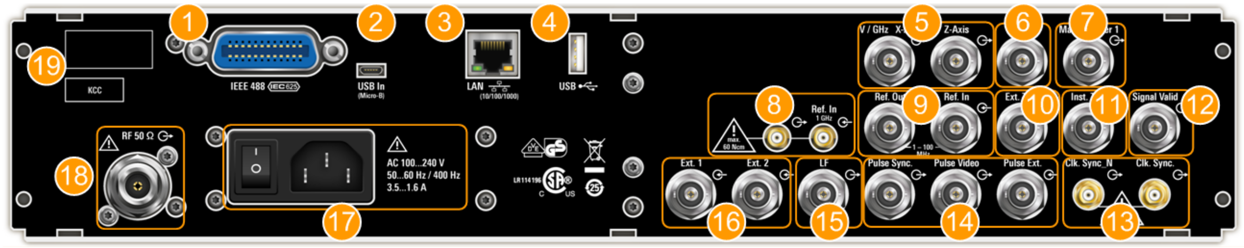


Figure 2-4: Rear panel view of the R&S SMA100B RF Signal Generator with height unit 2HU (option R&S SMAB-B92)

1 = IEC 625/IEEE 488 connector
2 = USB IN connector (type micro-B)
3 = LAN connector
4 = USB connector (type A)
5 = V/GHZ X-AXIS and Z-AXIS output connectors (BNC)
6 = STOP input and output connector (BNC)
7 = MARKER USER1 output connector (BNC)
8 = REF IN 1GHz and REF OUT 1GHz connectors (SMA)
9 = REF IN and REF OUT connectors (BNC)
10 = EFC input connector (BNC)
11 = INST TRIG input connector (BNC)
12 = SIGNAL VALID output connector (BNC)
13 = CLK SYNC and CLK SYNC N output connectors (SMA)
14 = PULSE SYNC, PULSE VIDEO and PULSE EXT connectors (BNC)
15 = LF output connector (BNC)
16 = EXT 1/2 input connectors (BNC)
17 = AC power supply connection and main power switch
18 = RF output connector
19 = Serial number (last six digits in the string 1419.8888.02-<serial number>)

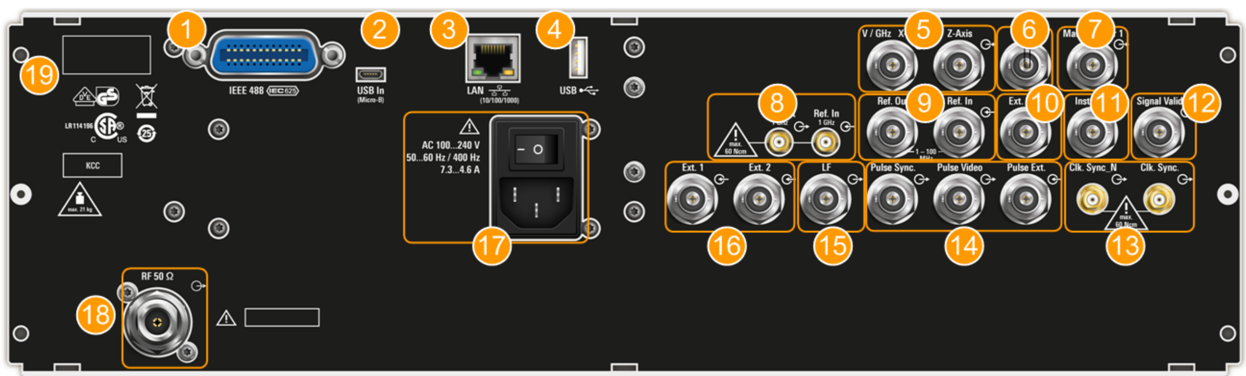


Figure 2-5: Rear panel view of the R&S SMA100B RF Signal Generator with height unit 3HU (option R&S SMAB-B93)

1 = IEC 625/IEEE 488 connector
2 = USB IN connector (type micro-B)
3 = LAN connector
4 = USB connector (type A)
5 = V/GHZ X-AXIS and Z-AXIS output connectors (BNC)
6 = STOP input and output connector (BNC)
7 = MARKER USER1 output connector (BNC)
8 = REF IN 1GHz and REF OUT 1GHz connectors (SMA)
9 = REF IN and REF OUT connectors (BNC)
10 = EFC input connector (BNC)
11 = INST TRIG input connector (BNC)

12 = SIGNAL VALID output connector (BNC)
13 = CLK SYNC and CLK SYNC N output connectors (SMA)
14 = PULSE SYNC, PULSE VIDEO and PULSE EXT connectors (BNC)
15 = LF output connector (BNC)
16 = EXT 1/2 input connectors (BNC)
17 = AC power supply connection and main power switch
18 = RF output connector
19 = Serial number (last six digits in the string 1419.8888.02-<serial number>)

2.2.2.1 Connectors

IEC 625/IEEE 488
Option: R&S SMAB-B86

GPIB-bus interface for remote control of the instrument.

The IEC 625 interface is in compliance with IEEE488 and SCPI. A computer for remote control can be connected via this interface. To set up the connection, we recommend that you use a shielded cable.

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

See also Chapter B.1, "GPIB-Bus Interface", on page 532 and Chapter 11, "Network Operation and Remote Control", on page 243.

USB/USB IN
- Female USB type A connector, to connect devices like a keyboard, a mouse, a memory stick, or the R&S NRP-Z3/Z4 cable for the R&S NRP sensors
- Female USB IN connector (USB type B), for example for remote control.
  Option: R&S SMAB-B86

See also Chapter 2.1.2, "Connecting USB Devices", on page 25.

LAN
The LAN interface can be used to connect the R&S SMA100B to a local network for remote control, remote operation, and data transfer.

For details, see Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 26.

V/GHZ X-AXIS
Output of a voltage ramp:
- "V / GHz": the voltage is proportional to the frequency.
- "X-Axis": output of a voltage ramp for the X deflection of an oscilloscope or an XY recorder.

Z-AXIS
Output of a voltage pulse, e.g. for the combined blanking and marker generation of network analyzers.

STOP
Input and output for stopping the sweep in all modes.

This connector is bidirectional. Used as:
- "Input": enables you to stop a sweep triggered by an external network analyzer.

- "Output": enables the R&S SMA100B to stop the sweep of an external network analyzer.

MARKER USER1
Output signal for marker or trigger signal.

SIGNAL VALID
Output signal that marks the valid signal times (valid level and frequency) for all analog modulations.

INST TRIG
Input for external trigger of sweeps and list mode.

For detailed information on the sweep modes and the triggering, see Chapter 5.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 110.

EFC
Input connector for an EFC (external frequency control) signal for electronic tuning of the internal reference frequency.

See Chapter 7, "Reference Oscillator", on page 174.

REF IN/REF OUT
Input/output for external reference signal.

Incl. dedicated connectors for the 1GHz reference signal.

See Chapter 7, "Reference Oscillator", on page 174.

CLK SYNC/CLK SYNC N
Connectors for output of the clock synthesizer signal, or the inverted signal.

PULSE EXT
Input for an external pulse modulation signal or an external trigger/gate signal for the pulse generator.

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

See Chapter 4.4.1, "Pulse Modulation", on page 77.

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

LF
Output for internal LF generator signal.

See also data sheet and user manual, section "Analog Modulation".

EXT 1/2
Inputs for external analog modulation signal, and an external detector voltage.

See Chapter 4, "Analog Modulations", on page 74.

AC supply and power switch
The AC power supply connector and the main power switch are located in a unit on the rear panel of the instrument.

Main power switch function:
- Position 1: The instrument is in operation.
- Position 0: The entire instrument is disconnected from the AC power supply.

For details, refer to Chapter 2.1.1.6, "Turning the Instrument On and Off", on page 23.

RF
Rear panel connector for the RF signal. This connector is for use of the instrument in a 19" rack.

2.3 Trying Out the Instrument

This chapter introduces the first steps with the R&S SMA100B. It shows how to operate and configure the instrument using simple examples. The complete description of the functionality and its usage is given in the R&S SMA100B user manual. Basic instrument operation is described in Chapter 2.4, "Instrument Control", on page 51.

Prerequisites

The instrument is set up, connected to the power supply, and started up as described in Chapter 2.1, "Preparing for Use", on page 19.

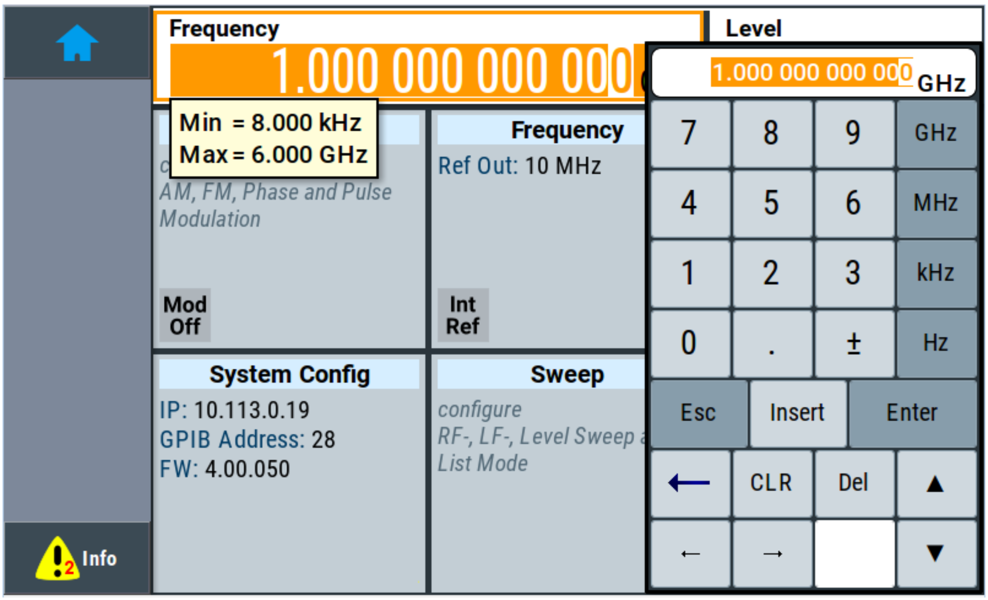
The first signal generation tasks explain how to generate an unmodulated signal, to configure the RF signal output, and how you can vary the RF frequency and level in sweep mode.

The instrument is manually operated via the touchscreen. Try out the following:

2.3.1 Generating an Unmodulated Carrier

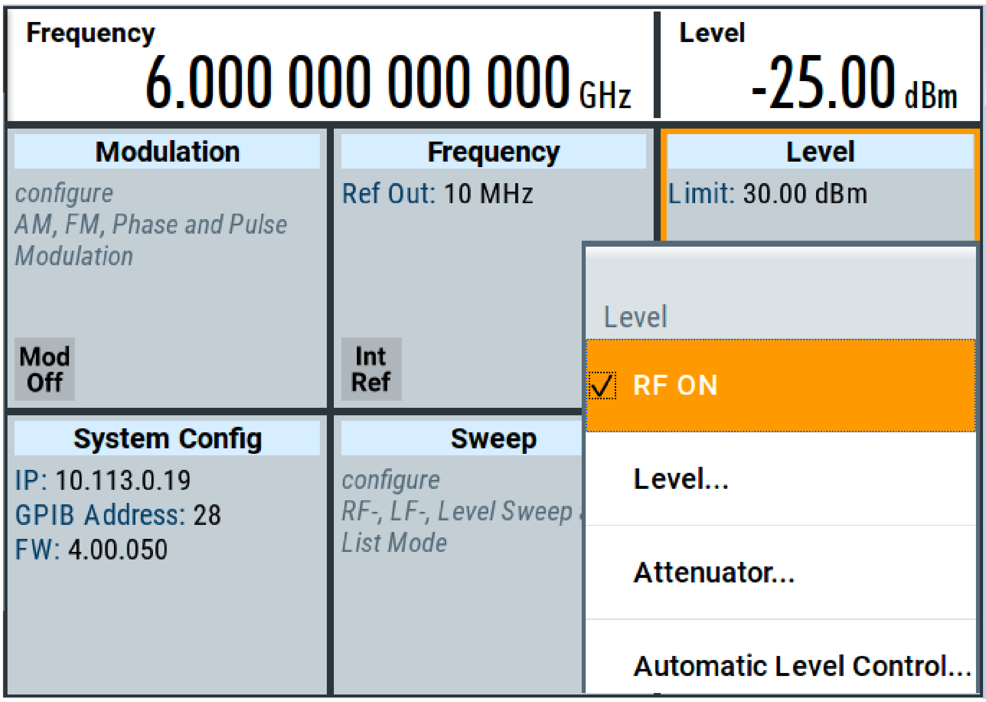
We start to generate a simple unmodulated signal. In this example, the R&S SMA100B can be in its minimal configuration.

1. On the R&S SMA100B front panel, press the PRESET key to set a defined initial instrument state.
2. Set the frequency:
   a) In the "Status Bar", tap the "Frequency" field.
   b) On the on-screen keypad, enter "6" and press the "GHz" key.



The on-screen key pad closes and the frequency value is displayed.

3. To set the signal level, tap the "Level" field and enter the level in the same way.
4. To activate RF signal output, select "Level" > "RF On" in the tile diagram.



The blue colored "RF On" icon indicates that the RF output is activated.

The R&S SMA100B provides the 6 GHz signal at the RF A connector at the front panel.

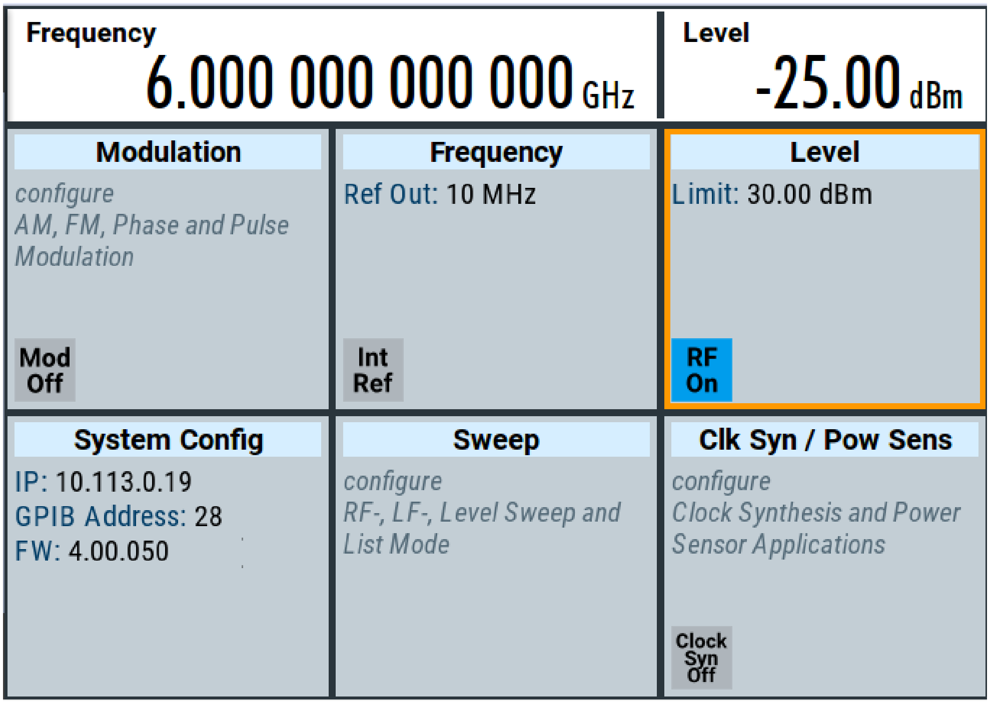


Figure 2-6: Generating an unmodulated signal

Alternative ways to access the instrument functions

To fulfill the same task, you can also use the front panel keys or the setting parameters provided in the frequency and level dialogs.

Try out the settings dialogs

1. In the "Frequency" tile, select "Frequency > RF Frequency".
   a) Tap the "Frequency" field.
   b) Set the frequency via the on-screen keypad.
2. Access the "RF Level" dialog via the "Level" tile.
   a) In the "RF Level" tab, select "Amplitude".
   b) Set the amplitude (level) via the on-screen keypad.
3. Select "RF State > On" to activate the RF signal generation.

See Chapter 3, "RF Signal Configuration", on page 62.

Try out the front panel keys

► Use the FREQ, LEVEL, and RF ON/OFF key on the front panel.

Connect RF of the R&S SMA100B to a signal analyzer, for example R&S®FSW, to display the generated signal.

For the required settings of the signal analyzer, refer to its user manual or its online help.

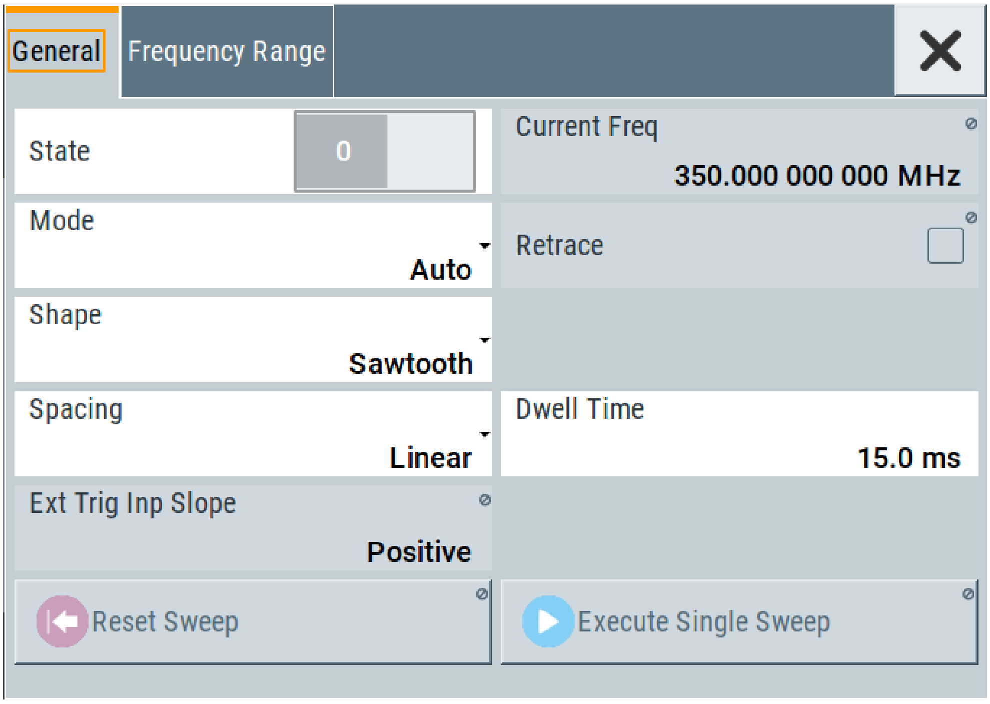
2.3.2 Generating an RF Frequency Sweep Signal

The "Sweep" operating mode allows you to generate an RF signal with periodically varying frequencies or amplitudes.

This example deals with an RF signal with varying frequency and constant level. To configure the sweep, you need to determine a defined start and end frequency with constant time intervals between the frequency steps.

The sweep function does not require specific options.

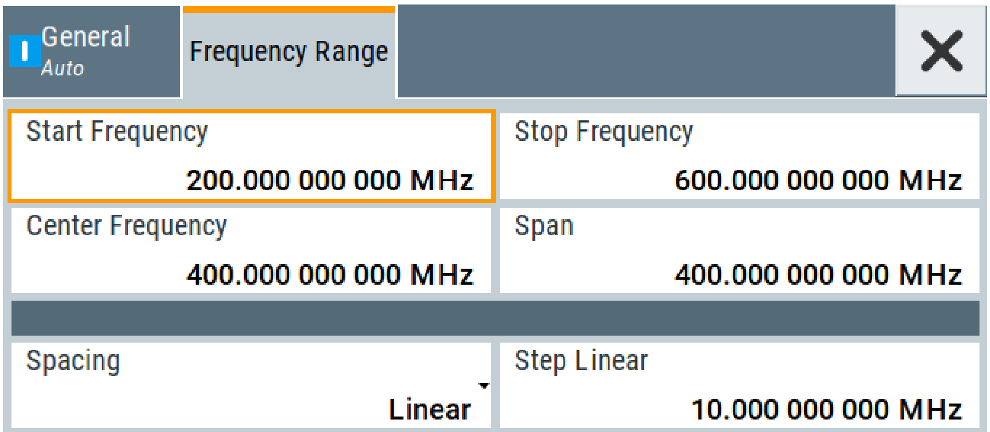
1. On the front panel, press the PRESET key to set a defined initial instrument state.
2. In the status bar, set "Frequency > 6 GHz".
3. Set "Level > -25 dBm".
4. In the tile diagram, select "Sweep" > "RF Frequency Sweep".
5. In the "General" tab:



   a) Select "Mode > Auto" to run the sweep continuously.
   b) Select "Shape > Sawtooth" to set the waveform shape of the sweep signal.

c) Select "Spacing > Linear", to determine the calculation method for the frequency shift of a step.
d) Set "Dwell Time > 15.0 ms", to determine the time interval of the sweep steps.

6. Select the "Frequency Range" tab.



a) Set "Start Freq > 200 MHz" and "Stop Freq > 600 MHz" to determine the frequency sweep range.
b) Set the step width "Step Lin > 10.0 MHz" to determine the width for a frequency step.

7. In the "General" tab, activate the frequency sweep with "State > On".

8. Close the sweep dialog.
(Alternatively, tap the "Home" button to minimize the dialog. The R&S SMA100B indicates the "Sweep" dialog as active dialog in the task bar.)

9. To activate the RF signal output, select "Level" > "RF On".

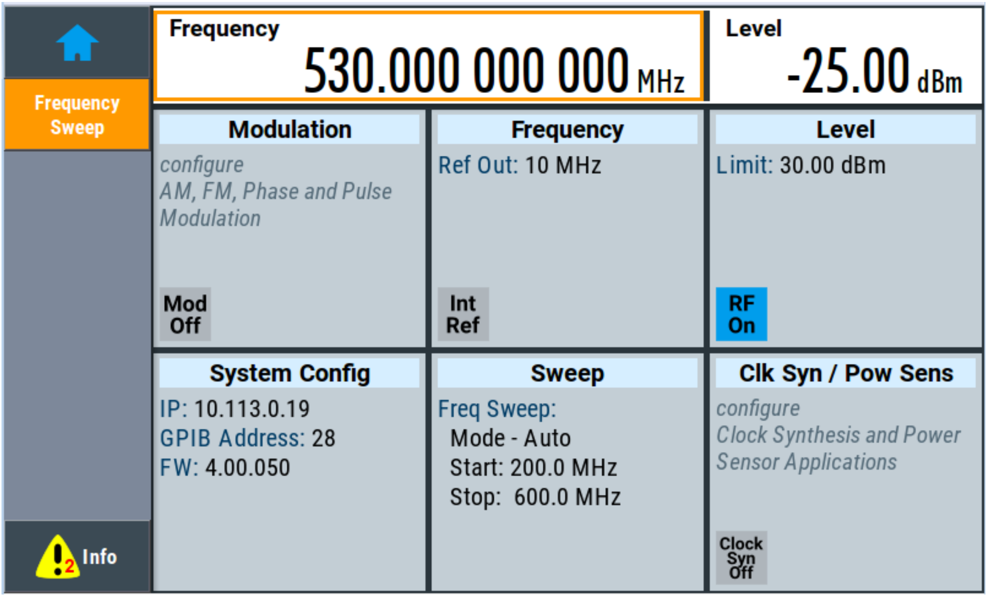


Figure 2-7: Generating a frequency sweep signal

The frequency display indicates the frequencies of the running sweep.
The R&S SMA100B provides the 6 GHz signal at the RF connector at the front panel.

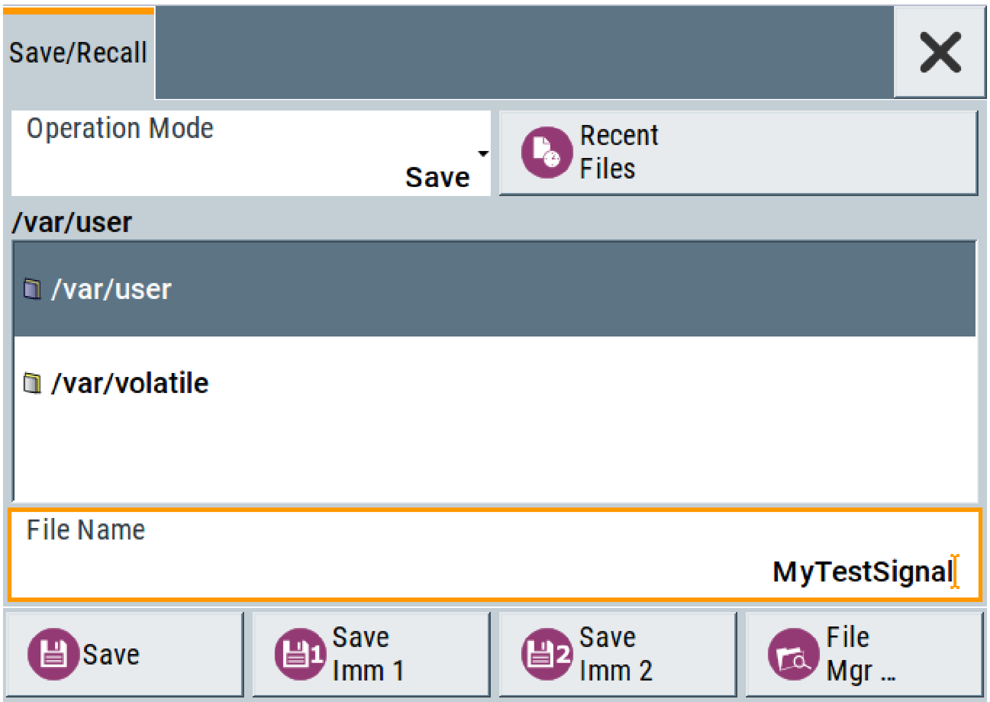
2.3.3 Saving and Recalling Settings

To restore the results of our measurements later, we save the instrument settings in a file.

To save the instrument settings in a file

We assume, a test configuration as described in Chapter 2.3.2, "Generating an RF Frequency Sweep Signal", on page 46.

1. Press the SETUP key on the front panel.
2. In the "Setup" menu, select "Settings > Save/Recall".
3. In the "Save/Recall" dialog, select "Operation Mode > Save".



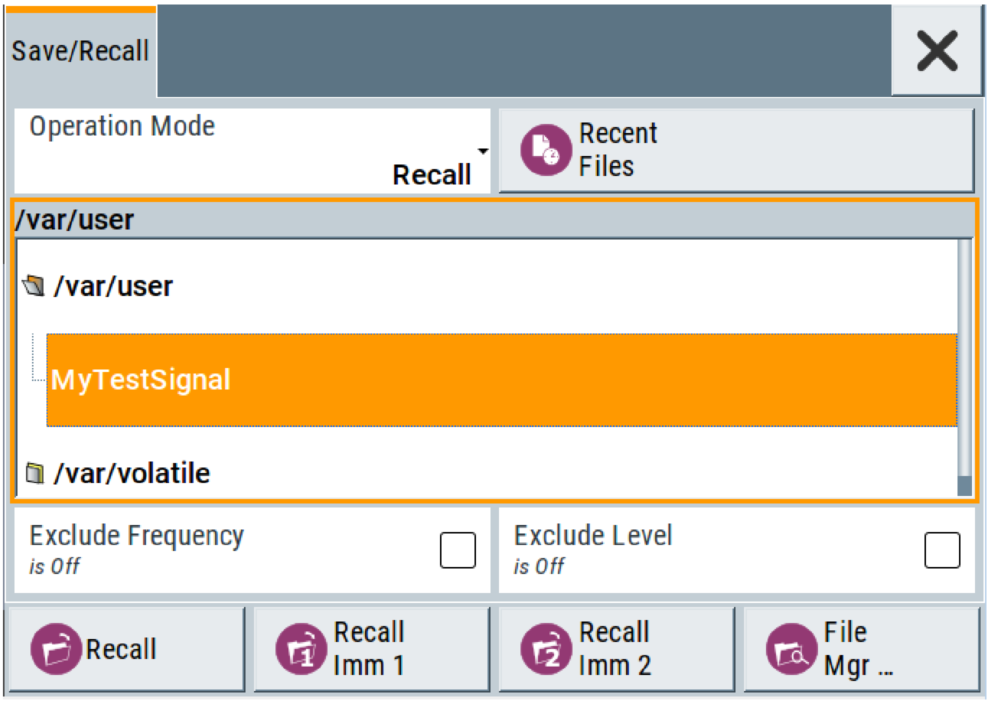
4. Tap the "Filename", use the on-screen keyboard, and enter *MyTestSignal*.
5. Tap the "Save" button.

   The file `MyTestSignal.savrcltxt` is stored in the default directory `/var/user/`.

To load saved instrument settings

You can restore the settings to the instrument at any time using the settings file.

1. Press the PRESET button to restore the default instrument settings so you can check that the stored user settings are restored afterwards.
2. Press the SETUP key on the front panel.
3. In the "Setup" menu, select "Settings > Save/Recall".
4. In the "Save/Recall" dialog, select "Operation Mode > Recall".
   Navigate to the directory the file is saved in and select the `MyTestSignal` file.



5. Tap the "Recall" button.

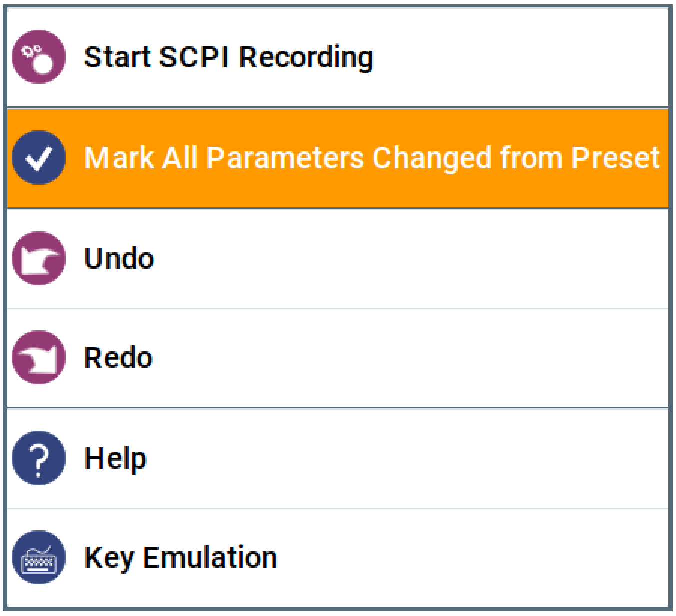
   All instrument settings are restored and the display resembles Chapter 2.3.2, "Generating an RF Frequency Sweep Signal", on page 46, which shows the instrument display right before the settings were saved.

How to display all parameters with values different to their preset values

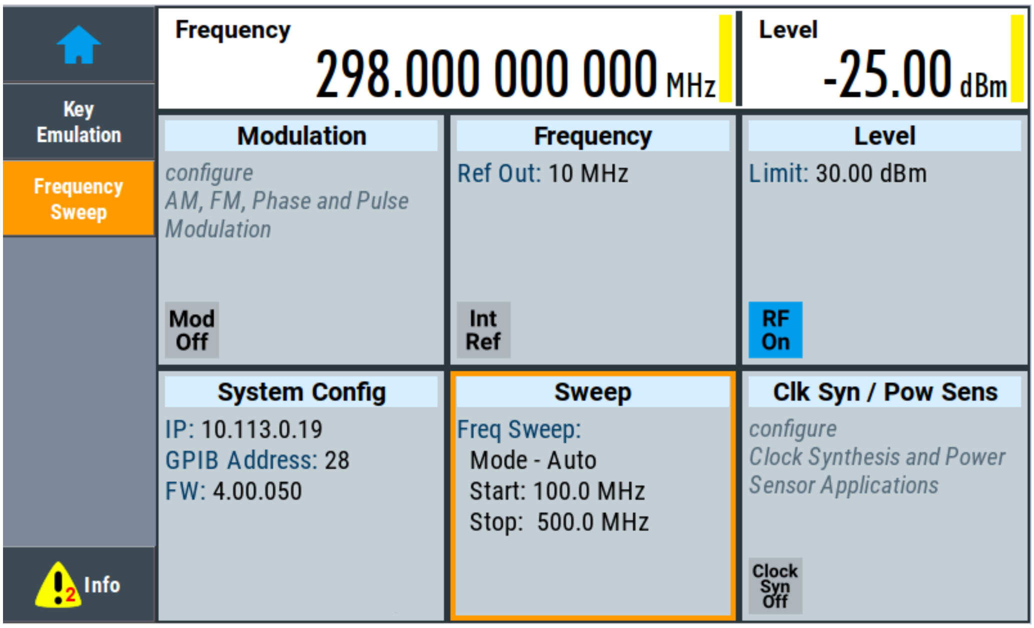
When you load a file to your instrument, you do not have enough information on the changed settings. In such case, it is useful to visualize all parameters that have been changed from their default state.

Try out the following:

- Tap and hold on an empty space on in the tile diagram to access the context-sensitive menu.
- Select "Mark All Parameters Changed from Preset".



- All changed parameters are highlighted.



See also Chapter 9, "File and Data Management", on page 187.

2.4 Instrument Control

This chapter provides an overview on how to work with the R&S SMA100B.

It covers the following topics:

2.4.1 Possible Ways to Operate the Instrument

There are three ways to operate the R&S SMA100B:

- Manual operation:
  Use the touchscreen, hard keys and rotary knob, or an optional mouse and/or keyboard. The principles of manual operation are explained in Chapter 2.4, "Instrument Control", on page 51.
- Remote control:
  Create programs to automatize repeating settings, tests and measurements. The instrument is connected to a computer running the program.
  This way of operation is described in Chapter 11, "Network Operation and Remote Control", on page 243.
- Remote operation from a computer:
  Remote monitoring and control of the instrument from a connected computer is based on the common cross-platform technology VNC (Virtual Network Computing). On the remote computer, any standard web browser (supporting Java) or a dedicated VNC client (like Ultr@VNC) can be used. See also Chapter 2.4.8, "Remote Operation over VNC", on page 60.

2.4.2 Means of Manual Interaction

For the manual interaction with the R&S SMA100B, you have several methods that you can use as an alternative to perform a task:

- Touchscreen:
  Touchscreen operation is the most direct way to interact. Almost all control elements and actions on the screen are based on the standard operating system concept. You can tap any user interface element to set parameters in dialog boxes, enter data, scroll within a dialog etc., as if you work with a mouse pointer.

  Tapping the screen works like clicking mouse buttons:

  – Touch quickly = click: Selects a parameter or provokes an action.
  – Touch and hold = right-click: Opens a context-sensitive menu.
  – Touch and swipe = drag: Scrolls through the contents of a display element larger than the screen, e.g. a list or a table.
- Function keys and rotary knob:
  The front panel provides nearly all functions and controls to operate the instrument in the classic way, without touchscreen.

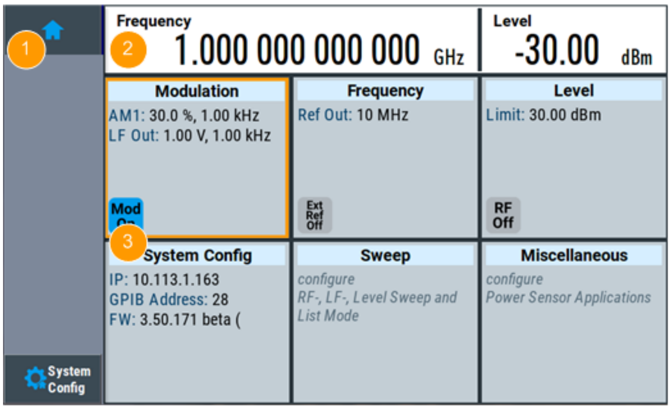
- Optional mouse and/or keyboard:
  These devices work like known from PCs. The navigation keys on the front panel correspond to the keys on the keyboard.

This manual describes the manual interaction with the instrument via the touchscreen. It mentions the alternative methods using the keys on the instrument or the on-screen keyboard if it deviates from the standard operating procedures. The usage of the touchscreen and navigation keys is described in Chapter 2.4.4, "Accessing the Functionality", on page 56.

Throughout the manual, the term "select" refers to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

2.4.3 Understanding the Display Information

The home screen of the R&S SMA100B displays all main settings and generator states, divided into three main operation areas.



1 = Taskbar/softkey bar with "Home" and "System Config" key
2 = Status bar
3 = Tile diagram

2.4.3.1 Status Bar

The status bar at the top of the screen indicates the RF frequency and the level of the output signal provided to the DUT. You can set both parameters directly here.

2.4.3.2 Tile Diagram

The tile diagram is the main entry to the settings of the R&S SMA100B.

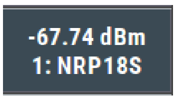
Tile	Access to:
"Modulation"	• Analog and pulse modulation settings[1)] • Built in LF generator
"System Config"	• "Save/Recall": settings for saving and loading instrument configurations • "Remote access": Network and emulation settings. • "Setup": general system configuration
"Sweep"	• Frequency and level sweeps • List mode
"Frequency"	• RF frequency and phase • Reference frequency
"Level"	• RF level • Attenuator • Automatic level control • User correction
"Clk Syn / Pow Sens"	• Clock synthesis[1)] • Power sensors
[1)] requires additional options	

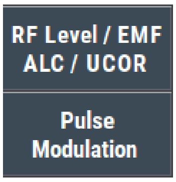
2.4.3.3 Taskbar

The "Taskbar" shows a home and an info button, and assigns a labeled button whenever you open a dialog. If more dialogs are open than the taskbar can display, touch and swipe the taskbar to scroll up and down.

The buttons shown in the following example represent the variants.

Table 2-8: Example of buttons in the taskbar

	"Home" button Returns to the home screen.
	"User Menu" Lists parameters that can be defined for quick access.
	Shows the current remote access connections when the instrument is remotely controlled. **Tip:** An indicator in the "System Config" tile shows the current remote control status.
	R&S NRP power sensors Shows a connected external power sensor. The button displays the current readings when the sensor is active.



Active dialogs

Indicates the dialog name of each active dialog in a separate button.

"Info" key

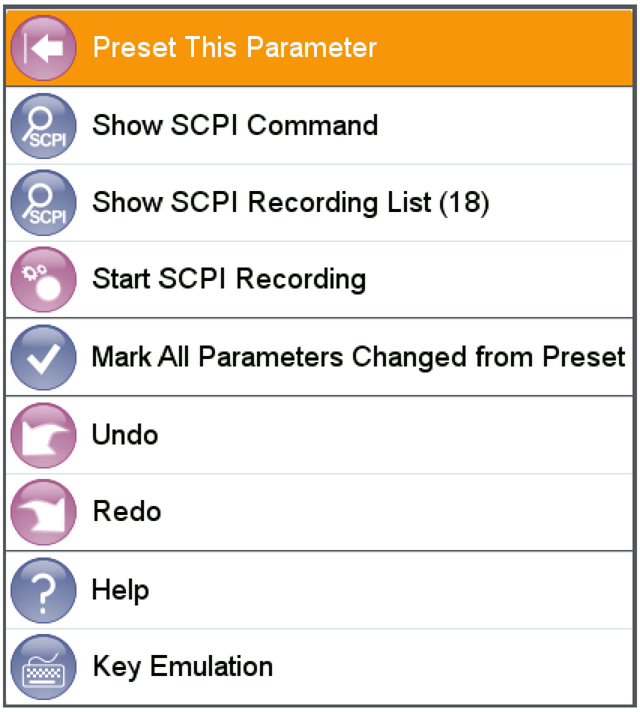
Provides access to status and error messages.

Note: The warning symbol signifies a permanent error message.

2.4.3.4 Additional Display Characteristics

The following section provides a short insight on the indication of the screen in general, and significant elements that you see under specific operating modes, in dialogs or settings.

- **Appearance of active elements**
  - *Active* elements like On/Off switches, state buttons, etc. have a **blue** background
  - *Selected* elements are framed or highlighted **orange**.
  - *Inactive* elements are **gray**
- **On-Screen keypads**
  As additional means of interacting with the instrument without having to connect an external keyboard, either a numerical or alphanumerical on-screen keypad appears when you activate an entry field (see Chapter 2.4.5, "Entering Data", on page 57).
- **Info line**
  The "Info line" shows brief status information and error messages. It appears when an event generates a message.
- **Key parameters indicated in tab labels**
  Most dialogs are divided into tabs with logically grouped parameters. The tab label expresses the content and can also contain status indicators or the set value of a key parameter.
- **Scroll bar handle**
  An arrow icon that appears when you touch a scroll bar helps you to scroll in a dialog or list.
  If no scrollbar handle appears, you can touch and swipe an element to scroll up and down.
- **Context-sensitive menus**
  Within the entire screen display, including single parameters, you can access context-sensitive menus that provide some additional functions.



2.4.4 Accessing the Functionality

All functionalities are provided in dialog boxes as known from computer programs. You can control the instrument intuitively with the touchscreen. This section provides an overview of the accessing methods.

The instrument's functions and settings can be accessed by selecting one of the following elements:

- System and function keys on the front panel of the instrument
- Taskbar/softkeys on the touchscreen
- Context-sensitive menus for specific elements on the touchscreen
- Elements on the status bar in the touchscreen
- Displayed setting on the touchscreen, that means block diagram and all settings available in dialogs.

To open a dialog box

► Perform one of the following actions:
  - Tap the required tile, and then the menu entry.
  - Tap the minimized view (button) on the taskbar.

  Some of the utility keys access a dedicated dialog, too.

To minimize a dialog box

1. To return to the home screen, tap the "Home" button.

2. To switch to another dialog, press the NEXT WINDOW button.

To close a dialog box

► Tap the "Close" icon in the upper right corner.
Or:
Press the ESC key on the front panel.

To select an option in a dialog box

► Tap the required option.

2.4.5 Entering Data

Some parameters have their own key on the front panel.

For data input in dialog boxes, the instrument provides an on-screen keypad for numeric values, and an on-screen keyboard for alphanumeric settings. Thus, you can always set the parameters via the touchscreen, the front panel, or an external keyboard.

Correcting an entry

1. Using the arrow keys, move the cursor to the right of the entry you want to delete.
2. Press the BACKSPACE key.
3. Deletes the entry to the left of the cursor.
4. Enter your correction.

Completing the entry

► Press the ENTER key or the rotary knob.

Aborting the entry

► Press the ESC key.
The dialog box closes without changing the settings.

2.4.5.1 Entering Numeric Parameters

To enter values with the on-screen keypad

If a field requires numeric input, the keypad provides only numbers. The provided units correspond to the units of the parameter.

1. Enter the numeric value.
2. Tap the unit button to complete the entry.

The unit is added to the entry.

3. If the parameter does not require a unit, confirm the entered value by pressing "Enter".

To enter values by using the front panel controls

1. Change the currently used parameter value by using the rotary knob (small steps) or the UP/DOWN keys (large steps).
2. If the parameter does not require a unit, confirm the entered value by pressing the ENTER key or any of the unit keys.
   The instrument highlights the editing line to confirm the entry.

If you edit numeric data in tables, the entry field must be in edit mode: Press ENTER, or the rotary knob to activate the edit mode.

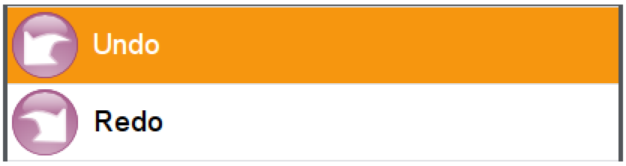
2.4.5.2 Entering Alphanumeric Parameters

If a field requires alphanumeric input, you can use the on-screen keyboard to enter numbers and (special) characters.

The interaction with the on-screen keyboard is as tipping on a connected keyboard.

2.4.5.3 Undo and Redo Actions

Accessed via the context-sensitive menus, "Undo" allows you to restore one or more actions on the instrument. Depending on the available memory, the "Undo" steps can restore all actions.



"Redo" restores a previously undone action.

2.4.6 Getting Information and Help

In some dialog boxes, graphics are included to explain the way a setting works.

For further information, you can use the following sources:

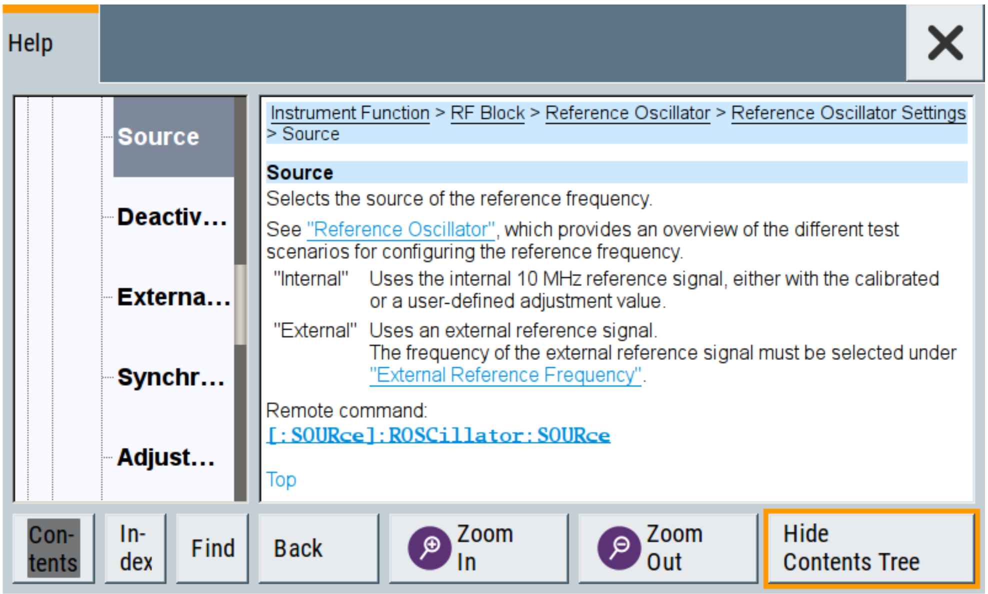
- Tooltips give the value range of the parameter.
- The context help provides functional description on a setting.
- The general help explains a dialog box, provides instructions, and general information.

To display context help

► To access a help topic, perform one of the following:

a) Tap and hold the parameter for which you need information and tap "Help" in the context menu.
b) Tap the parameter and press the HELP key.

The "Help" dialog opens. You can browse the help for further information.



Contents of the help dialog box

The help dialog box covers two main areas:

- "Contents" - contains a table of help contents
- "Topic" - contains a specific help topic

The help system also provides an "Index" and a "Find" area, and "Zoom" functions that are accessed via the corresponding buttons.

To open general help

► Press the yellow HELP key on the front panel.

If a dialog box is opened, the help topic for the current tab is shown. Otherwise the "Contents" page appears.

Navigating in the table of contents and in the help topics

1. To move through the displayed contents entries, tap on an entry and scroll or use a connected mouse or the UP/DOWN keys.
   Entries with a plus sign contain further entries.
2. To display a help topic, tap on the topic name or double click on the topic name or press the ENTER key.
3. To follow a cross-reference, tap on the link text.

4. To return to the previous page, select "Back".
   This function scrolls back all steps you have performed before.
5. Use the "scroll bars" to shift the visible section of content shown.
6. To maximize the "Topics" area, tap the "Hide Contents Tree" button to hide the contents tree.

Using the index

1. Select the "Index" button.
2. Enter the first characters of the topic you are interested in.
   The entries starting with these characters are displayed.
3. Tap on the index entry.
   The corresponding help topic is displayed.

2.4.7 Remote Control

In addition to working with the R&S SMA100B interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC.

The R&S SMA100B supports various methods for remote control:

- Connecting the instrument to a (LAN) network (see Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 26)
- 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

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.

How to configure the remote control interfaces is described in Chapter 11, "Network Operation and Remote Control", on page 243.

2.4.8 Remote Operation over VNC

The VNC is an application which can be used to access and control the instrument from a remote computer through a LAN connection. While the instrument is in operation, the instrument screen contents are displayed on the remote computer, and VNC provides access to all applications, files, and network resources of the instrument. Thus, remote operation of the instrument is possible.

Instrument control from a remote computer

To access the basic utility functions of the R&S SMA100B, perform a right mouse click on the block diagram and select "Key Emulation".

A key panel to the right of the block diagram gives access to the utility functions provided by the front panel keys.

The VNC is an add-on program, included in operating system Linux/Unix, and available as a free-of-charge download on the internet.

For more information, refer to Chapter 11.16, "How to Set Up Remote Operation via VNC", on page 294.

3 RF Signal Configuration

The R&S SMA100B signal generator generates RF signals with outstanding spectral purity within the frequency range from 8 kHz up to 6 GHz and with adjustable signal level over a wide range.

In addition to these real-time CW signals, you can also generate RF signals from pre-defined lists and sweep signals that vary according to the frequency or amplitude curves.

Moreover, you can apply versatile analog modulation types with definable characteristics.

The variably adjustable output level due to the built-in attenuator, allows you to vary the RF signal level over the full level range. There are different methods to improve signal performance and to optimize the signal quality for the particular application, or to increase the accuracy and reliability of the generated RF signal.

In addition, the R&S SMA100B supports R&S NRP power sensors. Power sensors can be used to monitor the output level in the generator and to determine the level correction values for user correction lists.

Signal modes and characteristics

The R&S SMA100B generates unmodulated or analog modulated RF signals. You can output the signal in fixed mode or as a signal having periodically varying frequencies or amplitudes.

Signal modes for RF signal generation:

- Unmodulated signal
  Generates an unmodulated continuous wave (CW) of constant frequency and amplitude.

  For information on the signal frequency and level settings and example on how to configure a simple CW signal, see:
  - Chapter 3.3, "RF Frequency Settings", on page 65
  - Chapter 3.4, "RF Level Settings", on page 67
  - Chapter 2.3.1, "Generating an Unmodulated Carrier", on page 43
- Analog modulated signal
  Modulates the signal with an analog signal and generates amplitude, phase, frequency and pulse modulation.
  See Chapter 4, "Analog Modulations", on page 74.

RF signal output modes:

- Fixed
  The RF signal as it is, that means modulated or unmodulated.
- Sweep
  An RF or LF frequency and RF level sweep signal, processed continuously, step-by-step or individually and with selectable trigger modes. Different sweeps cannot run simultaneously.
- List mode

Generates RF signal based on a list of predefined frequency and level values pairs and step widths.

See Chapter 5, "Varying the RF Signal in List or Sweep Mode", on page 109.

3.1 Activating RF Signal Output

Per default, the RF output signal is deactivated.

To activate the RF output

1. Configure the RF signal as required.
   Set for example the frequency and level values.
2. Activate the RF output in one of the following ways:
   a) Select "Level > RF ON > On"
   b) Press the RF ON/OFF key at the front panel.
3. In the "Level" tile, observe the color of the "RF On" icon.

   The blue color indicates that the RF output is activated.

RF State/RF ON
Activates or deactivates the RF output.

Acts as the RF ON/OFF key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 347

RF output impedance
You can query the impedance of the RF output.

Remote command:
`:OUTPut<hw>:IMPedance?` on page 348

3.2 How to Set the Frequency and Level

The simplest form of the RF signal is a continuous wave (CW) of constant frequency and amplitude. Such an unmodulated signal transmits the information without varying the carrier signal as with a modulation, for example. The RF signal is defined by its frequency, level and phase.

► Use one of the following:
- "Status Bar > Frequency and Level"
- "Frequency panel > Frequency"

- "Level panel > Level"
- "Frequency panel > Frequency > Phase"
- On the front panel, press the FREQ or the LEVEL key.

Current frequency and level values are indicated on the "Status bar" so that you can see them at a glance. Values displayed in the status bar and in the "Frequency/Level" dialogs can deviate form each other.

See "RF frequency and level display with a downstream instrument" on page 64.

RF frequency and level display with a downstream instrument

If your test setup includes a downstream instrument, you can enter the parameter of the downstream instrument in the frequency or level settings dialog of the R&S SMA100B. Examples of downstream instruments are mixers, frequency multipliers, amplifiers or attenuators and of their corresponding major parameters offset, multiplier, amplitude.

The R&S SMA100B generates the signal without the downstream parameters, but considers all additional parameters concerning the frequency and level, like frequency offset and multiplication factor, or user correction. Any of these cases is indicated by a dedicated icon, displayed in the "Frequency" or "Level" tile, depending on the affected parameter.

Figure 3-1 illustrates the calculation of the "Frequency" and "Level" values displayed in the status bar.

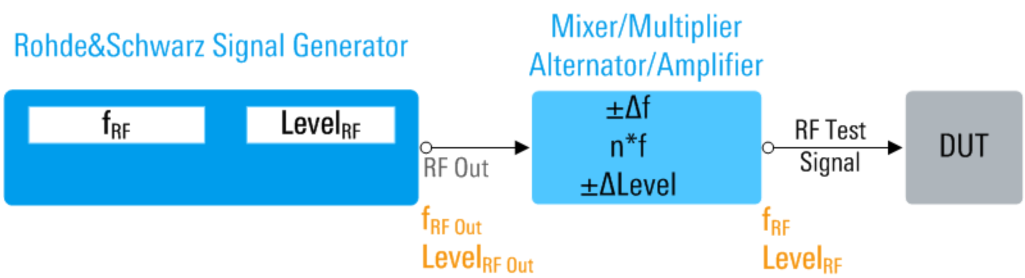


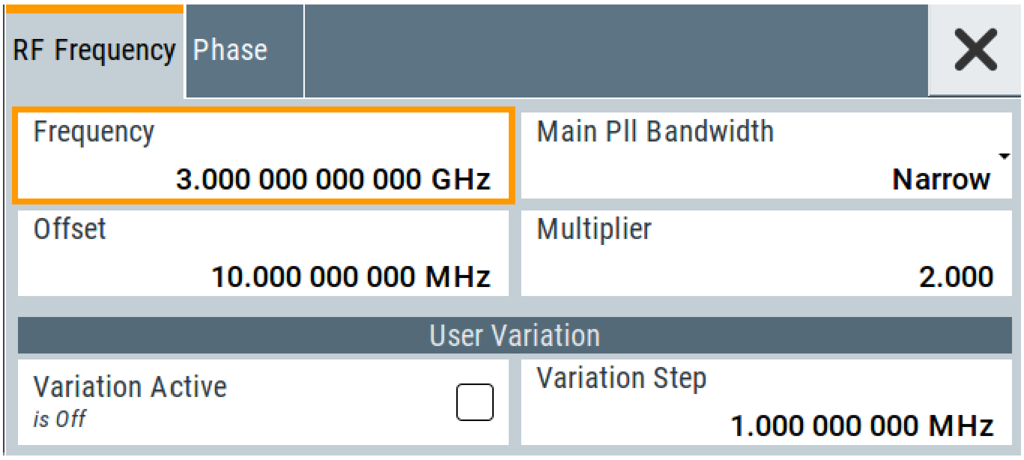
Figure 3-1: Frequency and Level display vs frequency and level at the RF output

f_{RF}	$= n*f_{RF\ Out} + \Delta f$
$Level_{RF}$	$= Level_{RF\ Out} + \Delta Level$
f_{RF}, $Level_{RF}$	= Frequency and level at the output of the downstream instrument ("Status bar > Frequency and Level")
$f_{RF\ Out}$, $Level_{RF\ Out}$	= Frequency and level at the output connector RF ("Frequency > RF Frequency > Frequency" and "Level > RF Level > Amplitude")
n*f	= Multiplication factor ("Frequency > RF Frequency > Multiplier")
Δf	= Frequency offset ("Frequency > RF Frequency > Offset")
ΔLevel	= Power offset ("Level > RF Level > Offset")

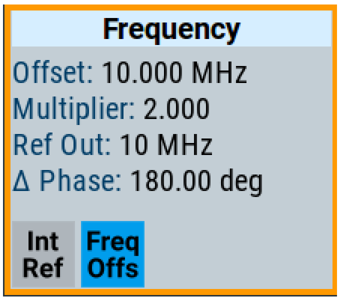
3.3 RF Frequency Settings

Access:

1. Select "Frequency" > "Frequency".



2. Observe the information on the home screen, "Frequency" tile.



The "Frequency" tile indicates the reference frequency, current frequency offset and multiplier values, and phase offset value.

In the "RF Frequency" dialog, you can configure:
- RF frequency, incl. an offset or multiplication factor of a downstream instrument
- The step size for varying the frequency with the rotary knob.

The remote commands required to define the settings are described in Chapter 12.15.3, "SOURce:FREQuency Subsystem", on page 392.

Settings

Frequency

Sets the RF frequency.

This frequency is output at the RF connector. It does not consider an Offset or multiplication factor (Multiplier).

See "RF frequency and level display with a downstream instrument" on page 64.

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
  - Annotation Amplitude
- ---.--

  The display is disabled when list mode is running, see Chapter 5, "Varying the RF Signal in List or Sweep Mode", on page 109.

Remote command:
`[:SOURce<hw>]:FREQuency[:CW|FIXed]` on page 394

Main PLL Bandwidth

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

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

"Narrow"
Sets the narrow PLL bandwidth.

Remote command:
`[:SOURce<hw>]:FREQuency:PLL:MODE` on page 399

Offset

Sets the frequency offset.

This value represents the frequency shift of a downstream instrument, like for example a mixer.

The "Frequency" value displayed in the status bar is the resulting frequency, as it is at the output of the downstream instrument. The frequency at the R&S SMA100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 64.

Remote command:
`[:SOURce<hw>]:FREQuency:OFFSet` on page 396

Multiplier

Sets the multiplication factor for the RF frequency.

This value represents the multiplication factor of a downstream instrument, like for example a multiplier.

The "Frequency" value displayed in the status bar is the resulting frequency, as it is at the output of the downstream instrument. The frequency at the R&S SMA100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 64.

Remote command:
`[:SOURce<hw>]:FREQuency:MULTiplier` on page 396

User Variation
Defines and activates a user-defined step width for varying the RF frequency or RF level with the rotary knob.

If disabled, the step width varies in steps of one unit at the cursor position.

Variation Active ← User Variation
Activates the set user-defined step width.

Remote command:
`[:SOURce<hw>]:FREQuency:STEP:MODE` on page 398
`[:SOURce<hw>]:POWer:STEP:MODE` on page 436

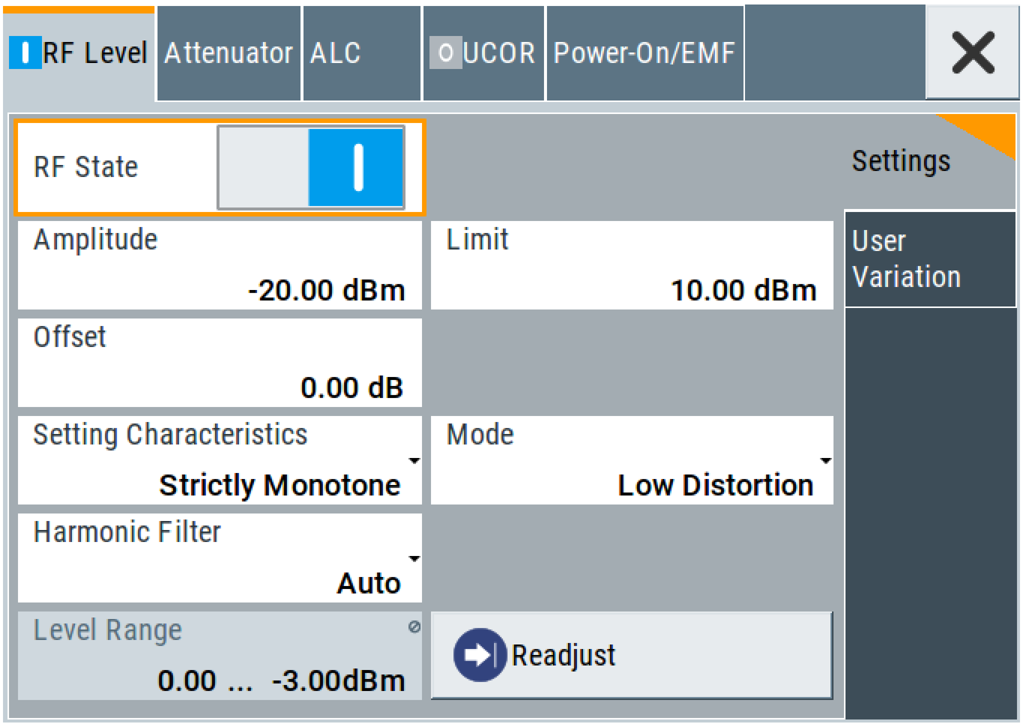
Variation Step ← User Variation
Sets the user-defined step width.

Remote command:
`[:SOURce<hw>]:FREQuency:STEP[:INCRement]` on page 399
`[:SOURce<hw>]:POWer:STEP[:INCRement]` on page 437

3.4 RF Level Settings

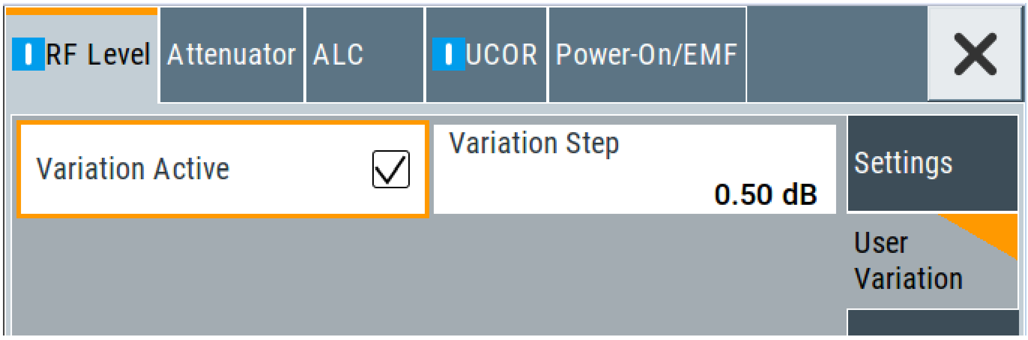
Access:

1. Select "Level" > "Level".

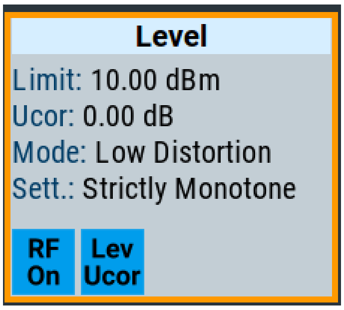


In the "RF Level" dialog, you can configure the offset-free level, the level limit, and the step width for varying the level with the rotary knob.

2. Select "User Variation" to set the step width to be used when setting the RF level using the rotary knob.



3. Observe the information on the home screen, "Level" tile.



The "Level" tile indicates the level limit, the user correction status and current correction value, current setting characteristics incl. mode.

The remote commands required to define the settings are described in Chapter 12.15.10, "SOURce:POWer Subsystem", on page 430.

Settings

RF State/RF ON

Activates or deactivates the RF output.

Acts as the RF ON/OFF key.

Remote command:
`:OUTPut<hw>[:STATe]` on page 347

Amplitude

Sets the level of the RF signal.

The value is offset-free and corresponds to the level at the RF connector.

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
  – Annotation Amplitude

- 

  The display is disabled when list mode is running, see Chapter 5, "Varying the RF Signal in List or Sweep Mode", on page 109.

See "RF frequency and level display with a downstream instrument" on page 64.

Remote command:
[:SOURce<hw>]:POWer:POWer on page 435
Note: The SCPI command [:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] sets the level of the "Level" display.
This means, the level containing offset.

Limit
Sets an upper limit for the RF output power.

You can use this value 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 the warning message:

"Pep value higher than the defined limit."

However, the level indication in the status bar is not affected.

The value is not affected by an instrument preset (PRESET key or *RST) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:
[:SOURce<hw>]:POWer:LIMit[:AMPLitude] on page 434

Offset
Sets a level offset.

This value represents the level shift of a downstream instrument, like for example a an attenuator or an amplifier.

The "Level" value displayed in the status bar is the resulting level, as it is at the output of the downstream instrument. The level at the R&S SMA100B RF output is not changed.

See "RF frequency and level display with a downstream instrument" on page 64.

Remote command:
[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet on page 437

Setting Characteristics
Selects additional quality characteristics to optimize the behavior of the RF signal level for the corresponding application.

"Auto" Sets the RF output level automatically according to the selected mode.
In this mode, the instrument provides the highest dynamic range and fastest setting times, as specified in the data sheet.
The RF signal is shortly blanked when the step attenuator is switching.

"Uninterrupted Level Settings"
Suppresses blanking at frequency and level transitions.
This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

"Strictly Monotone"
Executes signal level changes monotonically increasing or decreasing.
The setting makes sure that increasing the level value exclusively results in an increased output level, and vice versa.
All electronic switches, which might affect the monotonicity are fixed.
The operation mode is useful for applications using level searching algorithms which rely on a strictly monotonous behavior.

"Constant-VSWR"
Suppresses output impedance variations at the RF output connector, due to changed level settings.

"User" Indicates that a setting has been modified in the expert mode. The expert mode is a protected function, that requires protection level 2 password.

Remote command:
`[:SOURce<hw>]:POWer:LBEHaviour` on page 433

Mode
Allows you to optimize the RF output signal for applications, where improved harmonic distortion or improved wideband noise is required.

"Normal" Generates an RF output signal with high signal to noise ratio as well as low distortion, according to the data sheet.

"Low Noise" Optimizes the signal to noise ratio.

"Low Distortion"
Reduces distortion (harmonics) of the RF signal to a minimum.

Remote command:
`[:SOURce<hw>]:POWer:LMODe` on page 434

Harmonic Filter
Activates low harmonic filter or enables its automatic switching.

"On" Ensures best low harmonics performance but decreases the level range.

"Auto" Applies an automatically selected harmonic filter that fits to the current level setting.

Remote command:
`:OUTPut<hw>:FILTer:MODE` on page 349

Level Range
Shows the interruption-free range of the level that you can use in the currently selected mode.

Remote command:
`[:SOURce<hw>]:POWer:RANGe:LOWer?` on page 439
`[:SOURce<hw>]:POWer:RANGe:UPPer?` on page 439

Readjust

Recalculates and adjusts the internal switch positions of the RF chain according to the current level.

Remote command:
`[:SOURce<hw>]:POWer:ALC:SONCe` on page 432

User Variation

Defines and activates a user-defined step width for varying the RF frequency or RF level with the rotary knob.

If disabled, the step width varies in steps of one unit at the cursor position.

Variation Active ← User Variation

Activates the set user-defined step width.

Remote command:
`[:SOURce<hw>]:FREQuency:STEP:MODE` on page 398
`[:SOURce<hw>]:POWer:STEP:MODE` on page 436

Variation Step ← User Variation

Sets the user-defined step width.

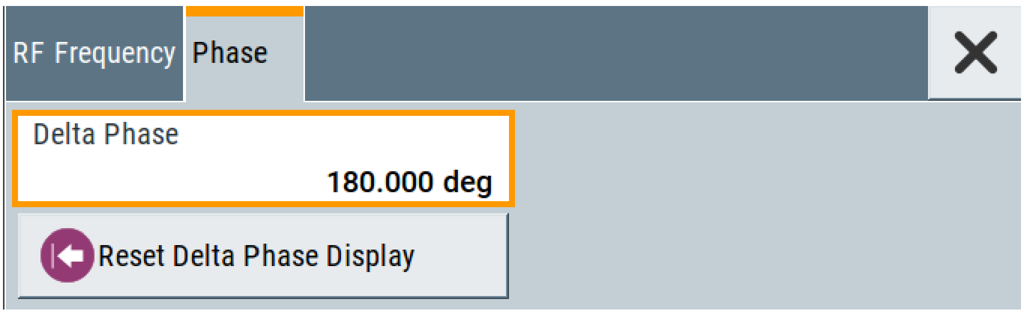
Remote command:
`[:SOURce<hw>]:FREQuency:STEP[:INCRement]` on page 399
`[:SOURce<hw>]:POWer:STEP[:INCRement]` on page 437

3.5 RF Phase Settings

The phase in sinusoidal signals defines the initial angle at its origin.

Access:

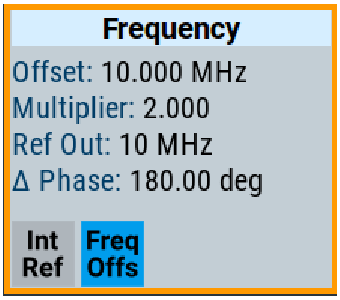
1. Select "Frequency" > "Phase".



   In the "RF Phase" tab, you can determine the delta phase value and reset the phase to this reference.

2. Observe the information on the home screen, "Frequency" tile.

   The "Frequency" tile indicates used reference frequency, current frequency offset and multiplier values, and the delta phase value.



The remote commands required to define the settings are described in Chapter 12.15.9, "SOURce:PHASe Subsystem", on page 429.

Settings

Delta Phase

Sets the phase of the RF signal.

The current phase of the signal is used as the reference.

Remote command:
`[:SOURce<hw>]:PHASe` on page 430

Reset Delta Phase Display

Adopts the selected "Delta Phase" value as the current value, and resets delta phase to 0 degrees.

Remote command:
`[:SOURce<hw>]:PHASe:REFerence` on page 430

4 Analog Modulations

The R&S SMA100B supports AM (amplitude modulation), FM (frequency modulation), ΦM (phase modulation (PhiM)), and also PULM (pulse modulation). It generates low frequency signals (LF) as sine, triangle, trapezoidal or square (pulse) waveform, that can be output and further processed by a downstream instrument.

4.1 Required Options

R&S SMA100B base unit equipped with the following options:

- Option frequency (R&S SMAB-B10x)
- Option pulse modulator (R&S SMAB-K22)
- Option pulse generator (R&S SMAB-K23)
  (supports generation of single and double pulse signals)
- Option multi-function generator (R&S SMAB-K24)
- Option pulse train generator (R&S SMAB-K27)
  (requires R&S SMAB-K23)
- Option AM/FM/PhiM, up to 6 GHz (R&S SMAB-K720)

For more information, see data sheet.

4.2 Modulation Types and Signal Sources

Radio transmitters do not transmit an audio signal directly. Instead, they modulate the audio signal onto a continuous wave (CW) carrier with much higher frequency.

A CW carrier has a sinusoidal waveform with constant amplitude and constant frequency. Modulating a signal onto the carrier means varying a property of the carrier according to the modulating signal. The three basic modulation types FM, AM and PhiM for example, vary one property of the carrier proportional to the instantaneous amplitude of the modulating signal.

Signal sources

If fully equipped, the R&S SMA100B modulates signals from the following sources:

- **Internal modulation source**
  - *Two LF generators*
    Supplie sinusoidal and square waves in the frequency range 0.1 Hz to 10 MHz and selectable shapes.
    The R&S SMA100B generates any other modulation signal shapes (triangle, trapezoid and square wave or a pulse signal) by converting the sinusoidal signal
  - *Multifunction generator and a noise generator*

A further LF generator for use as a second modulation source or to generate a noise modulation signal
The noise generator supplies white noise with selectable bandwidth and level distribution.
- *High-performance pulse generator*
  Generates double pulse or pulse train signals.

- **External modulation source**
  - Amplitude, frequency or phase modulation signals are input at the EXT connector
  - Pulse modulation signals, at the PULSE EXT connector.

Signal output

You can perform the AM, FM and PhiM with the signal of any of the provided sources. Moreover, you can combine two modulation signals and generate a two-tone signal. Regardless of the signal source, the generated signal, can be output for further processing in a downstream instrument.

Current configuration is indicated in the Chapter 4.4.8, "Overview", on page 104 dialog; the output signal routing can be changed, too.

Input and output connectors

Direction	Modulation	Connector	Required option
Output	Pulse generator	PULSE SYNC	R&S SMAB-K22
	Pulse generator Loop through of pulse signal from PULSE EXT	PULSE VIDEO	R&S SMAB-K22
	LF generator	LF	
	Pulse modulation form internal signal External trigger or gate signal[*)]	PULSE EXT	R&S SMAB-K22/-K23
Input	AM, FM, PhiM	EXT 1/2[1)]	R&S SMAB-K720
	Pulse modulation form external source[*)]	PULSE EXT[2)]	R&S SMAB-K23/-K24/-K27

[*)] External trigger signal and external signal for the pulse modulation cannot be used simultaneously, because these signals are expected at the same connector PULSE EXT. Signal polarity and impedance are the same for both signals.

Signal characteristics:

- [1)] The external modulation signal must have a voltage of US = 1 V (UEFF = 0.707 V) to achieve the displayed modulation depth and range.
  The input voltage should not exceed 1 V, otherwise modulation distortions can occur.
- [2)] The input shows some hysteresis with threshold levels of -0.5 V/5 V
  The voltage must not exceed 10 V

Interactions and characteristics

- Some modulations exclude each other and cannot be performed simultaneously. See Chapter 4.8.1, "Simultaneous Operation of Several Modulations", on page 108
- The settings of the modulation signal affect all analog modulations that use an internal modulation source.
- In sweep mode, LF frequency sweep is possible.

4.3 Activating Analog Modulations

► Use one of the following:
  - Select "Modulation > Amplitude Modulation/Frequency Modualtion/Phase Modualtion > State > On".
  - Select "Modulation > MOD ON".
  - Press the MOD ON/OFF key.

MOD ON/OFF
Activate one or more analog modulations and press the MOD ON/OFF key to toggle the state of all them.

Pressing the key again restores the status that was active before the last switch-off.

Remote command:
`[:SOURce<hw>]:MODulation[:ALL][:STATe]` on page 363

4.4 Modulation Settings

Access:

► Select "Modulation" > "Modulation Sources".

The "Modulation" dialog contains all functions and settings to configure the analog modulations, the LF signal sources for performing a modulation, and the LF signal output.

The remote commands required to define these settings are described in:

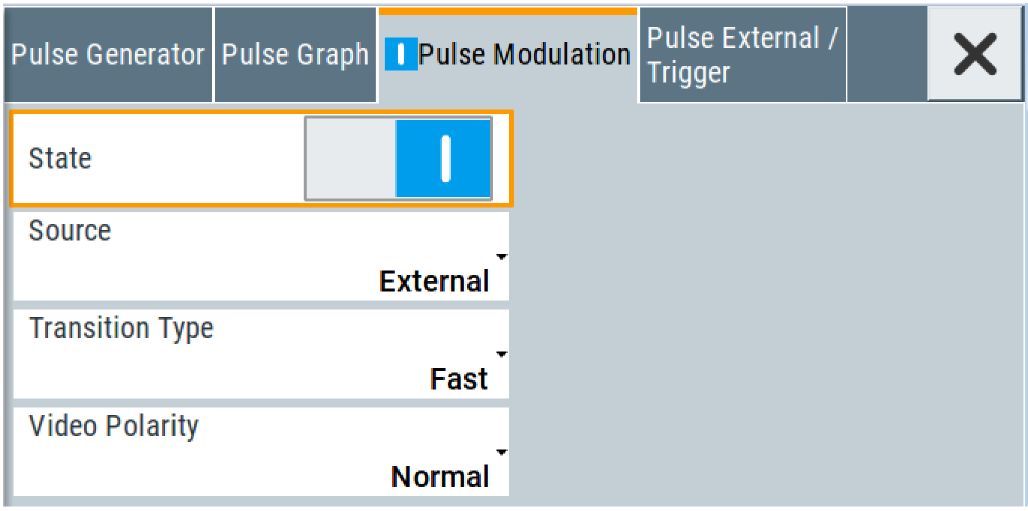
- Chapter 12.15.1.2, "SOURce:AM Subsystem", on page 363
- Chapter 12.15.1.3, "SOURce:FM Subsystem", on page 367
- Chapter 12.15.1.4, "SOURce:PM Subsystem", on page 370
- Chapter 12.15.1.5, "SOURce:PULM Subsystem", on page 374
- Chapter 12.15.5, "SOURce:LFOutput Subsystem", on page 400

4.4.1 Pulse Modulation

Option: see Chapter 4.1, "Required Options", on page 74.

Access:

► Select "Modulation" > "Pulse Modualtion".



The "Pulse Modulation" dialog contains all parameters required to configure pulse modulation and pulse signal generation.
It also displays the pulse signal graphically.

For an overview of the supported signals sources and related connectors, see Chapter 4.2, "Modulation Types and Signal Sources", on page 74.

The remote commands required to define these settings are described in Chapter 12.15.1.5, "SOURce:PULM Subsystem", on page 374.

Settings:

State

Activates pulse modulation and triggers the following automatic settings:

- Pulse generator is activated.
  The signal is output at the PULSE VIDEO connector.
  To deactivate the signal output, set Pulse Output State > "Off".
- ALC is set to "Table & On".

Remote command:
`[:SOURce<hw>]:PULM:STATe` on page 378

Source
Selects between the internal "Pulse Generator" or an "External" pulse signal for the modulation.

"Pulse Generator"
Selects the internal generator.
See Pulse Generator.

"External" Modulation source is fed to the input connector.
See "Signal sources" on page 74.

Remote command:
`[:SOURce<hw>]:PULM:SOURce` on page 375

Transition Type
Selects between "Fast" or "Smoothed" slew rate (slope).

"Fast" Enables fast transitions with shortest rise and fall times.

"Smoothed" Flattens the slew rate, resulting in longer rise / fall times. Use this mode if you are working with devices that are sensitive to steep slopes.

Remote command:
`[:SOURce<hw>]:PULM:TTYPe` on page 378

Video Polarity
Sets the polarity of the internally generated pulse video (modulating) signal, related to the RF (modulated) signal.

This signal synchronizes the pulse generator signal and the RF signal.

"Normal" The video signal level follows the RF signal, that means it is high and low simultaneously with the RF signal.

"Inverse" Inverts the polarity between the video and the RF signal, that means it is high, when RF is low, and vice versa.

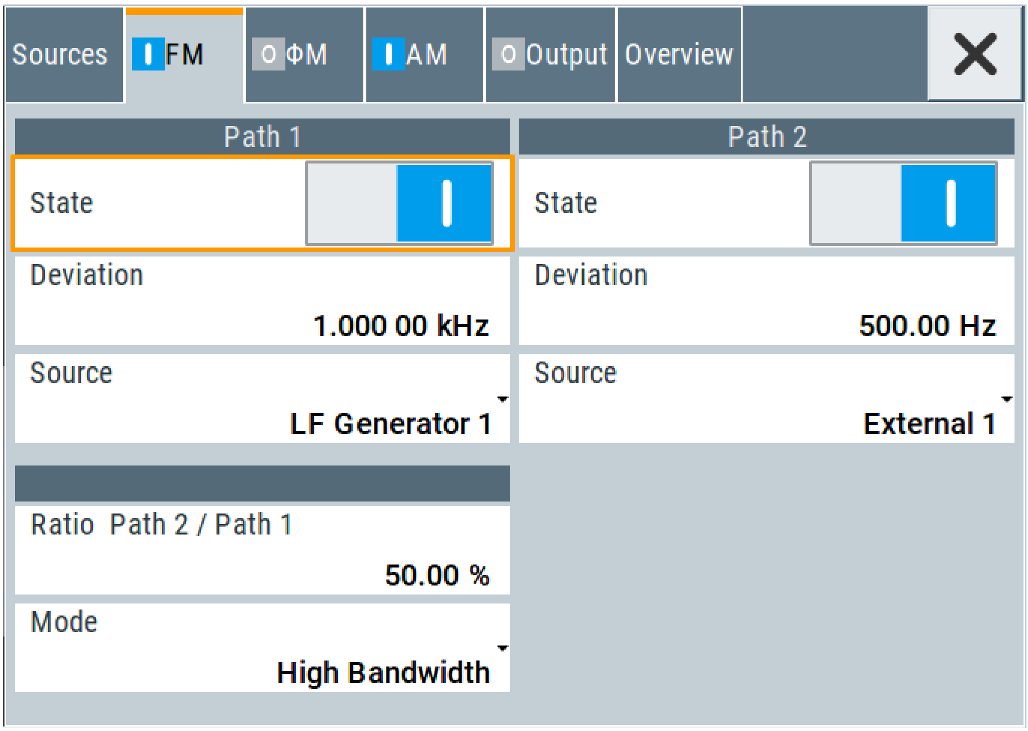
Remote command:
`[:SOURce<hw>]:PULM:OUTPut:VIDeo:POLarity` on page 378

4.4.2 FM, PhiM and FM Modulation Settings

Option: R&S SMAB-K720

Access:

► Select "Modulation" > "Amplitude Modulation/Frequency Modualtion/Phase Modualtion".



The "FM", "Φ" and "AM" tabs contain the parameters per modulation type.

Source

State
Activates a modulation.

Note: Some analog modulations cannot be run simultaneously, see Chapter 4.8.1, "Simultaneous Operation of Several Modulations", on page 108.

Remote command:
[:SOURce<hw>]:AM<ch>:STATe on page 366
[:SOURce<hw>]:FM<ch>:STATe on page 370
[:SOURce<hw>]:PM<ch>:STATe on page 373

Source

Selects the LF signal source.

You can vary the signal sources for each of the modulations.

"LF Generator1/2"
Selects one of internally generated LF signals.
See Chapter 4.4.6.1, "Source > LF Generator Settings", on page 96.

"External 1/2" Selects an externally supplied LF signal.

"Noise Generator"
Selects the internally generated noise signal.
See Chapter 4.4.6.3, "Source > Noise Generator Settings", on page 101.

Remote command:
[:SOURce<hw>]:AM<ch>:SOURce on page 365
[:SOURce<hw>]:FM<ch>:SOURce on page 370
[:SOURce<hw>]:PM<ch>:SOURce on page 372

FM settings

The following settings are dedicated to FM.

Deviation ← FM settings

Sets the frequency modulation deviation in Hz.

The maximal deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Maximal possible deviation is selected automatically, if one of the following applies:

- The selected deviation is too high for the particular frequency
- The selected frequency is outside of the range where deviation is possible.

A warning message indicates this situation, too.

Remote command:
[:SOURce<hw>]:FM<ch>[:DEViation] on page 368

Ratio Path2/Path1 ← FM settings

Sets the deviation ratio (path2 to path1) in per cent.

Example:

If the deviation in path1 is 10 kHz and the ratio is 50%, the deviation in path 2 is automatically set to 5 kHz.

Remote command:
[:SOURce<hw>]:FM:RATio on page 369

Mode ← FM settings
Selects the mode of the frequency modulation.

"High Bandwidth"
The maximum range for modulation bandwidth is available.

"Low Noise"
Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).
To reduce the phase noise further, set the Main PLL Bandwidth = "Narrow"

Remote command:
`[:SOURce<hw>]:FM:MODE` on page 369

PhiM
The following settings are dedicated to PhiM.

Deviation ← PhiM
Sets the phase modulation deviation in radians or degrees.

The maximal deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Maximal possible deviation is selected automatically, if one of the following applies:
- The selected deviation is too high for the particular frequency
- The selected frequency is outside of the range where deviation is possible.

A warning message indicates this situation, too.

Remote command:
`[:SOURce]:PM<ch>[:DEViation]` on page 373

Ratio Path2/Path1 ← PhiM
Sets the deviation ratio (path2 to path1) in per cent.

Example:

If the deviation in path1 is 10 rad and the ratio is 50%, the deviation in path 2 is automatically set to 5 rad.

Remote command:
`[:SOURce<hw>]:PM:RATio` on page 372

Mode ← PhiM
Selects the mode of the phase modulation.

"High Bandwidth"
The maximum range for modulation bandwidth and PhiM deviation is available.
However, phase noise increases at low frequencies, and the range of PhiM deviation is limited. This mode is suitable if you process high frequencies.

"High Deviation"
The maximum range for PhiM deviation is available.
Phase noise is improved for low frequencies compared to the default mode. The range for modulation frequency is limited (see data sheet).
This mode is suitable for low modulation frequencies and/or high PhiM deviation.

"Low Noise" Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

Remote command:
`[:SOURce<hw>]:PM:MODE` on page 371

AM settings
The following settings are dedicated to AM.

AM Depth ← AM settings
Determines the depth of the modulation signal in percent.

The depth is limited by the maximum peak envelope power (PEP).

Remote command:
`[:SOURce<hw>]:AM<ch>[:DEPTh]` on page 366

Ratio Path2/Path1 ← AM settings
Sets the deviation ratio (path2 to path1) in per cent.

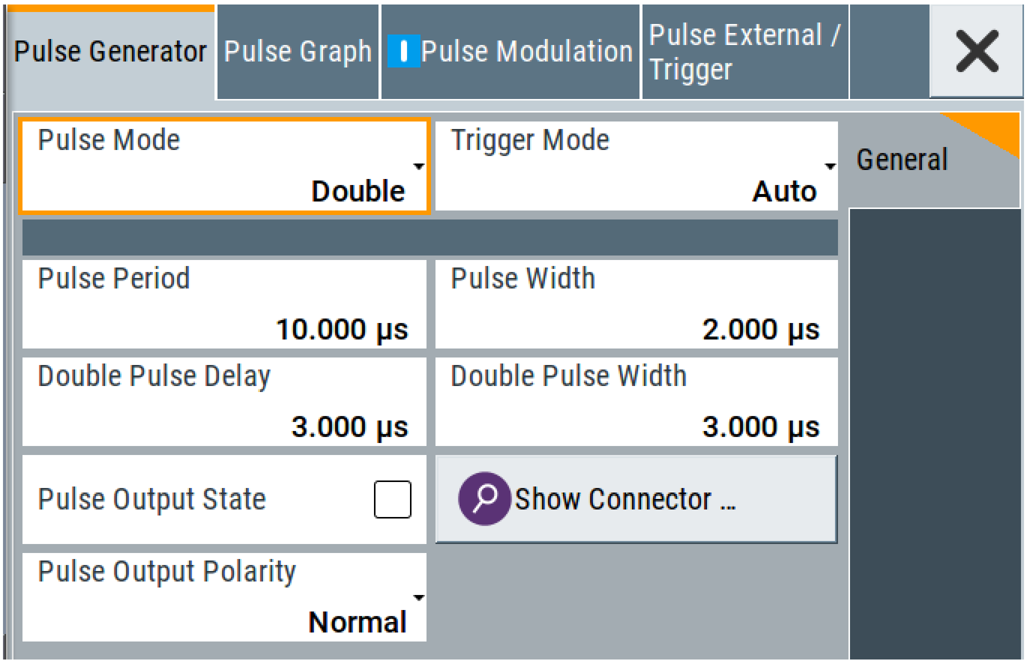
Remote command:
`[:SOURce<hw>]:AM:RATio` on page 365

4.4.3 Pulse Generator

Option: see Chapter 4.1, "Required Options", on page 74.

Access:

► Select "Modulation" > "Pulse Modualtion > Pulse Generator".



The "Pulse Generator" tab contains the settings for creating the pulse modulation signal internally.

4.4.3.1 Pulse Generator > General Settings

Access:

► Select "Modulation" > "Pulse Modulation > Pulse Generator".

Settings

Pulse Mode

Sets the operating mode of the pulse generator. Depending on the selection, the instrument displays the associated parameters.

"Single"	Generates a single pulse in one pulse period.
"Double"	Generates two pulses in one pulse period.
"Train"	Option: R&S SMAB-K27 Generates a user-defined pulse train. See Chapter 4.4.3.2, "Pulse Generator > Pulse Train Settings", on page 87.

Remote command:
`[:SOURce<hw>]:PULM:MODE` on page 377

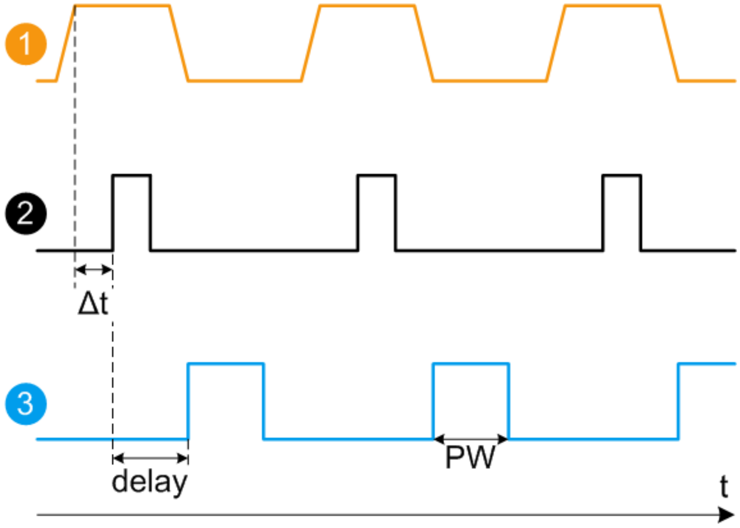
Trigger Mode
Selects between continuous triggering or triggering initiated by a trigger event from an external signal.

For an overview of the used connectors, see "Input and output connectors" on page 75.

"Auto"	Generates the modulation signal continuously.

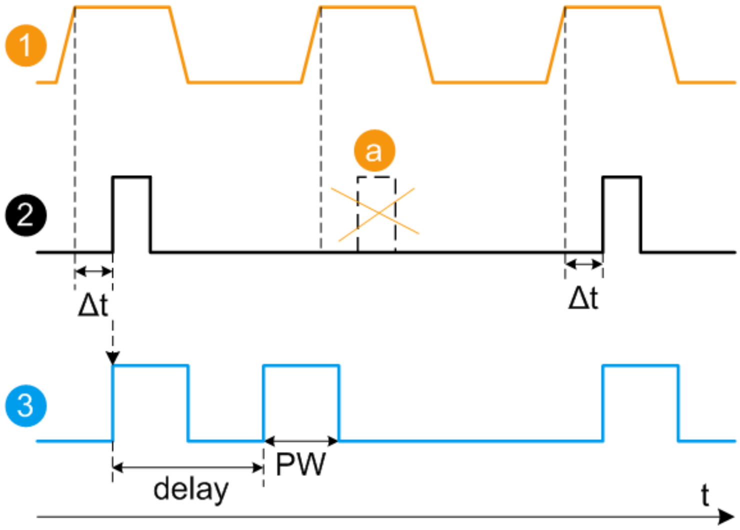
"Ext Triggered" Generates the signal each time an external trigger event occurs.

Example: Generation of single pulse signal ("Pulse Mode = Single") using "Trigger Mode = Ext Triggered"



1 = External trigger signal input with "Trigger Input Polarity = Normal" (the positive slope is active)
2 = Sync signal
3 = Pulse signal
Δt = Typically 50 ns, see data sheet (trigger delay between the trigger and the sync signal start)
delay = "Pulse Delay = 100 ns"
PW = "Pulse Width = 100 ns"

Example: Generation of double pulse signal ("Pulse Mode = Double") using "Trigger Mode = Ext Triggered"



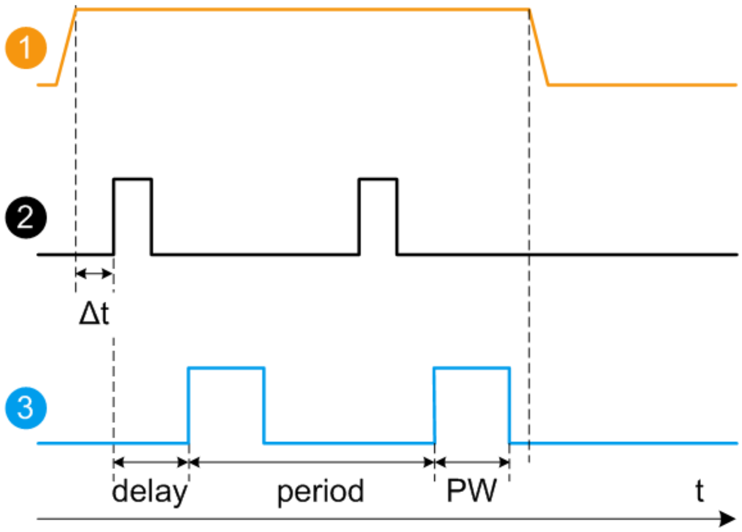
1 = External trigger signal input with "Trigger Input Polarity = Normal" (the positive slope is active)
2 = Sync signal
3 = Pulse signal
a = Trigger signal during double pulse generation is without effect

Δt = Typically 50 ns, see data sheet (trigger delay between the trigger and the sync signal start)
delay = "Double Pulse Delay = 200 ns"; the first pulse starts without a delay
PW = "Double Pulse Width = 100 ns"

"Ext Single" Generates the signal triggered by an external trigger event.

"Ext Gated" Generates the signal triggered by an external gate signal.

Example: Generation of single pulse signal ("Pulse Mode = Single") using "Trigger Mode = Ext Gated"



1 = External trigger signal input with "Trigger Input Polarity = Normal" (the positive slope is active)
2 = Sync signal
3 = Pulse signal
Δt = Typically 50 ns, see data sheet (trigger delay between the trigger and the sync signal start)
delay = "Pulse Delay = 100 ns"
PW = "Pulse Width = 100 ns"
period = "Pulse Period = 300 ns" (time between the pulse start of two consecutive pulses)
a = Gate active duration (pulses are generated during the gate active part)

Remote command:
`[:SOURce<hw>]:PULM:TRIGger:MODE` on page 378

Pulse Period

Sets the repetition rate of the generated pulse signal.

Remote command:
`[:SOURce<hw>]:PULM:PERiod` on page 375

Pulse Width

Sets the pulse duration of the generated pulse signal.

Note: The pulse width must be at least 20 ns less than the set pulse period.

Remote command:
`[:SOURce<hw>]:PULM:WIDTh` on page 379

Double Pulse Width
Sets the width of the second pulse.

Remote command:
[:SOURce<hw>]:PULM:DOUBle:WIDTh on page 376

Pulse Delay
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 376

Double Pulse Delay
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 376

Pulse Output State
Activates the output of the pulse modulation signal.

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

Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

Pulse Output Polarity
Sets the polarity of the pulse output signal.

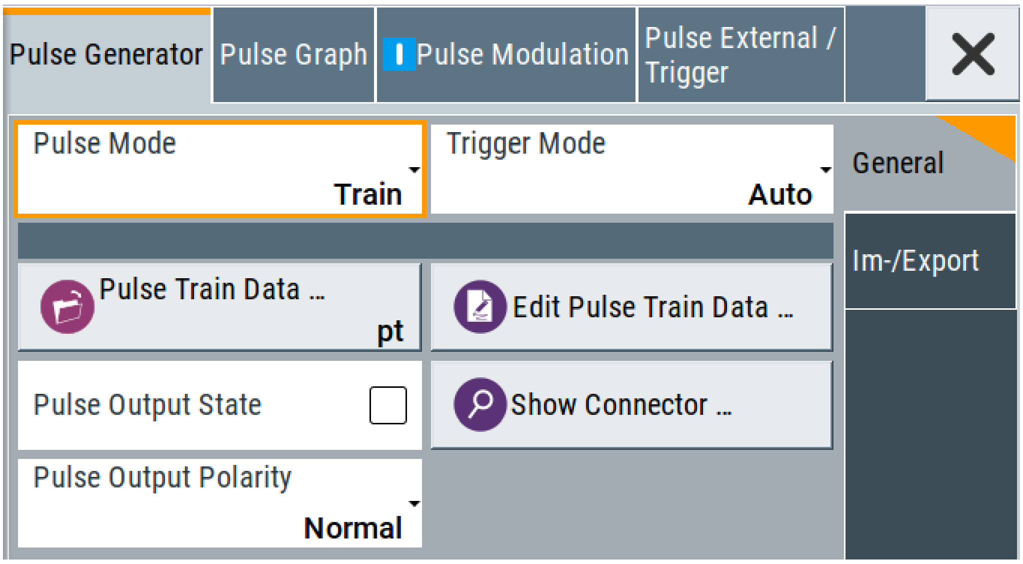
Remote command:
[:SOURce<hw>]:PGENerator:OUTPut:POLarity on page 428

4.4.3.2 Pulse Generator > Pulse Train Settings

Option: see Chapter 4.1, "Required Options", on page 74.

Access:

1. Select "Modulation" > "Pulse Modulation > Pulse Generator" > **"Pulse Mode = Train"**.



2. Select "Pulse Train Data".
3. Select an existing file or select "New" to create one.
4. Define the filename.
   Select "Edit Pulse Train Data", if the file is empty or to control and change the values.
5. In the "Edit Pulse Train Data" dialog, enter the pulse on/off times and pulse repetition values.
6. Select "Save".

   A pulse train is a sequence of pulses with user-defined repetition, and pulse on and off times. Once defined, pulse train settings can be saved in a file. The filename is user-definable; the file extension (`*.pulstrn`) is assigned automatically.
   When a file is selected, the filename is indicated.

Possible ways to configuring a pulse train

You can configure a pulse train in the following ways:

- **Internally**
  – Use the built-in editor table editor, see in the "Pulse Generator > Pulse Train" dialog.
    Once defined, pulse train settings can be saved in a file. For example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.
    The filename is user-definable; the file extension is `*.pulstrn`.
  – Using the corresponding remote-control commands.
    Note that you have to create a pulse train file first.
- **Externally**
  Create a pulse train sequence as a CSV file with Microsoft Excel, with a Notepad or a similar tool, save it with the predefined extension. Transfer the file to and load it into the instrument.

Pulse train ASCII file format

Files describing pulse trains are simple files in text or comma-separated value (CSV) file format. The filename is user-definable; the file extension is `*.csv` or `*.txt`.

The file contains a list of pulse definition values, one row per pulse; a new line indicator separates the pulses. Pulses are defined with their pulse on time, pulse off time given in us and number of repetitions.

Example: Pulse train file content (*.txt file)

```
0.0001,0.0005,2
0.00025,0.0005,1
0.0001,0.0003,3
```

For file handling, use the standard functions in the "File Manager", see Chapter 9.8, "Using the File Manager", on page 203.

Settings

Pulse Train Data

Accesses the standard "File Select" function of the instrument. The provided navigation possibilities in the dialog are self-explanatory.

Pulse train files are files with predefined file extension `*.pulstrn`. When a file is selected, the dialog indicates the filename.

You can create the file internally in the table editor or externally.

- To select an existing file, select "Select List > navigate to the file *.pulstrn > Select"
- Use the general editor function to create internally new file or to edit an existing one.
- Use the standard file manager function to load externally created files to the instrument.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:CATalog?` on page 381
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 382

Edit Pulse Train Data

Accesses the build-in table editor to define a new pulse train file or edit an existing one.

"On-Time, µs/Off-Time,µs"
Sets the pulse on and pulse off time.

"Count" Sets the number of repetitions of an "On-/ Off-Time" value pair.
Pulses with "Count = 0" are ignored.
Use this method to skip value pairs temporarily, without deleting them from the table.

Remote command:
`[:SOURce<hw>]:PULM:TRAin:ONTime` on page 381
`[:SOURce<hw>]:PULM:TRAin:OFFTime` on page 381
`[:SOURce<hw>]:PULM:TRAin:REPetition` on page 382
`[:SOURce<hw>]:PULM:TRAin:DELete` on page 381

Data handling keys
Standard functions for file and data handling.

Note: Save a list only after filling both columns (frequency and level), otherwise the entries are lost.

Goto ← Data handling keys
Selects a row for editing.

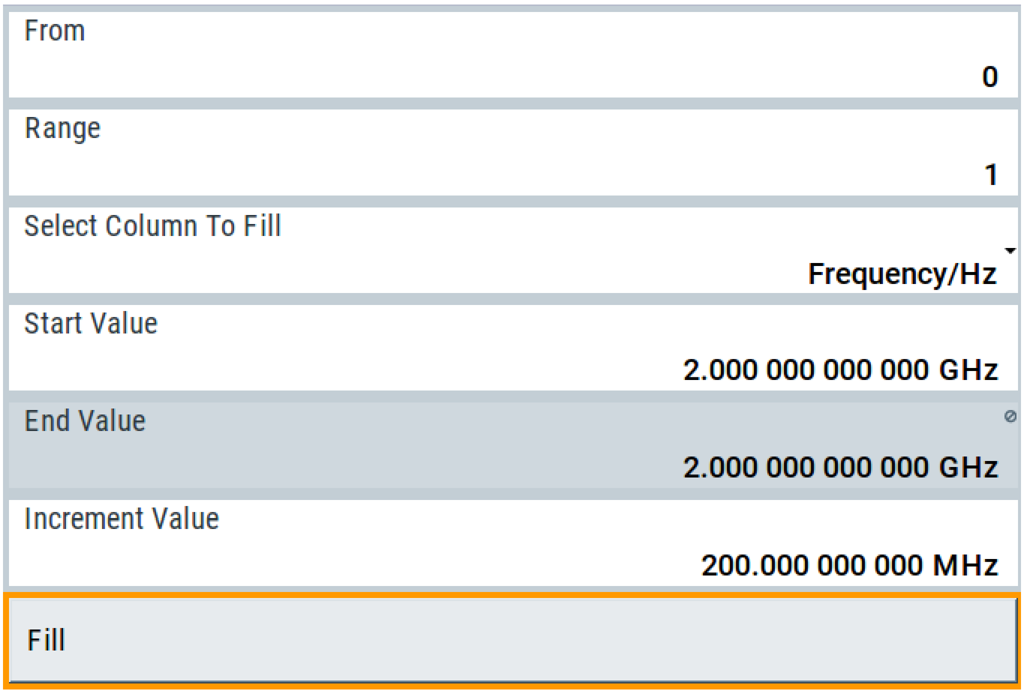
Edit ← Data handling keys
Enables you to insert, or delete a row or ranges within a list, and provides access to a dialog for automatic filling.

Fill with Sensor ← Data handling keys
In "UCOR" mode, opens a dialog to configure the settings for automatic filling of user correction data with an R&S NRP power sensor

See Chapter 6.3.3, "Fill with Sensor", on page 154

Save As/Save ← Data handling keys
Stores the list in a file with user-defined name and predefined file extension. To save a copy or create a file, use the "Save as" function.

Fill Table Automatically
Provides parameters for filling a table automatically with user-defined values.



The settings are interdependent; the affected parameters change accordingly if you set a value.

To fill the table, select "Fill".

Note: Save a list only after filling all columns and rows, otherwise the entries are lost.

"From / Range"
Defines the start line and number of the row to be filled.

"Select Column to Fill"
Selects the respective value, including the unit.

"Start / End Value"
Provides the default values corresponding to the selected column.

"Increment" Determines the step size.

"Fill" Fills the table.
Fill both columns and then save the list. Otherwise the entries are lost.

4.4.3.3 Import/Export List Files

Access:

1. Select one of the following:
   a) "Sweep" > "List mode".
   b) "Level" > "Level > User Correction".
   c) "Modulation > Pulse Modulation > Pulse Generator > Pulse Mode = Train".

2. Select "Import/Export".

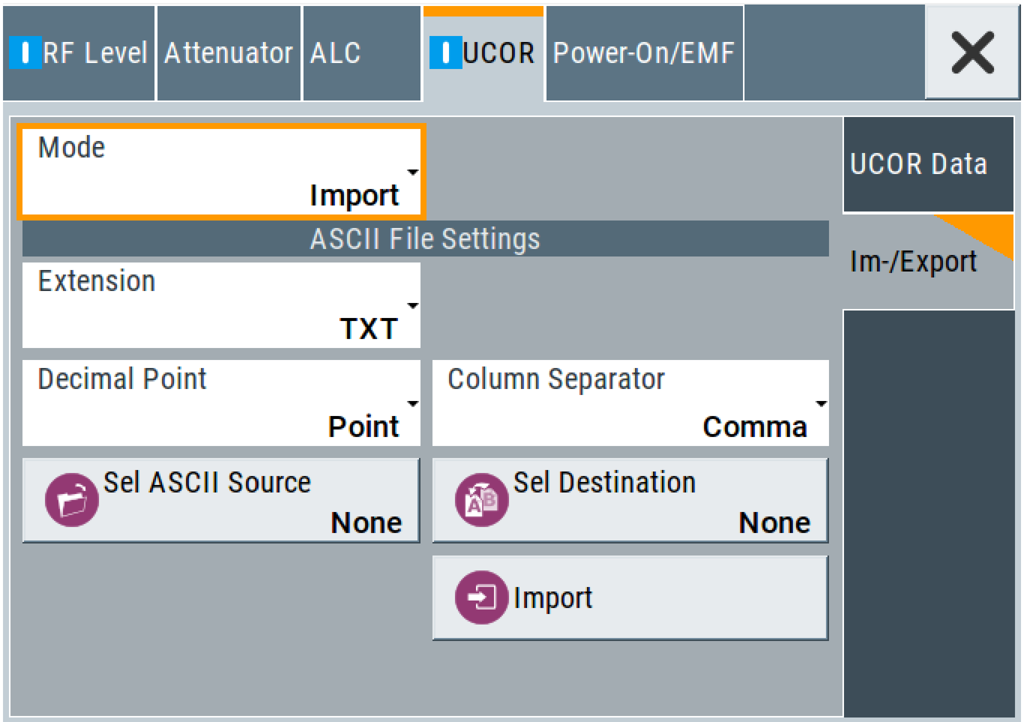


Figure 4-1: Im-/Export dialog (example with UCOR settings)

The "Import/Export" dialog contains all functions and settings to import externally created list data or to export it accordingly. You can process and store a list in the formats `*.txt` (ASCII), or `*.csv` (plain text with identical sequence of fields). The table separators and the decimal floating point numbers are customizable.

Settings

Mode

Selects import or export of a data list file. The provided parameters vary according to the selected mode.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:MODE` on page 425
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 392
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 383

ASCII File Settings

Defines the format and the separators of the associated data file.

"Extension" Selects `*.csv` or `*.txt` format.

"Decimal Point" Sets "Point" (dot) or "Comma" as the decimal separator used in the ASCII data with floating-point numerals.

"Column Separator"
Sets the separator between the columns in an ASCII table.
Available are: "Tab", "Semicolon", "Comma" or "Space".

Remote command:
[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension on page 424
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 425
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 425
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 391
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal on page 391
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn on page 391
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 383
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal on page 383
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn on page 384

Select Source/Select Destination
In "Mode > Import", access the file select dialog that provides standard file handling functions.

Where:
- "Select ASCII Source": defines the file to be loaded (imported)
- "Select ASCII Destination": selects the filename the loaded file is saved as

Remote command:
[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog? on page 424
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 425
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 390
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 391
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 384
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 384

Select Source / Select ASCII Destination
In "Mode > Export", access the file select dialog that provides standard file handling functions.

Where:
- "Select Source": selects the file to be exported
- "Select ASCII Destination": defines the filename and the file path the exported file is saved as

Remote command:
[:SOURce<hw>]:LIST:DEXChange:SELect on page 426
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 392
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 384

Import / Export

Imports or exports the selected data list file, depending on the current mode.

Remote command:

[:SOURce<hw>]:LIST:DEXChange:EXECute on page 424

[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 392

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 385

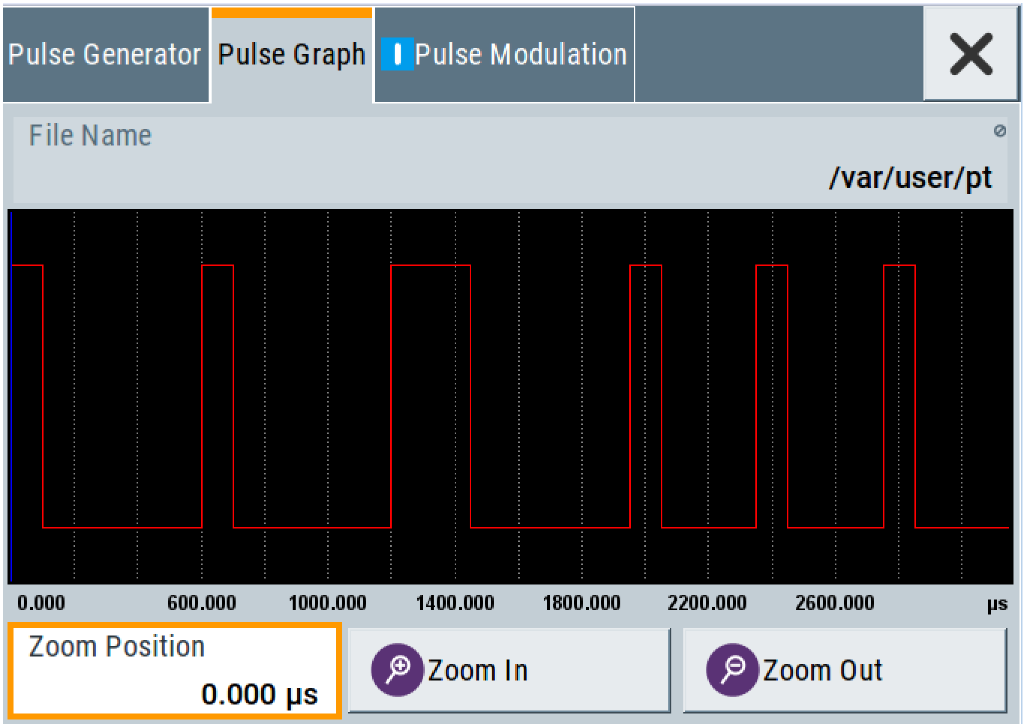
4.4.4 Pulse Graph

Option: see Chapter 4.1, "Required Options", on page 74.

Access:

► Select "Modulation" > "Pulse Modualtion > Pulse Graph".

The pulse graph is the graphical representation of the current pulse signal.

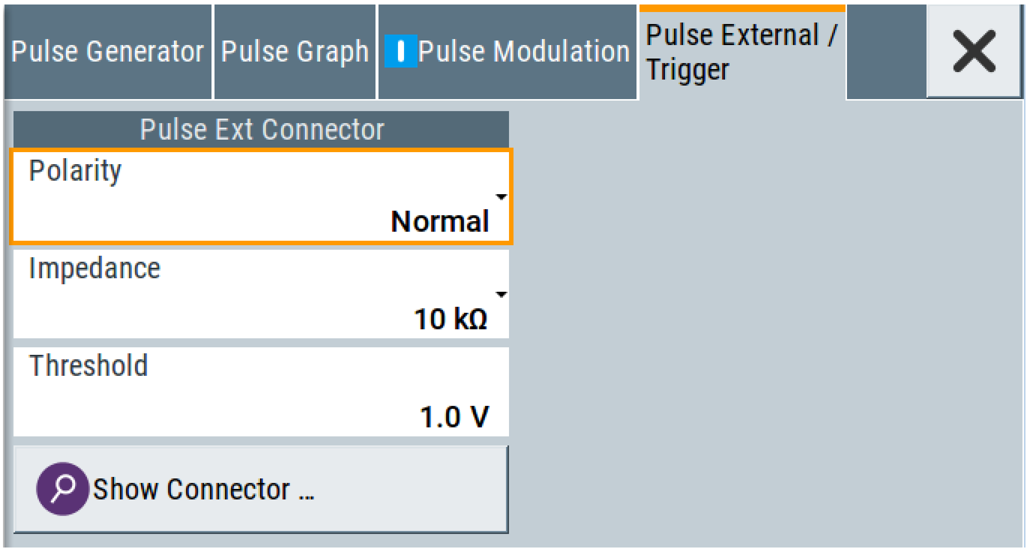


The height of the bars corresponds to the selected amplitude of the pulse signal.

4.4.5 Pulse External/Trigger Settings

Access:

► Select "Modulation" > "Pulse Modulation > Pulse External /Trigger".



The dialog comprises the characteristics of the PULSE EXT connector.
This connector is common for the pulse generator and the pulse modulator. For an overview, see "Input and output connectors" on page 75.

Settings

Polarity

Sets the polarity of the active slope of a pulse input signal, that is the external pulse modulation signal.

Remote command:
[:SOURce<hw>]:PULM:POLarity on page 376

Impedance

Sets the input impedance.

Remote command:
[:SOURce<hw>]:PULM:IMPedance on page 377

Threshold

Sets the high/low threshold in volts for the signal at the PULSE EXT connector.

Remote command:
[:SOURce<hw>]:PULM:THReshold on page 377

Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

4.4.6 FM, AM and PhiM Modulation Sources

Access:

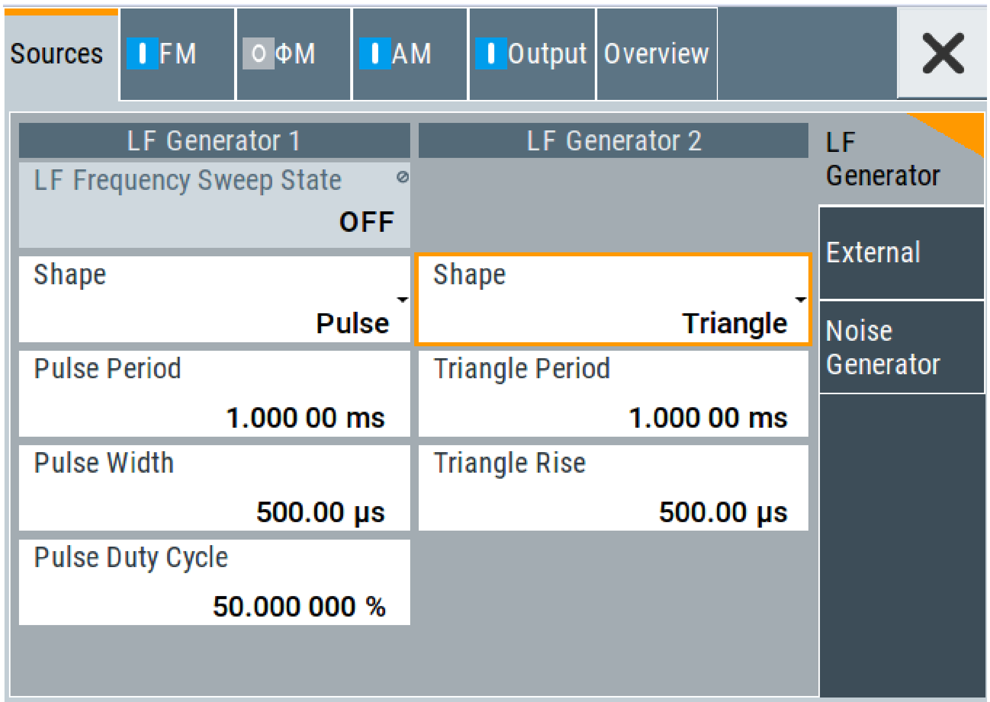
▶ Select "Modulation > Modulation Sources".

In the "Sources" tab, you can configure an LF modulation signal for performing analog modulations. It includes the setting parameters of the internal LF-and multi-function generators, the noise generator, and an external signal source.

4.4.6.1 Source > LF Generator Settings

Access:

▶ Select "Modulation" > "Modulation Sources > LF Generator".



The internal LF signal can be used as modulation signal source for any of the analog modulations. The LF signal applies to all modulations which use the internal modulation signal. Therefore, any modification of the LF signal influences immediately all currently active modulations.

Settings

State (LF frequency sweep)

Activates the generation of an LF frequency sweep signal in the "LF Frequency" dialog.

In the "Sources" tab of the analog modulations, the instrument shows the current state of the LF frequency sweep.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

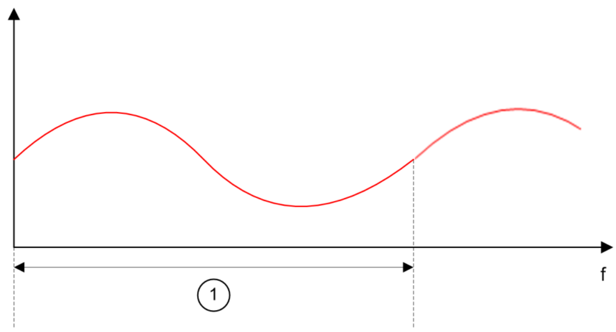
Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 404

Shape

Selects the waveform shape of the LF signal.

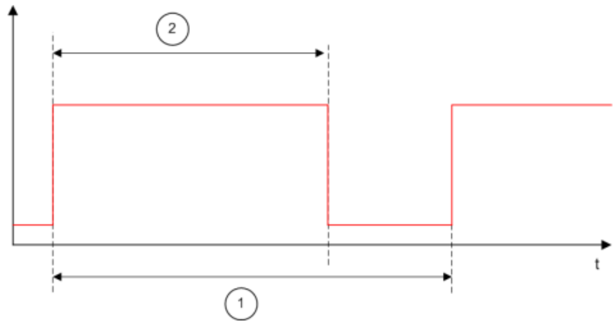
The "Triangle" and "Trapezoid" waveforms require option R&S SMAB-K24.

"Sine"



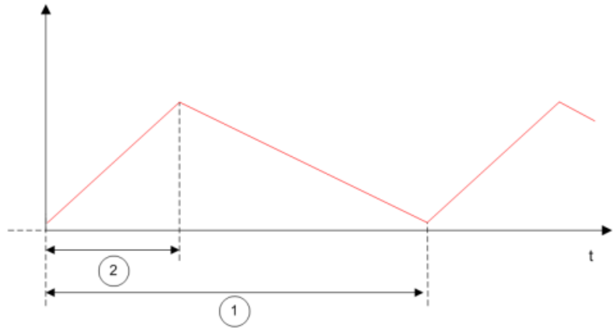
1 = Period

"Pulse"



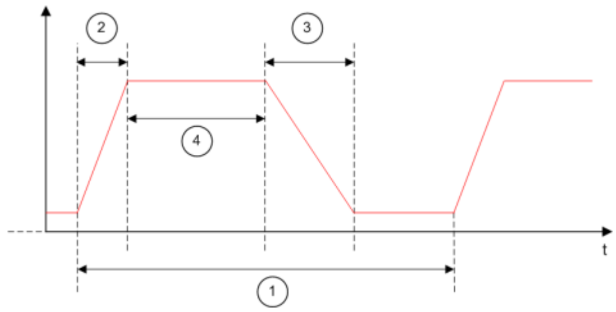
1 = Pulse period
2 = Pulse width

"Triangle"



1 = Triangle period
2 = Triangle rise

"Trapezoid"



1 = Trapezoid period
2 = Trapezoid rise
3 = Trapezoid fall
4 = Trapezoid high

Remote command:
`[:SOURce<hw>]:LFOutput<ch>:SHAPe` on page 407

Frequency
Sets the frequency of the LF generator for sine signals.

Set the signal shape with the parameter Shape.

Remote command:
`[:SOURce]:LFOutput<ch>:FREQuency` on page 403

Period
Sets the repetition rate of the generated LF signal for triangle, trapezoid or pulse shapes, see Shape.

The period of sine signals is calculated from the selected Frequency

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:PERiod on page 409
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod on page 409
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod on page 407

Pulse Width
Sets the pulse duration of the generated pulse signal.

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh on page 408

Pulse Duty Cycle
Sets the ratio between the pulse duration and the pulse period in percent.

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:DCYCle on page 407

Triangle Rise
Sets the time required for the triangle signal to change from low level to high level.

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:RISE on page 409

Trapezoid Rise / Fall
Sets the time required for the trapezoid signal to change from low level to high level, and vice versa.

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE on page 409
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL on page 408

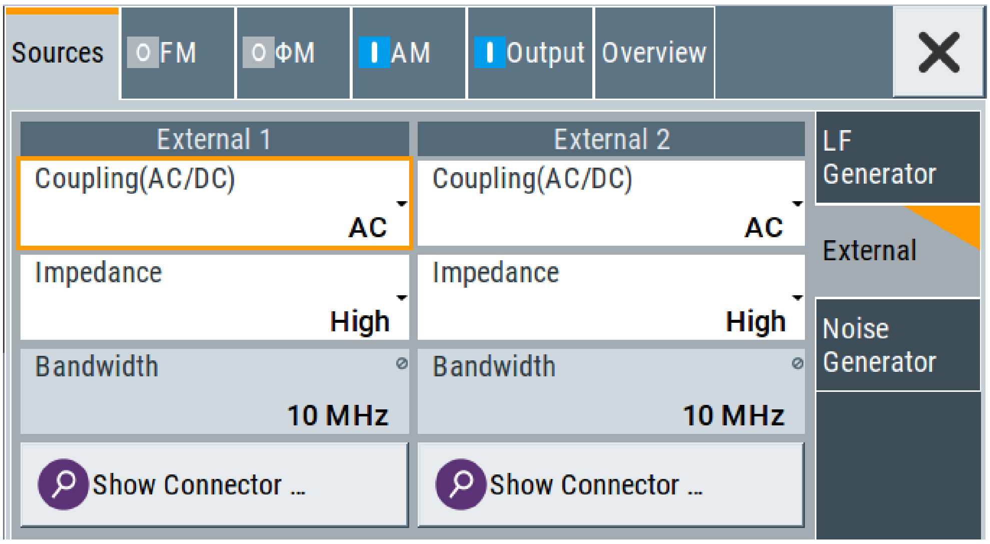
Trapezoid High
Sets how long the trapezoid signal is at high level.

Remote command:
[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH on page 408

4.4.6.2 Source > External Settings

Access:

► Select "Modulation" > "Modulation Sources > External".



The "External" settings section contains all parameters required to configure the signal of an externally supplied LF signal.

Settings

Coupling (AC/DC)

Selects the coupling mode (AC or DC) for the external 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>]:INPut:MODext:COUPling` on page 399

Impedance

Sets the impedance for the externally supplied signal.

Remote command:
`[:SOURce<hw>]:INPut:MODext:IMPedance<ch>` on page 400

Bandwidth

Displays the bandwidth of the external LF signal.

Remote command:

[:SOURce]:LFOutput<ch>:BANDwidth? on page 403

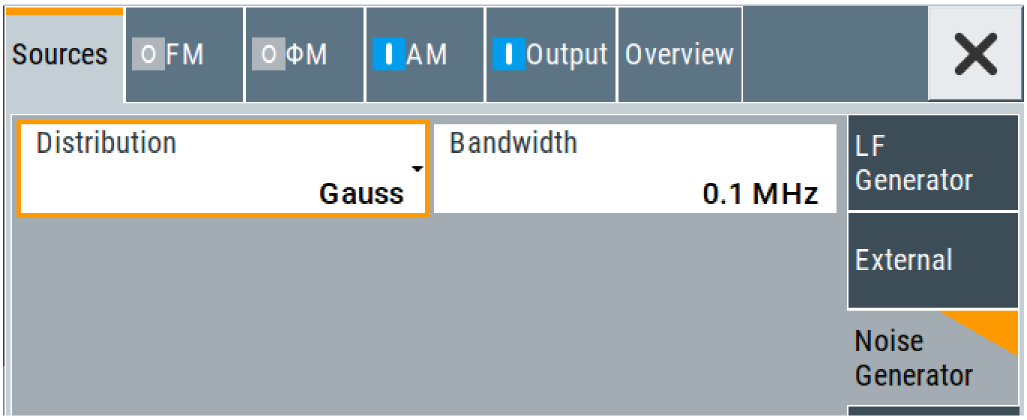
Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

4.4.6.3 Source > Noise Generator Settings

Access:

► Select "Modulation" > "Modulation Sources > Noise Generator".



The "Noise Generator" settings contain all parameters to configure the signal of the internal noise generator.

Settings

Distribution

Selects the distribution of the noise power density.

"Gaussian" Generates the noise power according to a Gaussian distribution.

"Equal" Generates an even distributed noise.

Remote command:

[:SOURce<hw>]:NOISe:DISTribution on page 427

Bandwidth

Sets the noise bandwidth as distinct value.

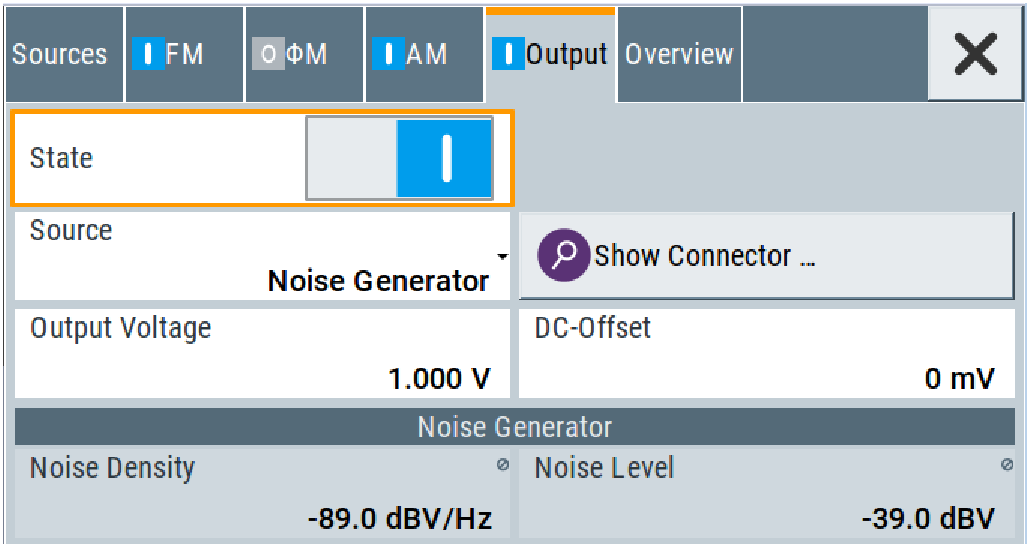
Bandwidth range	Step size
100 kHz to 1 MHz	100 kHz
1 MHz to 5 MHz	1 MHz
5 MHz to 10 MHz	5 MHz

Remote command:
`[:SOURce<hw>]:NOISe:BANDwidth|BWIDth` on page 426
`[:SOURce<hw>]:NOISe:BWIDth:STATe` on page 427

4.4.7 LF Signal Output Settings

Access:

► Select "Modulation" > "LF Output".



In the "Output" tab, you can configure the signal at the LF output, determine the output voltage or add a DC offset.

Settings:

State
Activates the output of the LF signal.

Remote command:
[:SOURce]:LFOutput<ch>[:STATe] on page 406

Source
Selects the signal to be output at the LF connector.

Use the "Show Connector" function to find out where this connector is located.

"LF Generator 1/2"
Selects one of internally generated LF signals.

"AM" Option: R&S SMAB-K720
Selects the AM signal.

"FM/PhiM" Option: R&S SMAB-K720
Selects the signal also used by the frequency or phase modulations.

"Noise Generator"
Selects the internally generated noise signal.

"External 1/2" Selects an externally supplied LF signal

Remote command:
[:SOURce]:LFOutput<ch>:SOURce on page 405

Output Voltage
Sets the voltage (peak) of the LF output.

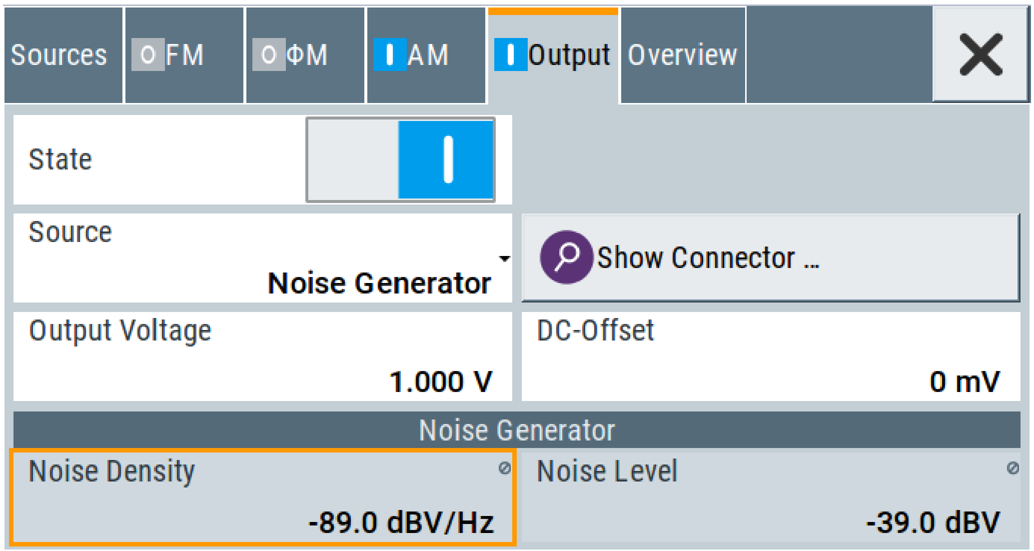
Remote command:
[:SOURce]:LFOutput<ch>:VOLTage on page 406

DC-Offset
Adds a DC offset to the LF output signal.

Remote command:
[:SOURce]:LFOutput<ch>:OFFSet on page 405

Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

Noise Generator
Access:
- Select "Modulation" > "LF Output > Noise Generator".



Noise Density ← Noise Generator
Indicates the level of the noise signal for a bandwidth of 1 Hz (relative).

Remote command:
`[:SOURce<hw>]:NOISe:LEVel:RELative?` on page 427

Noise Level ← Noise Generator
Indicates the level of the noise signal per Hz within the total bandwidth (absolute).

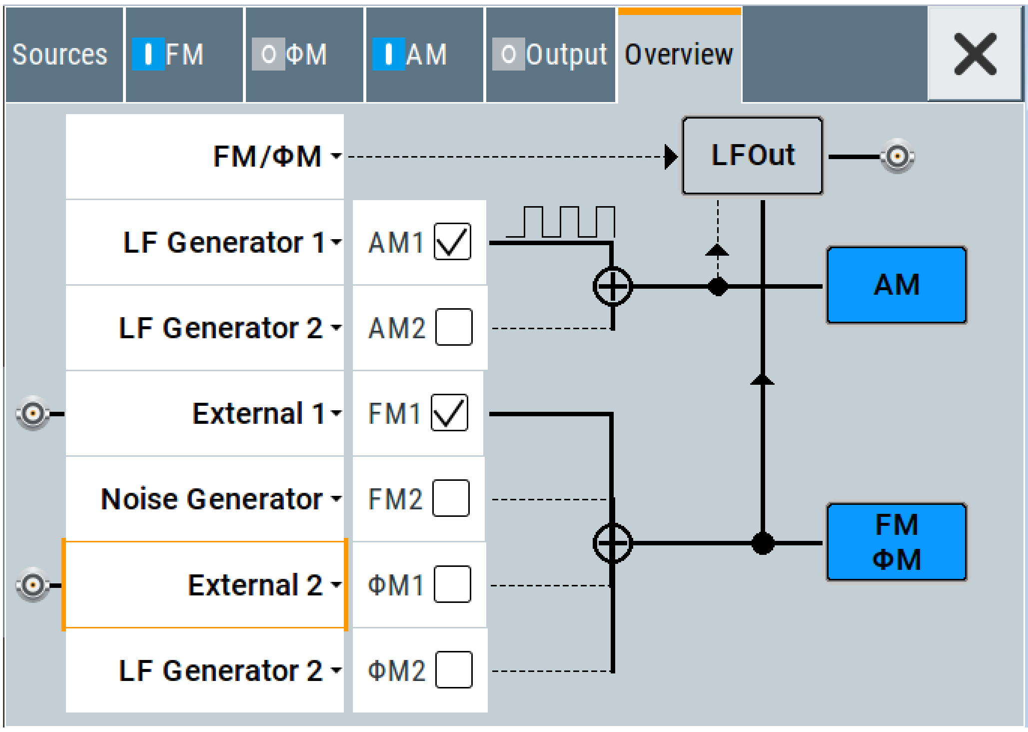
Remote command:
`[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?` on page 428

4.4.8 Overview

Option: AM and FM/PM require R&S SMAB-K720

Access:

► Select "Modulation" > "Modulation Sources > Overview".



Blue color = Active modulation (AM and FM/PM)
Gray color = Inactive modulation
Thick line = Routing of the active modulation (FM/PM)
Dash line = Inactive modulation
"LF Out" = Indicates the signal output: observe both, the source and the thick input line to the block (in this example, the FM/PMM signal is output)

The "Overview" tab is an interactive diagram that indicates the active modulations and the signal being output. Here you can:

- Select the output signal ("LF Out"); the setting acts as the parameter "LF Output Source"
- Select the source for each modulation and modulation path; the setting acts as the parameter "Source"
- Activate modulation in one or two paths; the setting acts as the parameter "State"
  To generate a two-tone signal composed form the two paths of the same modulation type, activate both paths.

4.5 How to Generate an Amplitude Modulated Signal

The following examples use the internal LF generator.

Setting the frequency and level of the RF signal

1. Press PRESET to start from a defined state.

2. In the status bar, set "Frequency = 2 GHz".
3. Set "Level = -20 dBm".

Configuring the modulation signal (LF generator)

1. Select "Modulation" > "Modulation Source".
2. In the "Sources" tab, select "Shape > Sine".
3. Set "Frequency = 20 kHz".
   The period is calculated automatically and indicates "Period = 50.00 µs".

Configuring the amplitude modulation settings

1. In "Modulation" dialog, select the "AM" tab.
2. Set "Depth = 30%"
3. Set "Source = LF Generator1"
4. Select "AM > State = On" to activate the modulation.
5. Set "Level > RF ON" to enable signal output.

4.6 How to Generate a Pulse Modulated Signal

The following example uses the internal pulse generator.

Setting the frequency and level of the RF signal

1. Press PRESET.
2. In the status bar, set "Frequency = 4 GHz".
3. Set "Level = -25 dBm".

Configuring the pulse generator

1. Select "Modulation" > "Pulse Generator".
2. Select "Pulse Mode = Double".
3. Set "Pulse Period = 10 us".
4. Set "Pulse Width = 2 us".
5. Set "Double Pulse Width = 1.2 us".
6. Set "Double Pulse Delay = 4.5 us".
7. In the "Pulse Generator" dialog, select "Pulse Output State = On".
8. Select "Trigger Settings > Trigger Mode = Auto"
9. Observe the graph on the "Pulse Graph" tab.

Enabling pulse modulation

1. Select the "Pulse Modulation" tab.
2. Set "State = On".
3. Set "Level > RF ON" to enable signal output.

4.7 How to Generate a Pulse Train Modulated Signal

The following example uses the internal pulse generator.

Setting the frequency and level of the RF signal

1. Press PRESET.
2. In the status bar, set "Frequency = 6 GHz".
3. Set "Level = -25 dBm".

Configuring the pulse generator

1. Select "Modulation" > "Pulse Generator".
2. Select "Pulse Mode = Train".
3. Select "Pulse Train Data".
4. Select an existing file or select "New" to create one.
5. Define the filename.
   Select "Edit Pulse Train Data", if the file is empty or to control and change the values.
6. In the "Edit Pulse Train Data" dialog, enter the pulse on/off times and pulse repetition values.

   For example:
   - "On-Time = 500 us", "OFF-Time = 2 ms", "Count = 2"
   - "On-Time = 100 us", "OFF-Time = 2.5 ms", "Count = 1"
   - "On-Time = 10 us", "OFF-Time = 50 us", "Count = 10"
7. Select "Save".
   Close the dialog.
8. In the "Pulse Generator" dialog, select "Pulse Output State = On".
9. Select "Trigger Settings > Trigger Mode = Auto"
10. Observe the graph on the "Pulse Graph" tab.

Enabling pulse modulation

1. Select the "Pulse Modulation" tab.

2. Set "State = On".
3. Set "Level > RF ON" to enable signal output.

4.8 References

4.8.1 Simultaneous Operation of Several Modulations

The table shows the modulations and operating modes that can be activated simultaneously (+) or which deactivate each other (-).

	AM	FM	PhiM	Pulse
Amplitude modulation (AM)	/	+	+	-
Frequency modulation (FM)	+	/	-	+
Phase modulation (PhiM)	+	-	/	+
Pulse modulation	-	+	+	/

5 Varying the RF Signal in List or Sweep Mode

The operating modes "List" and "Sweep" allow you to generate an RF signal having periodically varying frequencies or amplitudes.

A signal generated with varying parameters scans a certain range of varying values of a parameter, with defined start and end points, and can be arbitrarily repeated.

The R&S SMA100B supports two basic methods:

- **Sweep** mode
  The instrument generates an RF signal which varies its frequency or level values cyclically between the start and end values. The values change according to a predefined waveform. Intermediate values are calculated internally by linear or logarithmic interpolation.

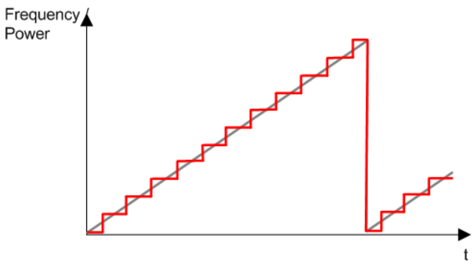
  

  Figure 5-1: Schematic representation of a signal generated in sweep mode (RF Freq Sweep)

  The main application field of the "Sweep" mode is to determine the frequency response or level-dependent behavior of the DUT.
- **List** mode
  The instrument generates the signal step-by-step, based on frequency and amplitude value pairs with individual step sizes. While in sweep mode the frequency **or** the level values change, in list mode you can vary **both parameters simultaneously** . The frequency and level values do not need to have ascending or descending order, they can vary arbitrarily.
  You can use a global dwell time, which means that the time interval is constant for all steps of the list, or vary the dwell time for each value pair.
  In this mode, the graph represents the frequency and power value pairs, and the dwell time of the corresponding index entry of the list mode table.

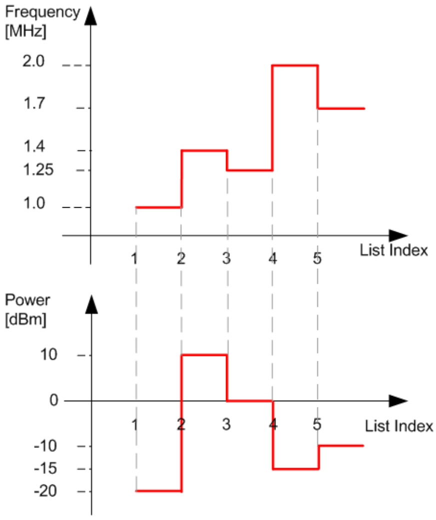


Figure 5-2: Schematic representation of a signal generated in list mode (global dwell time)

This mode is especially useful in high-speed measurements with fast changing frequency and level settings.

Interactions and characteristics

- Activating the list mode automatically deactivates all RF and LF sweeps and vice versa.
- In list processing mode, the frequency and level display in the status bar is disabled.
- The sweep modes only work with a *global* dwell time, that means the time intervals are constant during signal generation.
- If you want to hold a running sweep at a specific frequency or level value, enter the value in the status bar. The sweep stops immediately.
- We recommend that you switch off the display update for optimum sweep performance, especially with short dwell times
  See Chapter 10.1.2, "Display Update Settings", on page 219.

5.1 Signal Generation and Triggering in the Sweep and List Modes

In both operating modes "List" and "Sweep", triggering and signal generation follow the same principle. The instrument generates the signal continuously (that means triggered automatically) or in individual steps (controlled manually by an internal or external trigger signal).

The instrument expects the trigger signal at the INST TRIG connector.

The figures in this section give an overview on the signal generation in the sweep and list modes and the appropriate triggering. The figures show the signal state after activating the mode and the generation of the signal when a trigger event occurs. The relevant parameters and settings are briefly explained to each mode.

Each "Sweep" and "List" mode dialogs provides also a "Reset" function that sets the signal to the initial situation (that is, the start value or the list begin). Depending on the selected trigger mode, the signal generation proceeds accordingly.

The naming of the selection parameters in manual control (GUI) sometimes deviates from the naming in the remote-control commands. In addition, the value names of the selection parameters used in the signal generator partly differ from the SCPI syntax. The instrument accepts all value names.

The correlation between the manual control and the corresponding remote control commands, including the SCPI conform syntax are explained for each mode (see the cross-reference tables).

See also the following programming examples on the sweep and list modes in remote control:

- Example "Setup an RF frequency or power sweep" on page 445
- Example "Setup an LF sweep" on page 400
- Example "Create an RF list and activate the list mode" on page 413

Auto mode (Sweep/List)

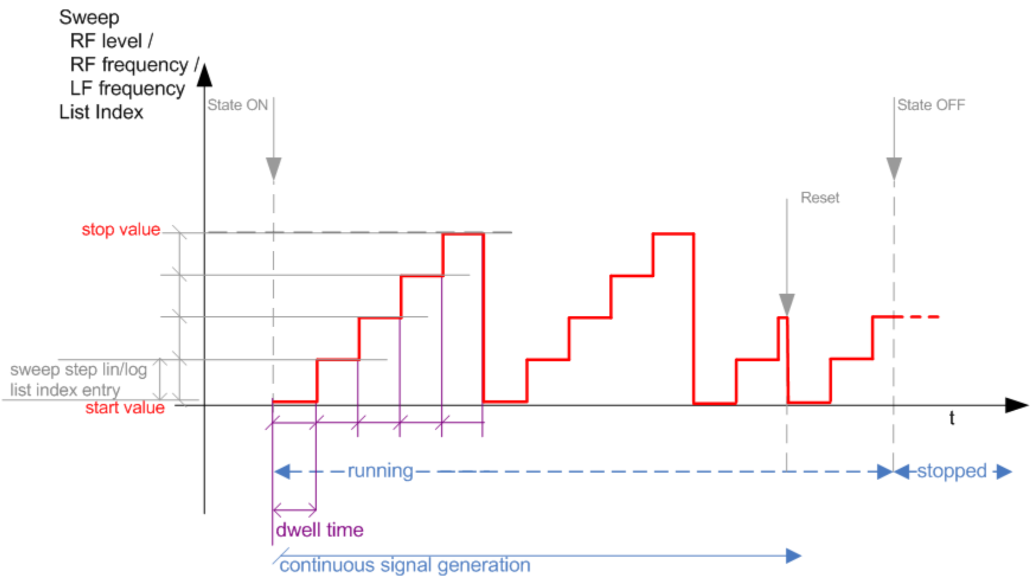


Figure 5-3: Auto mode (Sweep/List)

- The instrument generates the signal continuously.
- Trigger mode "Auto" is prerequisite. It causes the continuous generation of the sweep signal.
- Starts signal generation immediately with "State = On".
- Switches automatically to the next sweep step when the Dwell time has elapsed.
- Stops signal generation with "State = Off".

Table 5-1: Cross-reference between manual and remote control in Auto mode (Sweep/List)

Manual control mode: "Auto"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:TRIGger<hw>:FSWeep:SOURce AUTO [IMMediate]` `:SOURce<hw>:SWEep:FREQuency:MODE AUTO`
RF level sweep	`:TRIGger<hw>:PSWeep:SOURce AUTO [IMMediate]` `:SOURce<hw>:SWEep:POWer:MODE AUTO`
LF frequency sweep	`:TRIGger<hw>:LFFSweep:SOURce AUTO [IMMediate]` `:SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE AUTO`
List	`:SOURce<hw>:LIST:MODE AUTO` `:SOURce<hw>:LIST:TRIGger:SOURce AUTO`

Single / Extern Single mode (Sweep/List)

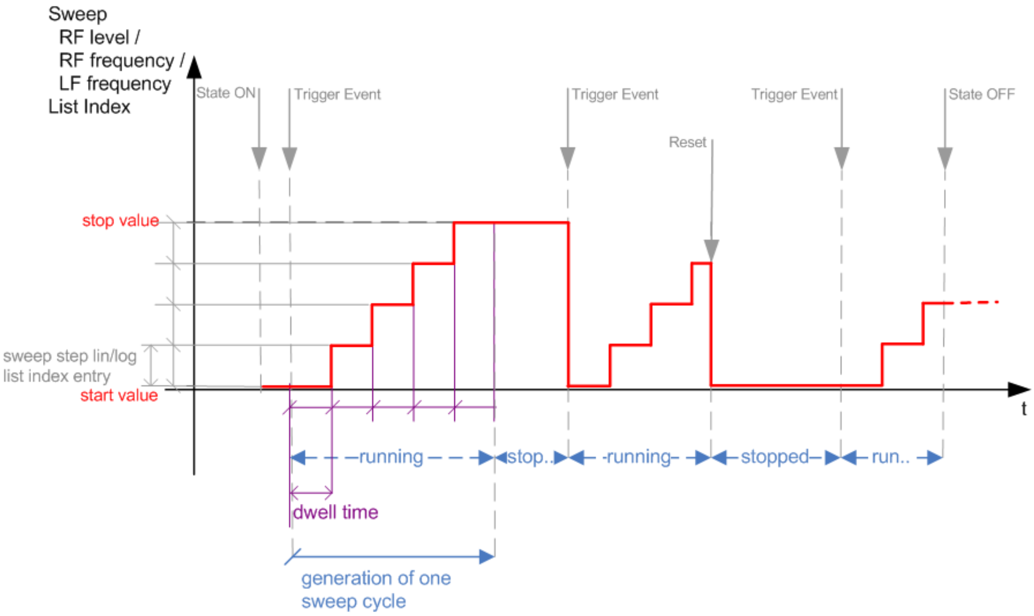


Figure 5-4: Single / Extern Single mode (sweep / list)

In single mode, you can specify, that the signal returns to the start value when a sweep cycle has been completed.

See "The Retrace function" on page 117 for details.

- The instrument generates a single sweep cycle.
- Trigger mode "Manual". A trigger event initiates one sweep from the start value to the end value.
- "State = On" sets the signal to the start value: the sweep start frequency, the sweep start power or the frequency-power value pair of the selected index in the list.
- Starts signal generation with a trigger event.

- Switches automatically to the next step when the Dwell time has elapsed.
- Stops signal generation at the set end value and waits for the subsequent trigger event.
- Trigger sources:
  – The "Execute Single" function.
  – The corresponding remote control command.
  – An externally applied trigger signal.
- "State = Off" stops the signal generation in sweep or list mode.

Table 5-2: Cross-reference between manual and remote control in Single / Extern Single modes (Sweep/List)

Manual control mode: "Single / Extern Single"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:TRIGger<hw>:FSWeep:SOURce SINGle [BUS]` "Single" **or** `:TRIGger<hw>:FSWeep:SOURce EXTernal [EXTernal]` "Extern Single" `:SOURce<hw>:SWEep:FREQuency:MODE AUTO`
RF level sweep	`:TRIGger<hw>:PSWeep:SOURce SINGle [BUS]` for "Single" **or** `:TRIGger<hw>:PSWeep:SOURce EXTernal [EXTernal]` for "Extern Single" `:SOURce<hw>:SWEep:POWer:MODE AUTO`
LF frequency sweep	`:TRIGger<hw>:LFFSweep:SOURce SINGle [BUS]` "Single" **or** `:TRIGger<hw>:LFFSweep:SOURce EXTernal [EXTernal]` "Extern Single" `:SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE AUTO`
List	`:SOURce<hw>:LIST:TRIGger:SOURce SINGle` "Single" **or** `:SOURce<hw>:LIST:TRIGger:SOURce EXTernal` "Extern Single" `:SOURce<hw>:LIST:MODE AUTO`

Step / Extern Step mode (Sweep/List)

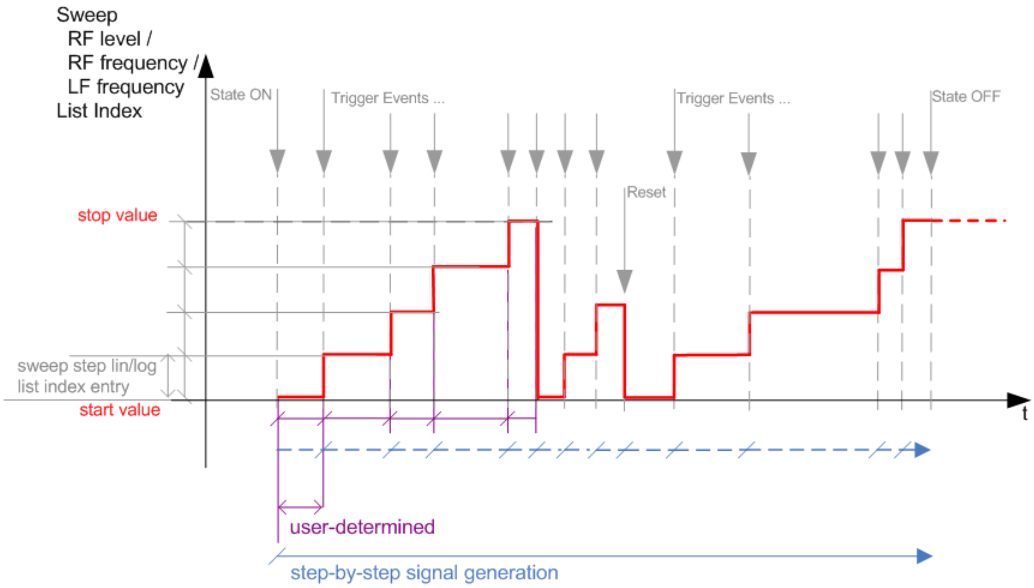


Figure 5-5: Step / Extern Step mode (sweep / list)

- The instrument generates the signal step-by-step.
- Starts signal generation with "State = On".
- Switches to the next step with a manual action.
  If the end value is reached, signal generation starts again from the beginning.
- Stops signal generation with "State = Off".
- Trigger sources:
  - The rotary knob at the front panel.
  - The ARROW keys at the front panel.
  - The corresponding remote control commands.
  - An externally applied trigger signal.

To step through the sweep frequencies or levels:

- In manual mode:
  - Set the Current Frequency or Current Level values
  - Use the UP and DOWN keys or the rotary knob
- In remote control mode:
  - Use the commands `[:SOURce<hw>]:FREQuency:MANual` or `[:SOURce<hw>]:POWer:MANual` with the `UP` or `DOWN` parameter

Steps that would exceed the sweep range are ignored.

Table 5-3: Cross-reference between manual and remote control in Step / Extern Step modes (Sweep/ List)

Manual control mode: "Step / Extern Step"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:TRIGger<hw>:FSWeep:SOURce SINGle [BUS]` "Step" **or** `:TRIGger<hw>:FSWeep:SOURce EXTernal [EXTernal]` for "Extern Step" `:SOURce<hw>:SWEep:FREQuency:MODE STEP`
RF level sweep	`:TRIGger<hw>:PSWeep:SOURce SINGle [BUS]` "Step" **or** `:TRIGger<hw>:PSWeep:SOURce EXTernal [EXTenal]` "Extern Step" `:SOURce<hw>:SWEep:POWer:MODE STEP`
LF frequency sweep	`:TRIGger<hw>:LFFSweep:SOURce SINGle [BUS]` "Step" **or** `:TRIGger<hw>:LFFSweep:SOURce EXTernal [EXTenal]` "Extern Step" `:SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE STEP`
List	`:SOURce<hw>:LIST:TRIGger:SOURce SINGle` "Step" **or** `:SOURce<hw>:LIST:TRIGger:SOURce EXTernal` "Extern Step" `:SOURce<hw>:LIST:MODE STEP`

Extern Start/Stop mode (sweep)

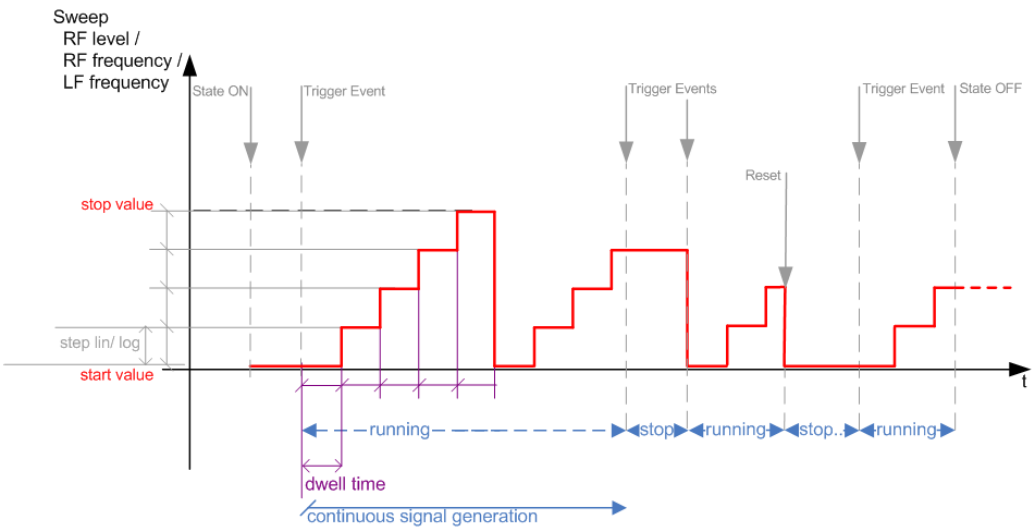


Figure 5-6: Extern Start/Stop mode (sweep)

- The instrument generates the signal continuously.
- Trigger mode "Auto" and "Sweep > State = On" are prerequisite.
- State "On" sets the signal to the start value, that is one of the following:
  – Sweep start frequency
  – Sweep start power
  – Frequency-power value pair of the selected index in the list
- Starts signal generation with a trigger event.

- Switches automatically to the next sweep step when the Dwell time has elapsed. If the end value is reached, signal generation continues with the next sweep cycle.
- Stops signal generation with the next external trigger event.
- Starts the signal generation again with the next trigger event, beginning at the start value.
- "State = Off" stops the signal generation in sweep or list mode.
- Trigger source: An externally applied trigger signal.

Table 5-4: Cross-reference between manual and remote control in Extern Start/Stop modes (sweep)

Manual control mode: "Extern Start/Stop"	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:TRIGger<hw>:FSWeep:SOURce EAUTo [-]` `:SOURce<hw>:SWEep:FREQuency:MODE AUTO`
RF level sweep	`:TRIGger<hw>:PSWeep:SOURce EAUTo [-]` `:SOURce<hw>:SWEep:POWer:MODE AUTO`
LF frequency sweep	`:TRIGger<hw>:LFFSweep:SOURce EAUTo [-]` `:SOURce<hw>:LFOutput<ch>:SWEep:FREQuency:MODE AUTO`

Manual mode (Sweep/List)

The **manual** mode only applies to remote control. It is not visible in the graphical user interface of the instrument and is described here for completeness.

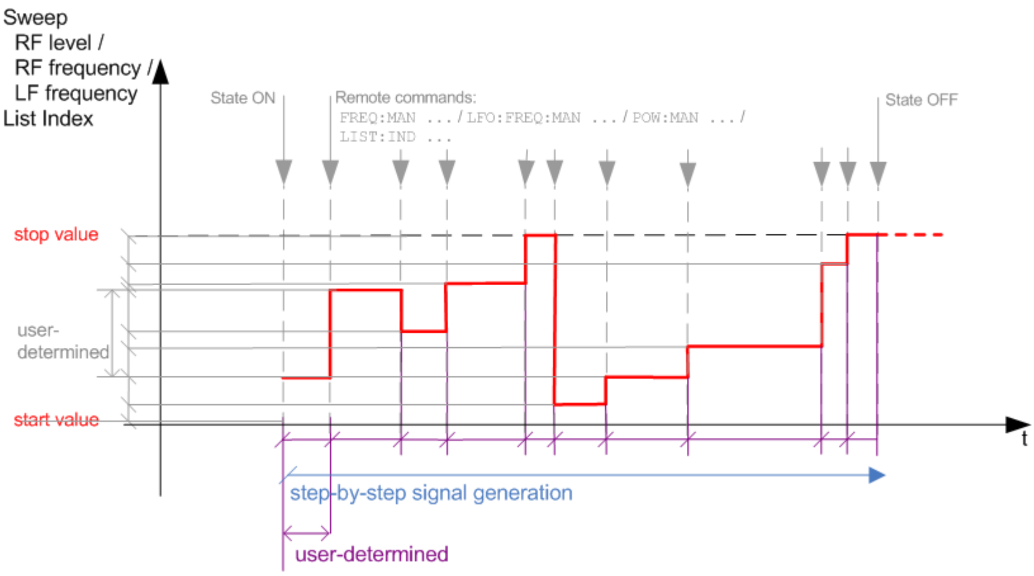


Figure 5-7: Manual mode in remote control (sweep / list)

- The instrument generates the signal in steps.
- Starts signal generation with "State = On".
- Switches to the next step with a user defined setting via remote control.

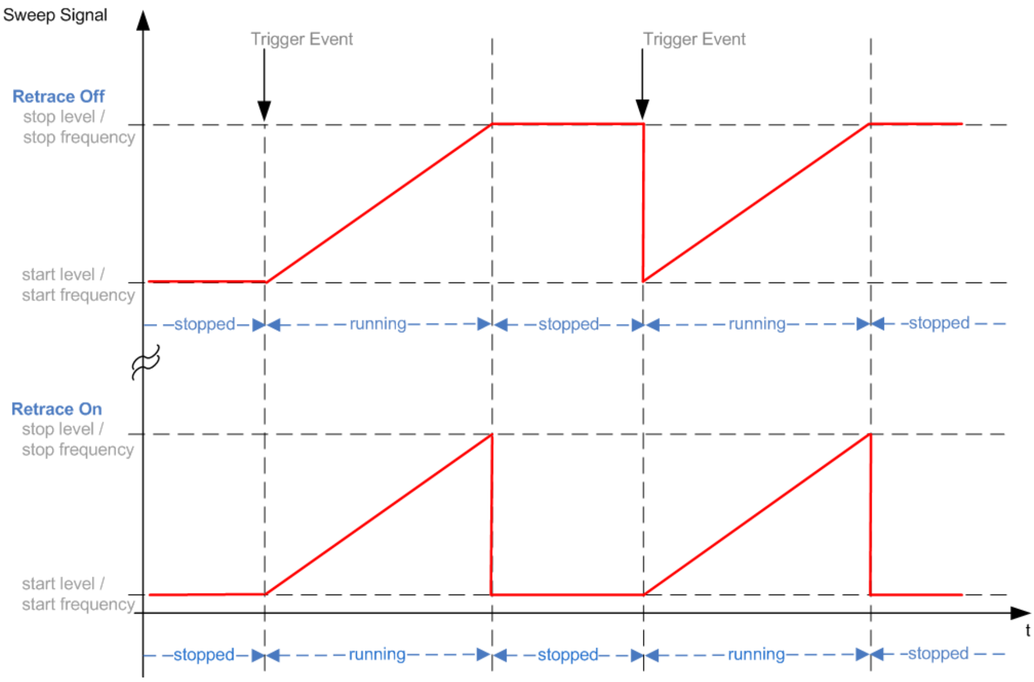
You can arbitrarily select a value within the range of the start and stop values by setting the frequency, power or index using the corresponding remote control command. There is no ascending or descending order.

- Stops signal generation with "State = Off".

Table 5-5: Remote control commands in manual mode (Sweep/List)

Remote control mode: Manual	Remote commands Rohde & Schwarz proprietary and [SCPI conform] value name
RF frequency sweep	`:SOURce<hw>:FREQuency:MANUal <Manual>`
RF level sweep	`:SOURce<hw>:POWer:MANual <Manual>`
LF frequency sweep	`:SOURce<hw>:LFOUTput:FREQuency:MANual <Manual>`
List	`:SOURce<hw>:LIST:INDex <Index>`

The Retrace function



Retrace is a function especially designed for "Single" sweep modes, when the sweep signal follows a sawtooth shape. Working in this mode, the instrument performs a single sweep cycle when a trigger event occurs. The signal generation stops at the set end point (stop frequency or stop level), and waits for the next trigger event.

In this state, the upper value of the signal remains at the output until the next cycle starts. In particular, if you generate a level sweep signal, the high amplitude of the signal is output for a certain time. To protect the DUT from overload, the retrace function immediately resets the signal value to the start value at the end of a sweep cycle. It shifts down the power, or frequency value during the waiting period.

You can use the "Retrace" function if "Sweep > Mode = Single/External Single" and "Shape = Sawtooth", see:

- " Shape " on page 126
- "Mode" on page 125

5.2 About Sweep Mode

In sweep mode, the signal generator scans the sweep range gradually from one point to another, using a defined step width and following a triangle or sawtooth shape. This mode also enables you to change direction, that means, it is possible to step backwards.

Configuration and operation of sweep mode signals

- The R&S SMA100B generates a sweep signal by varying one of the following parameters: the *RF frequency*, the *LF frequency* or the *RF level*.
- In all sweep modes, you can perform a complete sweep cycle once, repeat the cycle continuously or step through it gradually.
- The instrument generates the sweep signal according to the settings of the associated sweep.
- The "Reset Sweep" function sets the sweep to the start value.

Impact of changing the sweep mode during performance

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.

5.2.1 Correlating Parameters in Sweep Mode

A sweep signal is a periodic signal that changes its frequency or level from a starting value to an ending value in a defined time.

The R&S SMA100B provides various possibilities to configure a sweep signal. For example, you can determine the sweep range by the start and end values, or based on the start value and span. In any case, related parameters are adjusted accordingly.

The formulas below show how the sweep parameters correlate and the corresponding calculation basis, by the frequency and offset settings. Apart from "Center Frequency", "Span" and "Step_lin", the values apply accordingly to the level settings.

Table 5-6: Variables that are used in the following formulas

Variable	Description
Sweep range	Defined frequency or level value range
f_{CENTer}	Defined center frequency
f_{SPAN}	Defined extend of the sweep range

Variable	Description
f_{OFFSet}	Frequency offset
f_{STARt}	Start frequency of the sweep range
f_{STOP}	End frequency of the sweep range
f_1	Current sweep frequency
f_2	Next, subsequent sweep frequency
step_lin	Step width in linear scaling
step_log	Step width in logarithmic scaling
POINts	Number of steps within the sweep range

Sweep range

The sweep range is defined by a start and an end value. How the remaining parameters correlate is shown below.

Offset = 0

Sweep Range = f_{STARt} to f_{STOP}

$f_{CENTer} = (f_{STARt} + f_{STOP})/2$

$f_{SPAN} = (f_{STOP} - f_{STARt})$

Where:

$f_{STARt} = f_{CENTer} - (f_{SPAN}/2)$

$f_{STOP} = f_{CENTer} + (f_{SPAN}/2)$

Offset≠0

A defined offset also affects the sweep range and the center frequency. Therefore, the set frequencies are only absolute values, if the Offset = 0. Offset ≠ 0 shifts the frequencies with the offset value:

Sweep Range = $f_{STARt} + f_{OFFSet}$ to $f_{STOP} + f_{OFFSet}$

$f_{CENTer} = f_{CENTer} + f_{OFFSet}$

$f_{SPAN} = f_{SPAN} + f_{OFFSet}$

The value range of the instrument is calculated as follows:

$RF_{min} + f_{OFFSet}$ to $RF_{max} + f_{OFFSet}$

It is possible to set $f_{STARt} > f_{STOP}$ and $f_{STARt} < f_{STOP}$, so that even a negative value is permitted for the "Span".

If you change the start and/or stop frequency, the span and center frequency change accordingly, and vice versa.

Sweep steps

In the following, you see how the sweep steps are calculated depending on the defined spacing mode. The formulas show a frequency sweep, but apply to the level settings in the same way.

The step width is added to the current value, to get the subsequent sweep step.

With **linear** scaling, the next frequency is calculated according to:

$f_2 = f_1 + step\_lin$

In the **logarithmic** scaling, the step width is determined in per cent, as a constant fraction of the current frequency.

Successive frequencies are calculated as follows:

- For $f_{STARt} < f_{STOP}$
  $f_2 = f_1 * (1 + step\_log/100)$
  If $f_2 > f_{STOP}$, then $f_2 = f_{STOP}$
- For $f_{STARt} > f_{STOP}$
  $f_2 = f_1/(1 + step\_log/100)$
  If $f_2 < f_{STOP}$, then $f_2 = f_{STOP}$

With "Shape = Triangle", the frequency values on the slope from f_{STOP} to f_{STARt} are the same as on the slope from f_{STARt} to f_{STOP}.

If you specify the number of steps within the sweep range, the step width is adjusted according to the following correlation:

- For **linear** sweeps and $f_{STARt} < f_{STOP}$
  $POINts_{frequency} = ((f_{STARt} - f_{STOP})/step\_lin) + 1 = (f_{SPAN}/step\_lin) + 1$
- For **logarithmic** sweeps and $f_{STARt} < f_{STOP}$
  $POINts_{frequency} = ((\log f_{STOP} - \log f_{STARt})/\log step\_log) + 1$

If step_log changes, the value of POINts is adjusted. The f_{STARt} and f_{STOP} values are retained.

5.3 About List Mode

The list mode is used to generate the RF signal based on a set of predefined frequency and amplitude value pairs, with individual step times. You can define the values arbitrarily, in any order and varying step sizes, within the entire configurable value range of the instrument.

Configuration and operation of list mode signals

The parameters configuring the RF signal are defined in a list (table) and stored in a file.

Creating and handling lists

List files can be created in the following ways:

- **Internally**
  Use the build-in table editor with columns for the frequency-level values pairs and the dwell time.
  Define the values manually (row by row) or automatically, with linearly interpolated values, calculated based on value range and step size.
  (See Chapter 5.7, "List Editor", on page 138)
  Lists are saved as files with user-definable filename and the predefined file extension `*.lsw`. To load a saved file, use the "File Manager".
  (See Chapter 9.8, "Using the File Manager", on page 203)
  Lists can be exported, too. For example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.
- **Externally**
  Create a list file as a CSV file with Microsoft Excel, with a Notepad or a similar tool and save it with the predefined extension. Transfer the file to and load it into the instrument.

Dwell time mode

You can choose whether you want to use different dwell times or a fixed value for all steps in the list mode:

- "From List"
  This mode uses the values from the data table.
- "Global"
  This mode processes the list using a fixed time interval.
  With "Global" dwell time you, however, still need to enter the dwell time values in the data list.
  The reason is that the instrument stores only completed rows and ignores incomplete entries. In addition, the data list must be filled completely, in case you want to change the dwell time mode to "From List".
  See Edit List Mode Data

5.4 Significant Parameters and Functions

This section provides some basic parameters, settings and functions that affect the operating modes CW, list and sweep, that means at all frequency and level transitions of the RF signal.

Dwell time

Dwell time is the length of time that elapses from the beginning until the end of a step. It applies to "Auto", "Single" and "Extern Single" modes, that are triggered either continuously or manually.

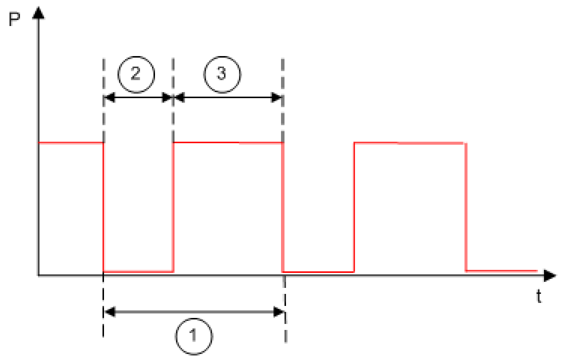


Figure 5-8: Dwell Time vs. settling time

1 = "Dwell Time" (as set with the parameter)
2 = Settling time
3 = Dwell time (effective)

The set dwell time defines the duration of a list or sweep step. However, the time the instrument requires for the signal to settle reduces the effective dwell time.

$t_{dwell(effective)} = t_{dwell} - t_{setlting}$

In "Single" mode, the time between two entries determines the duration of a step, and accordingly, the time between two trigger events in "Extern Step" mode. In these operating modes, the dwell time does not affect signal generation.

Hardware adjustments

The first time a list (new or modified) is processed, the instrument automatically calculates the necessary hardware settings. It can be performed during list processing, but delays the first cycle, especially with short dwell times.

With long dwell times, you can perform this calculation while the list is being processed; the entered dwell times are observed. With 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 indicates that there is a deviation between the current and set dwell times. After the first cycle, you do not need to perform additional calculations. The current dwell times do not deviate from the set dwell times.

Blanking

The instrument is equipped with a *blanking* circuit, which temporarily switches off the RF signal whenever the frequency changes, until the signal has settled to a stable state.

Live list processing mode

The R&S SMA100B generates the signal directly from the value pairs in the database, and adjusts the hardware settings accordingly. The current instrument state and thus any change during the signal generation directly affects the RF signal. The temporary memory is not used.

You can conveniently modify parameters like modulation settings during run-time. Learning list mode data is not required. Impacts like temperature drift are also considered immediately.

This mode is optimized for **maximum signal quality**, and is useful if dwell times higher than 2 ms are sufficient.

5.5 Sweep Mode Settings

This section lists the settings of **all** available sweep types.

Access:

1. Select "Sweep" > "RF Frequency Sweep"
2. Select "Sweep" > "RF Level Sweep"
3. Select "Sweep" > "LF Frequency Sweep"

The remote commands required to define these settings are described in:

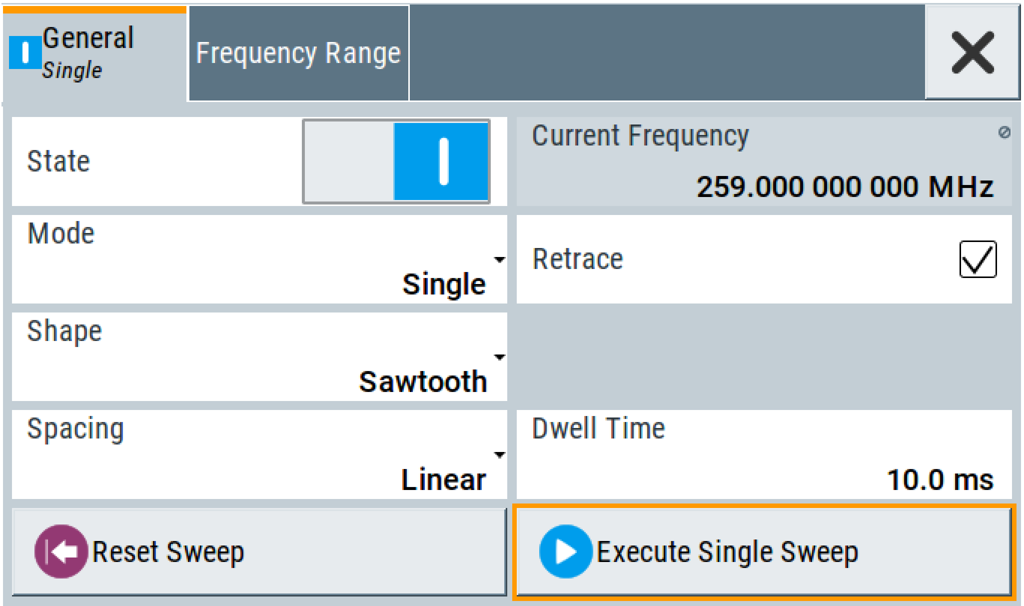
- Chapter 12.15.3, "SOURce:FREQuency Subsystem", on page 392
- Chapter 12.15.12, "SOURce:SWEep Subsystem", on page 444
- Chapter 12.15.5, "SOURce:LFOutput Subsystem", on page 400

Settings

5.5.1 General Sweep Settings

Access:

► Select for example "Sweep" > "RF Frequency Sweep"



Settings

State (RF frequency sweep)

Activates RF frequency sweep signal generation.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:
`[:SOURce<hw>]:FREQuency:MODE` on page 393

State (RF level sweep)

Activates RF level sweep signal generation.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:
`[:SOURce<hw>]:POWer:MODE` on page 435

State (LF frequency sweep)

Activates the generation of an LF frequency sweep signal in the "LF Frequency" dialog.

In the "Sources" tab of the analog modulations, the instrument shows the current state of the LF frequency sweep.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:
`[:SOURce<hw>]:LFOutput:FREQuency:MODE` on page 404

Current Frequency
In "RF/LF Frequency Sweep" mode, displays the current frequency.

In Mode = "Step", the parameter is editable and you can enter the next frequency step.

Remote command:
`[:SOURce<hw>]:FREQuency:MANual` on page 395
`[:SOURce<hw>]:LFOutput:FREQuency:MANual` on page 404

Current Level
Applies to "RF Level Sweep" mode.

Displays the current level value.

In Mode = "Step", the parameter is editable and you can enter the next level step.

Remote command:
`[:SOURce<hw>]:POWer:MANual` on page 434

Mode
Selects the sweep mode.

For detailed information on the sweep modes and the triggering, see Chapter 5.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 110.

"Auto" Generates a continuously repeating sweep signal directly after activating the sweep mode.
The sweep steps are performed automatically, controlled by the dwell time.

"Single / Extern 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.

"Step / Extern Step"
Generates the sweep signal step-by-step, manually triggered.

"Extern Start/Stop"
Generates a continuously repeating sweep signal that is started, stopped, and restarted by subsequent external trigger events.
The sweep steps are performed automatically, controlled by the dwell time.

Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:MODE` on page 449
`[:SOURce<hw>]:SWEep:POWer:MODE` on page 447
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE` on page 410
`:TRIGger<hw>[:SWEep]:SOURce` on page 480

:TRIGger<hw>:FSWeep:SOURce on page 480
:TRIGger<hw>:PSWeep:SOURce on page 480
:TRIGger<hw>:LFFSweep:SOURce on page 480

Retrace

For "Shape = Sawtooth" and "Mode = Single/External Single", activates that the signal changes to the start value while it is waiting for the next trigger event.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:RETRace on page 451
[:SOURce<hw>]:SWEep:POWer:RETRace on page 451
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RETRace on page 411

Shape

Selects the waveform shape of the sweep signal.

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

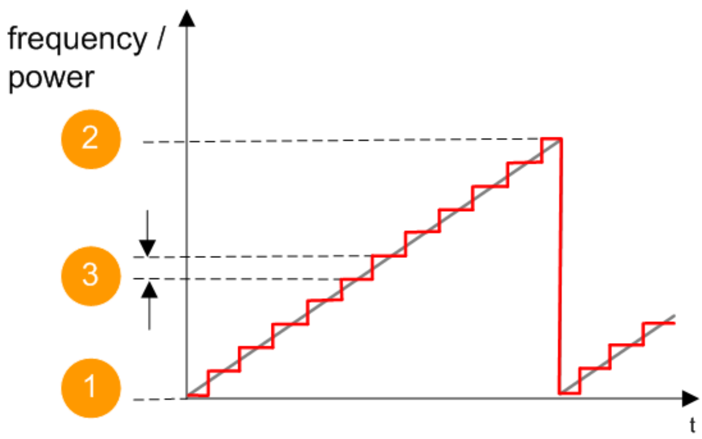


Figure 5-9: Sweep signal sawtooth shape

1 = Start value
2 = Stop value
3 = Step width

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

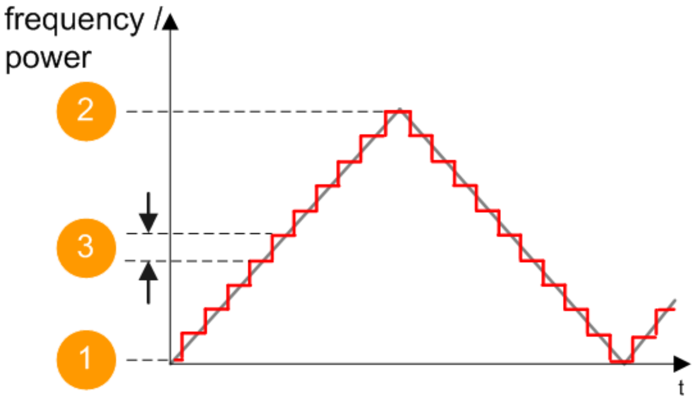


Figure 5-10: Sweep signal triangle shape

1 = Start value
2 = Stop value
3 = Step width

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe on page 450
[:SOURce<hw>]:SWEep:POWer:SHAPe on page 450
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe on page 412

Spacing

In "RF and LF Frequency Sweep" modes, selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

Enter the step size with the parameter Step Linear/Step Logarithmic .

"Linear" Takes the frequency value entered as absolute value in Hz.

"Logarithmic" Takes the value entered as a logarithmic value, i.e. as a constant fraction of the current frequency in %.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 449
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing on page 412

Dwell Time

Defines the duration of the individual sweep steps.

See also Chapter 5.4, "Significant Parameters and Functions", on page 121.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:DWELl on page 448
[:SOURce<hw>]:SWEep:POWer:DWELl on page 447
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl on page 410

Trigger Slope

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

Trigger signal is expected at the INST TRIG connector.

"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 400

Reset Sweep
Resets a sweep.

With the next trigger event, the sweep starts at the initial value.

Remote command:
[:SOURce<hw>]:SWEep:RESet[:ALL] on page 452

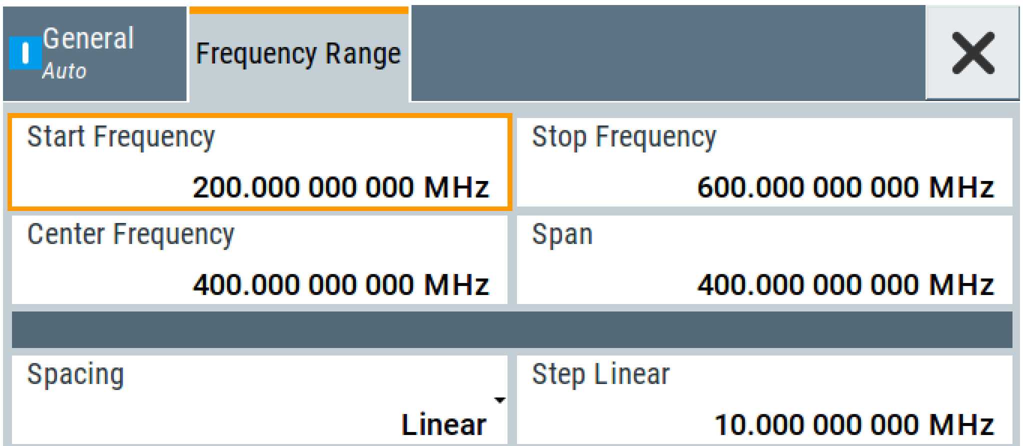
Execute Single Sweep
In "Mode = Single", starts a sweep manually.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute on page 450
[:SOURce<hw>]:SWEep:POWer:EXECute on page 450
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute on page 410
:TRIGger<hw>[:SWEep][:IMMediate] on page 481
:TRIGger<hw>:FSWeep[:IMMediate] on page 481
:TRIGger<hw>:PSWeep[:IMMediate] on page 481
:TRIGger<hw>:LFFSweep:IMMediate on page 481

5.5.2 Frequency Range Settings

Access:

1. Select for example "Sweep" > "RF Frequency Sweep"
2. Select "Frequency Range".



Settings

Start Frequency/Stop Frequency

Defines the frequency sweep range by setting the start and end values.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Remote command:
`[:SOURce<hw>]:FREQuency:STARt` on page 397
`[:SOURce<hw>]:FREQuency:STOP` on page 398
`[:SOURce<hw>]:LFOutput:FREQuency:STARt` on page 405
`[:SOURce<hw>]:LFOutput:FREQuency:STOP` on page 405

Center Frequency

In "RF Frequency Sweep" mode, sets the RF center frequency.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Remote command:
`[:SOURce<hw>]:FREQuency:CENTer` on page 397

Span

In "RF Frequency Sweep" mode, sets the extent of the frequency sweep range.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Remote command:
`[:SOURce<hw>]:FREQuency:SPAN` on page 397

Spacing

In "RF and LF Frequency Sweep" modes, selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

Enter the step size with the parameter Step Linear/Step Logarithmic .

"Linear"	Takes the frequency value entered as absolute value in Hz.
"Logarithmic"	Takes the value entered as a logarithmic value, i.e. as a constant fraction of the current frequency in %.

Remote command:
`[:SOURce<hw>]:SWEep[:FREQuency]:SPACing` on page 449
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing` on page 412

Step Linear/Step Logarithmic

In "RF/LF Frequency Sweep" mode, sets the step width for the individual frequency sweep steps. The value is added at each sweep step to the current frequency.

Depending on the current Spacing, you can enter either an absolute or logarithmic step width.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

"Step Linear" The step width is a constant value in Hz.

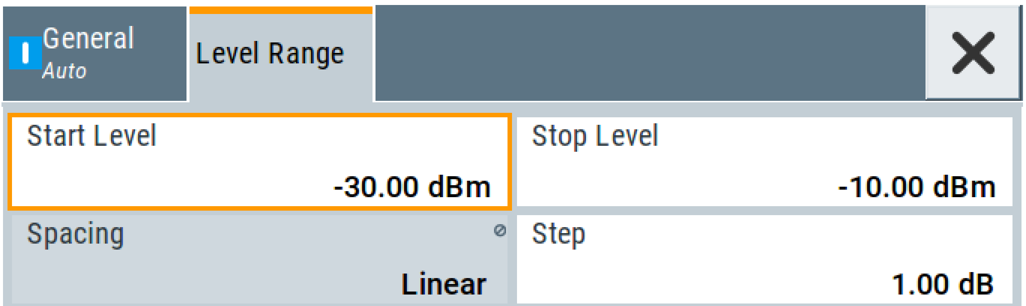
"Step Logarithmic"
The step width is determined logarithmically in %, i.e. as a constant fraction of the current frequency.

Remote command:
[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] on page 451
[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic on page 451
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] on page 413
[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic
on page 412

5.5.3 Level Range Settings

Access:

1. Select "Sweep" > "Level Sweep"
2. Select "Level Range".



Settings

Start Level / Stop Level

Defines the level sweep range by setting the start and end values.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Remote command:
[:SOURce<hw>]:POWer:STARt on page 436
[:SOURce<hw>]:POWer:STOP on page 436

Spacing

Indicates that the level step intervals are linearly (straight proportional) distributed, i.e. intervals are of equal size.

Set the step size with the parameter "Step".

Remote command:
n.a.

Step

Applies to "RF Level Sweep" mode.

Sets the step width for the level sweep steps.

The step width is specified logarithmically in dB, i.e. as constant fraction of the current level.

Remote command:
`[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic]` on page 448

5.6 List Mode Settings

The "List Mode" dialog contains all the functions and settings for creating and handling lists with RF frequency/level pairs for generating the RF signal based on these values.

Access:

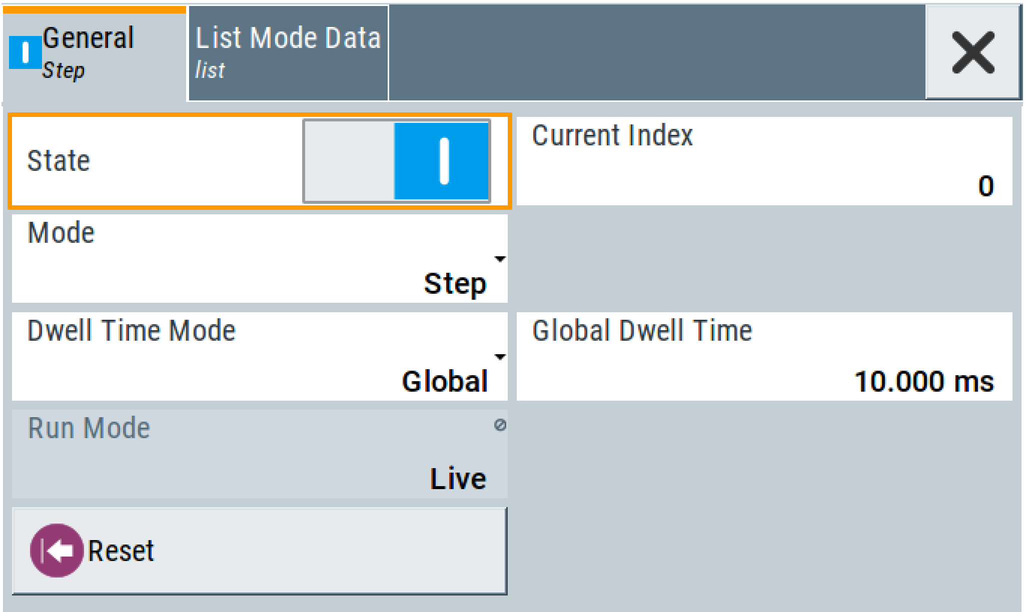
► Select "Sweep" > "List mode".

The dialog contains parameters for configuring the list mode processing, entering list mode data and transferring data files from or to the instrument.
The remote commands required to define these settings are described in Chapter 12.15.6, "SOURce:LIST Subsystem", on page 413.

5.6.1 General Settings

Access:

► Select "Sweep" > "List mode".



In the "General" tab, you can configure the trigger and dwell time modes for list processing and activate signal generation.

Settings

State

Activates the list mode and processes the currently selected list.

Note: Active sweep mode deactivates other sweeps or lists and vice versa.

Remote command:

`[:SOURce<hw>]:FREQuency:MODE` on page 393

Current Index

Sets the list index for list processing in "Step" mode. In the other modes, the index indicates the current step.

Remote command:
[:SOURce<hw>]:LIST:INDex on page 418

Mode
Selects the mode for list processing.

For detailed information on the sweep modes and the triggering, see Chapter 5.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 110.

"Auto" Generates the signal by processing the frequency/level value pairs of the list from the beginning to the end.
The list steps are performed automatically, controlled by the dwell time. If you switch from any mode to "Auto", signal generation always starts at the top of the list.

"Single / Extern Single"
Generates the signal by processing the frequency/level value pairs of the list once from the beginning to the end after a trigger event.
The list steps are performed automatically, controlled by the dwell time. If one cycle is completed, the instrument waits for the next trigger event.

"Step / Extern Step"
Generates the signal by processing the frequency/level value pairs of the list step-by-step, manually triggered.

Remote command:
[:SOURce<hw>]:LIST:TRIGger:SOURce on page 421
[:SOURce<hw>]:LIST:MODE on page 419

Dwell Time Mode
Selects either variable dwell times or a fixed dwell time to perform signal generation in list mode.

"Global" Uses the same dwell time for all lists steps, set with Global Dwell Time.

"From List" Uses the dwell times from the list.
You can define the dwell time for each frequency/level value pair individually, see Chapter 5.7, "List Editor", on page 138.

Remote command:
[:SOURce<hw>]:LIST:DWELl:MODE on page 417

Global Dwell Time
Sets the dwell time for Dwell Time Mode > "Global".

See also "Dwell time" on page 121.

Remote command:
[:SOURce<hw>]:LIST:DWELl on page 416

Run Mode
Selects how the instruments process the list data.

"Live" Generates the signal directly from the database.
The instrument reads the pairs of values from the list, calculates the hardware settings and generates the signal immediately.
See "Live list processing mode" on page 122.

Remote command:
[:SOURce<hw>]:LIST:RMODe on page 420

Trigger Slope

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

Trigger signal is expected at the INST TRIG connector.

"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 400

Execute Single

Manually starts list processing in "Single" mode.

Remote command:
[:SOURce<hw>]:LIST:TRIGger:EXECute on page 420

Reset

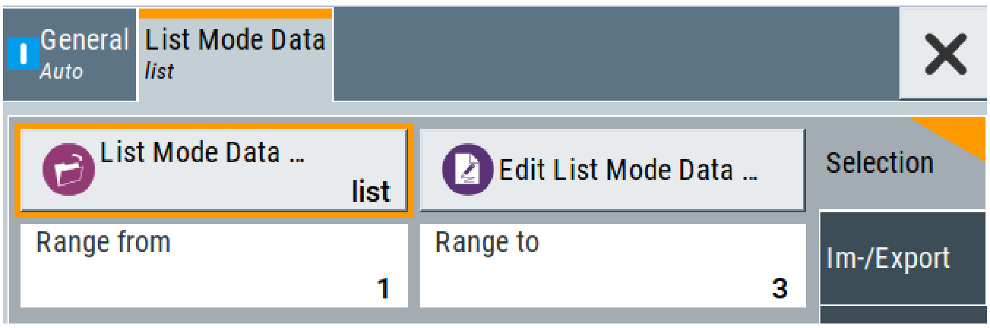
Resets the list to the starting point.

Remote command:
[:SOURce<hw>]:LIST:RESet on page 423

5.6.2 List Mode Data Settings

Access:

1. Select "Sweep" > "List mode".
2. Select "List Mode Data".



This dialog contains the parameters required for creating and editing lists, activating the learning function and selecting the list processing mode.

Settings

List Mode Data

Accesses the standard "Select List" dialog for selecting, creating and editing a list file. The currently loaded file is indicated.

You can create data lists with the internal editor or import externally created files, see "Creating and handling lists" on page 121.

Remote command:
`[:SOURce<hw>]:LIST:CATalog?` on page 422
`[:SOURce<hw>]:LIST:SELect` on page 423
`[:SOURce<hw>]:LIST:DELete` on page 422
`[:SOURce<hw>]:LIST:DELete:ALL` on page 422

Edit List Mode Data

Opens the editor to insert and save data lists with RF frequency, power and dwell time value pairs, see Chapter 5.7, "List Editor", on page 138.

You find this function also in standard file select dialog, accessed via List Mode Data .

List Range from/to

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.

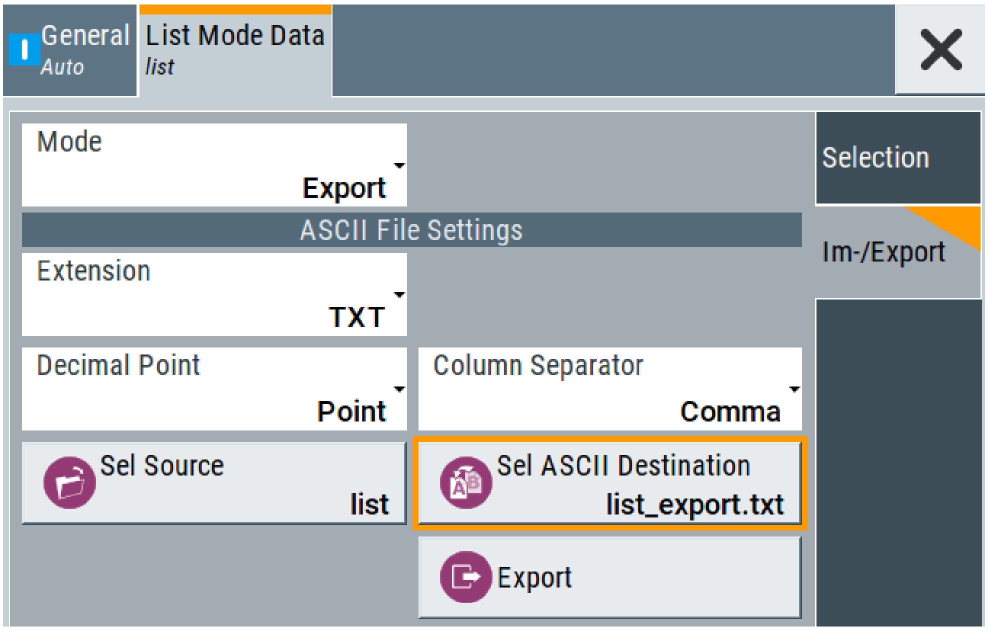
Remote command:
`[:SOURce<hw>]:LIST:INDex:STARt` on page 419
`[:SOURce<hw>]:LIST:INDex:STOP` on page 419

5.6.3 Import/Export Settings

Access:

1. Select "Sweep" > "List Mode".

2. Select "List Mode Data" > "Im-/Export".



The "Im-/Export" dialog provides the parameters for importing or exporting files with user data in standard ASCII `*.txt` or `*.csv` file format.
The table separators and the decimal floating point numbers are customizable.

Settings

Mode

Selects import or export of a data list file. The provided parameters vary according to the selected mode.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:MODE` on page 425
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 392
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 383

ASCII File Settings

Defines the format and the separators of the associated data file.

"Extension" Selects `*.csv` or `*.txt` format.

"Decimal Point" Sets "Point" (dot) or "Comma" as the decimal separator used in the ASCII data with floating-point numerals.

"Column Separator"
Sets the separator between the columns in an ASCII table.
Available are: "Tab", "Semicolon", "Comma" or "Space".

Remote command:
[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension on page 424
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 425
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 425
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 391
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal on page 391
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn on page 391
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 383
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal on page 383
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn on page 384

Select Source/Select Destination
In "Mode > Import", access the file select dialog that provides standard file handling functions.

Where:
- "Select ASCII Source": defines the file to be loaded (imported)
- "Select ASCII Destination": selects the filename the loaded file is saved as

Remote command:
[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog? on page 424
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 425
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 390
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 391
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 384
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 384

Select Source / Select ASCII Destination
In "Mode > Export", access the file select dialog that provides standard file handling functions.

Where:
- "Select Source": selects the file to be exported
- "Select ASCII Destination": defines the filename and the file path the exported file is saved as

Remote command:
[:SOURce<hw>]:LIST:DEXChange:SELect on page 426
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 392
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 384

Import / Export
Imports or exports the selected data list file, depending on the current mode.

Remote command:
[:SOURce<hw>]:LIST:DEXChange:EXECute on page 424
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 392
[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 385

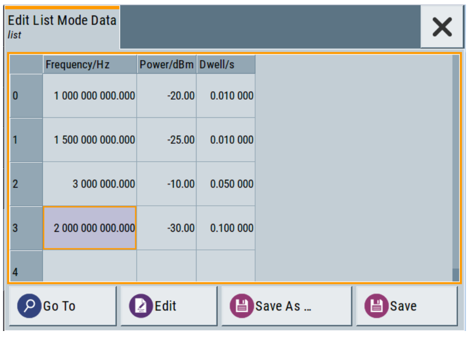
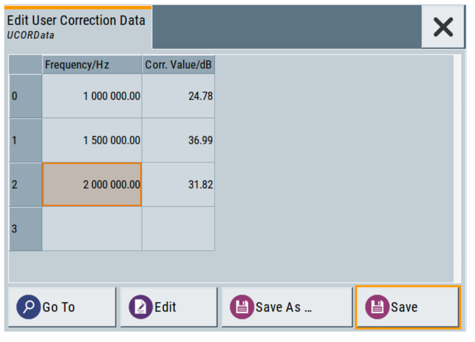
5.7 List Editor

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

The list editors in these two dialogs are similar. The following description shows the "List Data Editor".

Access:

1. "Sweep" > "List Mode" > "List Mode Data" > "Edit List Mode Data"
2. "Level" > "User Correction" > "Edit User Cor. Data"

	
List mode data editor	***User correction data editor***

The editor is a table with RF frequency and power value pairs and standard navigation functions.
The "Edit List Mode Data" dialog has an extra column for defining variable dwell times.

All values in one row have to be defined. Rows with missing values are ignored and not saved. Values of incomplete rows get lost.

If you use **global dwell time in list mode**, consider also the following:

- The instrument uses the value set with Global Dwell Time for all list steps.
- To save the list, however, you must fill in the "Dwell / s " column in each row, although the values are not used for generating the signal.
  Tip: Use the Fill Table Automatically function to fill the dwell time column automatically.

Settings

Edit List Mode Data

Table with correction or list values.

"Frequency /Hz"
Sets the frequency values.

Remote command:
`[:SOURce<hw>]:LIST:FREQuency` on page 418
`[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency` on page 387

"Power /dBm" Sets the level values.

Remote command:
`[:SOURce<hw>]:LIST:POWer` on page 419
`[:SOURce<hw>]:CORRection:CSET:DATA:POWer` on page 388

"Dwell /s" In list mode, sets the dwell time values.

Remote command:
`[:SOURce<hw>]:LIST:DWELl:LIST` on page 417

Data handling keys

Standard functions for file and data handling.

Note: Save a list only after filling both columns (frequency and level), otherwise the entries are lost.

Goto ← Data handling keys

Selects a row for editing.

Edit ← Data handling keys

Enables you to insert, or delete a row or ranges within a list, and provides access to a dialog for automatic filling.

Fill with Sensor ← Data handling keys

In "UCOR" mode, opens a dialog to configure the settings for automatic filling of user correction data with an R&S NRP power sensor

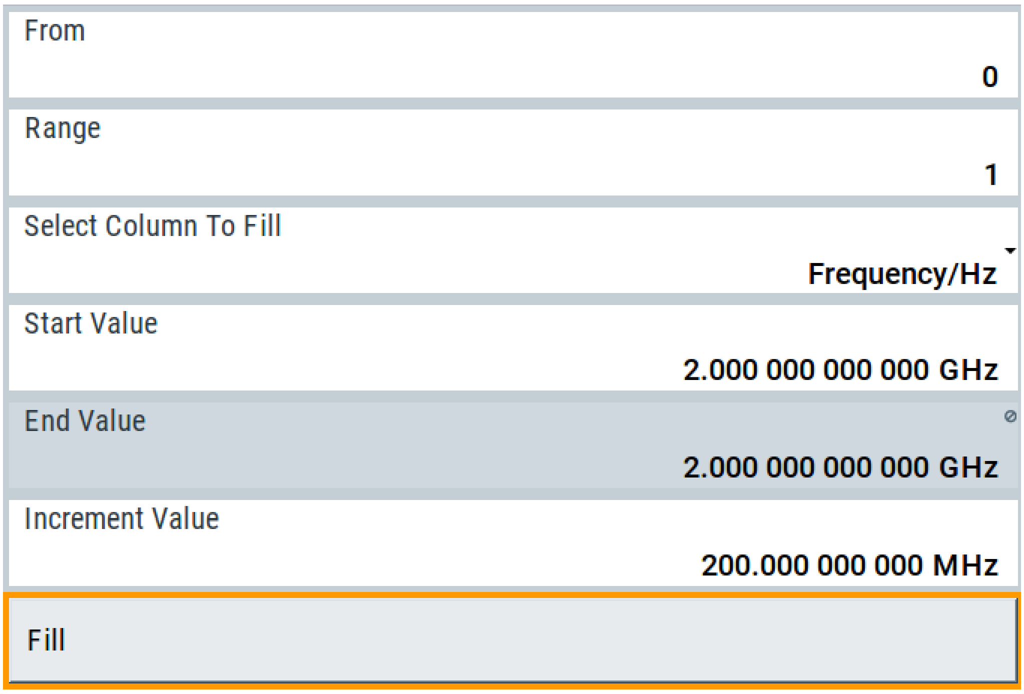
See Chapter 6.3.3, "Fill with Sensor", on page 154

Save As/Save ← Data handling keys

Stores the list in a file with user-defined name and predefined file extension. To save a copy or create a file, use the "Save as" function.

Fill Table Automatically

Provides parameters for filling a table automatically with user-defined values.



The settings are interdependent; the affected parameters change accordingly if you set a value.

To fill the table, select "Fill".

Note: Save a list only after filling all columns and rows, otherwise the entries are lost.

"From / Range"
Defines the start line and number of the row to be filled.

"Select Column to Fill"
Selects the respective value, including the unit.

"Start / End Value"
Provides the default values corresponding to the selected column.

"Increment" Determines the step size.

"Fill" Fills the table.
Fill both columns and then save the list. Otherwise the entries are lost.

5.8 How to Generate a Signal in List or Sweep Mode

This section shows you how to configure a varying RF output signal for both, the list and sweep modes.

To configure the frequency sweep signal

► For a step-by-step description, see Chapter 2.3.2, "Generating an RF Frequency Sweep Signal", on page 46.

Example: Fast changing frequency and level settings in list mode

The following example shows you how to generate an amplitude modulated RF signal based on list mode data.

General workflow

Since any change of the hardware settings or list entries can affect the RF signal characteristics directly, we recommend that you proceed as follows:

1. Configure the modulation settings.
   Activate the RF signal.
2. Wait until the hardware settings have settled.
3. Create a list file.
4. Configure the list processing mode.
5. Activate list mode.

To configure amplitude modulation and switch RF on

1. Press PRESET to start from an initial state.
2. Select "Modulation" > "Amplitude Modulation > On".
3. Select "Level" > "RF ON" to activate RF signal generation.

To create list mode data

1. Select "Sweep" > "List Mode".
2. In the "List Mode Data" tab, select "List Mode Data > New"
3. Enter the filename `ListMode_Test` for the data list and confirm with "Ok".

   The instrument creates a file and stores it in the `/var/user/` directory.
4. Select "Edit List Mode Data".
5. Enter the first value pairs "Frequency > 2", "Power > 0" and "Dwell > 2".
6. Enter further frequency, power and dwell time values in the same way.
7. Select "Save" and close the dialog.

To configure the list processing mode and start signal generation

1. In the "General" tab, select "List Mode > Auto".
2. Select "Dwell Time Mode > From List".
3. Switch state to "On".
4. Select "General > State > On".

   The instrument continuously generates an amplitude-modulated RF signal whose frequency and level values change according to the dwell times, as defined in the list.

During list processing, the generator displays no frequency and level values in the status bar, but you can check the following parameters.

- In the list mode dialog, the current index indicates the steps of the signal generation.
- In remote control mode, you can query:
  - The current state with `[:SOURce<hw>]:LIST:RUNNing?`
  - Current parameters with the commands FREQ?, POW? and LIST:DWEL?.

6 Improving Level Performance

To comply to the measurement requirements, the R&S SMA100B features various functions to optimize the RF signal level:

- **Attenuator**
  The large output level range is provided by a fast and wear-free switching electronic step attenuator.
  It provides also the generation of a constant VSWR (uninterrupted level) signal, highest level accuracy, noise suppression or compensation of external losses of cables.
  See "About the attenuator" on page 143.
- **ALC**
  The automatic level control system stabilizes the RF signal level over temperature and time.
  See "About ALC" on page 146.
- **UCOR**
  The user correction function allows you to compensate external losses (e.g. of cables) to achieve an input level of highest accuracy at the DUT.
  See "About UCOR" on page 148.
- **Power sensors**
  The R&S NRP power sensors support RF signal level optimization by determining the attenuation characteristics of downstream devices or cables, or by monitoring the RF signal level at the output directly.
  You can configure the measurement parameters of a power sensor directly in the R&S SMA100B and monitor its readings, including calibration and firmware update.
  See Chapter 6.4, "Using Power Sensors", on page 158

6.1 Attenuator

The R&S SMA100B is equipped with an electronic step attenuator unit that supports RF wear-free level setting.

About the attenuator

The attenuator is an electronic component which enables you to vary the amplitude of the RF signal. Basically, it is characterized by low VSWR (voltage standing wave ratio) up to 20 GHz over the full level range.

According to the requirements of your application, you can select different attenuator characteristics.

The following are examples of test requirements and the corresponding configuration:

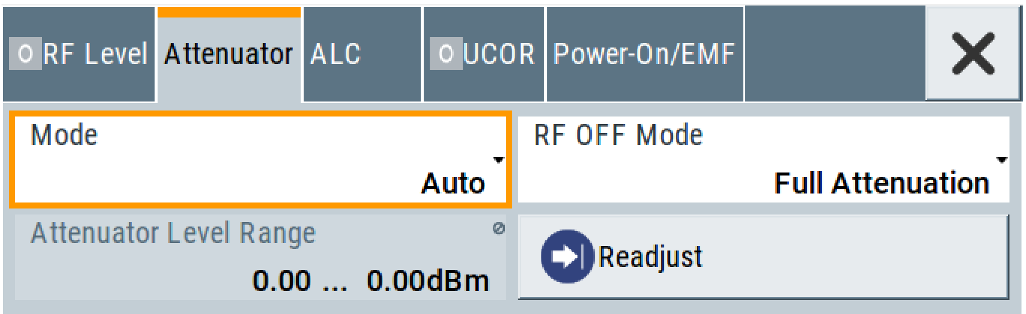
- Automatic configuration
  Select standard operation mode ("Auto"), in which the generator adjusts the attenuation of the RF output signal automatically
- Compensation for cable loss
  You can compensate the loss of a cable connection by a higher output power

- DUT tests under low signal to noise conditions
  Low output power is suitable to test the behavior of a DUT under low signal to noise conditions.
- Uninterrupted level settings with constant VSWR
  A fix attenuation value is required for obtaining uninterrupted level settings with constant VSWR.
  The configuration "RF Off Mode > Unchanged" ensures that constant VSWR is maintained if you turn the signal off and on again.
- Noise sensitive applications
  The parameter "RF OFF Mode > Full Attenuation" sets maximum attenuation and thus suppresses noise when you turn off the RF signal.

6.1.1 Attenuator Settings

Access:

► Select "Level" > "Level > Attenuator".



In the "Attenuator" dialog, you can select the operating mode of the electronic attenuator, the instrument is equipped with.

The remote commands required to define these settings are described in Chapter 12.13, "OUTPut Subsystem", on page 346 and Chapter 12.15.10, "SOURce:POWer Subsystem", on page 430.

Settings

Mode

Determines the operating mode of the attenuator at the RF output.

"Auto"	Adjusts the attenuator settings within the full variation range automatically.
"Fixed"	Fixes the attenuator and amplifier stages at the current position and provides signal output with constant output VSWR. The resulting variation range is calculated and indicated.

Remote command:
:OUTPut<hw>:AMODe on page 347

Attenuator Level Range
Shows the interruption-free range of the level that you can use in the currently selected mode.

Remote command:
:OUTPut<hw>:AFIXed:RANGe:LOWer? on page 348
:OUTPut<hw>:AFIXed:RANGe:UPPer? on page 348

RF OFF Mode
Determines the state of the attenuator, when the RF signal is switched off.

The value is not affected by an instrument preset (PRESET key or *RST) and the "Save/Recall" function. It is reset only by factory preset.

"Unchanged" Freezes the setting of the attenuator.
Use this mode if a constant VSWR (Voltage Standing Wave Ratio) is required.

"Full Attenuation"
Switches to the maximum attenuation.
Use this mode for applications that require a high level of noise suppression.

Remote command:
[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE on page 433

6.1.2 Reverse Power Protection

The R&S SMA100B is equipped against overloading by an external signal applied to the RF output.

The reverse power protection is tripped when the power of signals reflected from the load or external signals applied to the RF output becomes too high. A relay opens and interrupts the internal connection to the RF output. This condition is indicated in the status bar by the "Overload" status message.

Overload
If an "Overload" status message is indicated in the status bar, perform the following:
- Remove the cause for the overload
- Press the RF ON/OFF key to reset the overload protection

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

Remote command:
:OUTPut<hw>:PROTection:TRIPped? on page 349
:OUTPut<hw>:PROTection:CLEar on page 349

6.2 ALC - Automatic Level Control

The R&S SMA100B is equipped with an automatic level control (ALC) unit to obtain best RF level accuracy.

About ALC

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, if **pulse modulation** is used, the ALC uses table-based level settings with table values depending on the pulse timing.

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

ALC States and their effects

The following description basically explains the ALC states and their principle of operation:

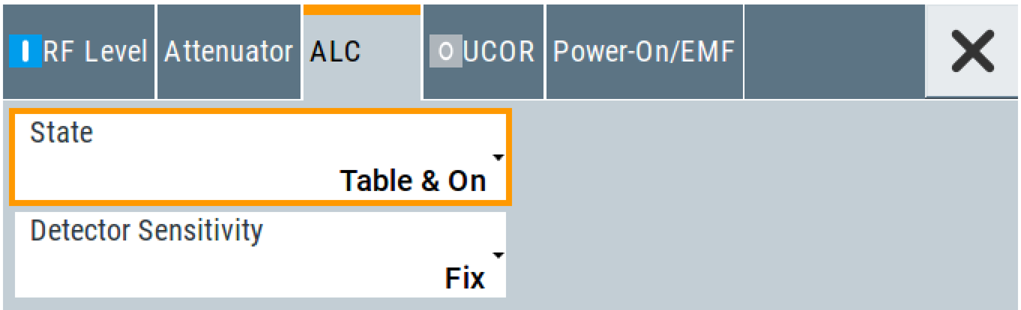
- "Auto"
  Adjusts the output level to the operating conditions automatically. ALC is active in almost all operating modes.
- "On"
  Activates the internal level control permanently, regardless of the operating conditions. This setting provides the highest level accuracy.
- "Off (Table)"
  Deactivates internal level control loop. The instrument calculates every level setting using the attenuation values from the internal (ALC) table. Level attenuation between two table values is done with linear interpolation. This mode enables you to perform a strictly monotonic, but not quite as precise level adjustment.
- "Table & On"
  Starts with the associated value of the internal level table and then activates the automatic level control. This mode achieves maximum level accuracy and fast setting times.
  If pulse modulation is applied, this mode ensures fast level setting even with narrow pulses at low repetition rate.

The R&S SMA100B displays the level control setting as a status message in the info line.

6.2.1 ALC Settings

Access:

► Select "Level" > "Automatic Level Control".



In the "ALC" dialog, you can configure the settings for the automatic level control of the RF signal to achieve optimal accuracy.

The remote commands required to define these settings are described in Chapter 12.15.10, "SOURce:POWer Subsystem", on page 430.

Settings

State

Selects the internal level control mode.

Find further details about the individual settings in "ALC States and their effects" on page 146. It covers an overview of the functionality and indicates what is to be considered.

"Auto" Selects the most appropriate ALC mode automatically.

"On" Activates ALC permanently.

"Off (Table)"
Controls the level using the attenuation values of the internal ALC table.

"Table & On"
Starts with the attenuation setting from the table and continues with automatic level control.

Remote command:
[:SOURce<hw>]:POWer:ALC[:STATe] on page 432

Detector Sensitivity

Determines the path of the internal level detector.

The level detector of the ALC has multiple paths distinguished by their sensitivity.

"Auto" Selects the detector sensitivity automatically, according to the given level.
This mode is the recommended operation mode.

"Fix" Fixes the last set sensitivity setting.

Remote command:
`[:SOURce<hw>]:POWer:ALC:DSENsitivity` on page 431

6.3 User Correction

The R&S SMA100B supports a correction function to compensate external losses, as for example caused by the RF cable, to achieve a precise target input level at the DUT.

About UCOR

User correction (UCOR) is a method that determines the external level loss over a frequency range in advance.

The difference between the generator output level and the level at the DUT determines the correction value at the respective frequency. Alternatively, the attenuation characteristics over a certain frequency range of e.g. an RF cable are also specified in the association data sheet.

During **signal generation**, the generator adds the correction value internally and thus increases the output level by exactly the amount of the loss between its output and the DUT. With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

Possible ways for configuring the user correction values

You can configure correction values in the following ways:

- **Internally**
  - Use the built-in table editor in the "UCOR > Edit User Correction Data" dialog.
    Once defined, user correction values can be saved in a file.
    Files with correction data can be exported for example, to exchange configuration between instruments or to modify the file content with an external program and reload them again.
  - Using the corresponding remote-control commands.
    Note that you have to create a user correction file first.
- **Externally**
  Create a file with correction values as a CSV file with Microsoft Excel, with a Notepad or a similar tool and save it with the predefined extension. Transfer the file to and load it into the instrument.

UCOR file format

Files containing correction data are simple files in text or comma-separated value (CSV) file format. The filename is user-definable; the file extension is `*.ucor`.

The file contains a list of correction values, one row per frequency and level pair; a new line indicator separates the correction values.

For file handling, use the standard functions in the "File Manager", see Chapter 9.8, "Using the File Manager", on page 203.

Collecting correction data

To fill the frequency and power values in the correction table, use one of the following options:

- Manually, row by row.
- Fill the table automatically with linearly interpolated values, calculated based on value range and step size.
- Acquire the real frequency response characteristics of the used component by R&S NRP power sensor.

Using power sensor for collecting correction data

Consider the following when using R&S NRP power sensors to collect correction values:

- Correction values can be acquired at any time, irrespective of the modulation settings of the generator.
- Measure the level directly at the input of the DUT.
- Use the internal correction functions of an R&S NRP power sensor to increase the accuracy and optimize the RF level.
- Use S-Parameter to consider the impact of any two-port device like an adapter between the signal generator and the sensor input.

Interactions and characteristics

Active "User Correction" is effective in all operating modes.

The RF output level ($Level_{RF}$) is the sum of the level value and the correction for the particular frequency:

$Level_{RF}$ = "Status bar > Level" + "UCOR"

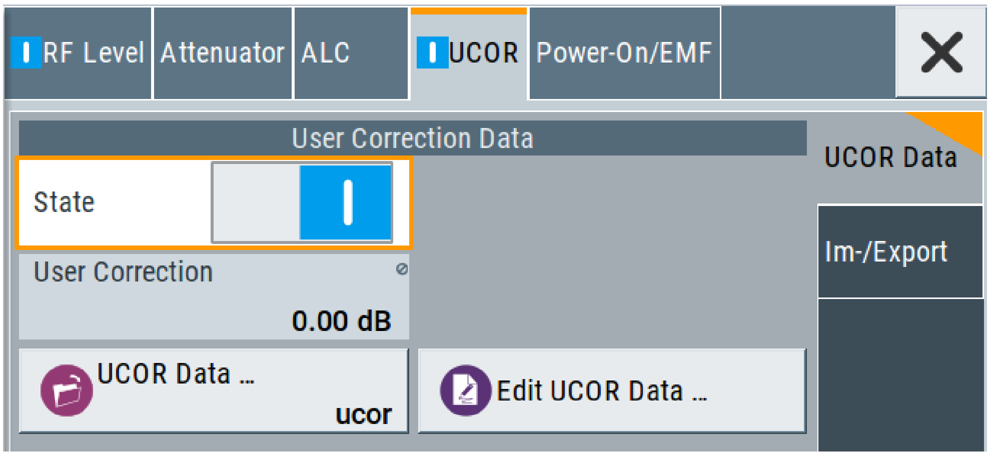
You recognize that user correction is enabled by the status indication "Lev Ucor" in the "Level" panel.

6.3.1 User Correction Settings

Access:

1. Select "Level" > "User Correction".
2. Select "User Cor. Data > navigate to the file *.ucor > Select".
3. Select "RF Level > RF State > On".

4. Select "State > On".



The "UCOR" dialog contains all settings for creating and handling files with user-defined level correction values.

The remote commands required to define these settings are described in Chapter 12.15.2, "SOURce:CORRection Subsystem", on page 385.

Settings

State

Activates user correction.

You recognize that user correction is enabled by the status indication "Lev Ucor" in the "Level" panel.

Remote command:
`[:SOURce<hw>]:CORRection[:STATe]` on page 390

User Correction

Indicates the current value for level correction.

Remote command:
`[:SOURce<hw>]:CORRection:VALue?` on page 389

UCOR Data

Accesses the standard "File Select" function of the instrument. The provided navigation possibilities in the dialog are self-explanatory.

Files with user correction values are files with predefined file extension `*.ucor`. When a file is selected, the dialog indicates the filename.

You can create the file internally in the table editor or externally.

- To select an existing file, select "Select List > navigate to the file *.ucor > Select"

- Use the general editor function to create internally new file or to edit an existing one.
- Use the standard file manager function to load externally created files to the instrument.

Remote command:
[:SOURce]:CORRection:CSET:CATalog? on page 390
[:SOURce<hw>]:CORRection:CSET[:SELect] on page 388
[:SOURce]:CORRection:CSET:DELete on page 390

Edit UCOR Data
Opens the build-it table editor to define a new correction table or edit an existing one.

See also:
- Chapter 5.7, "List Editor", on page 138
- " Fill Table Automatically " on page 90
- Chapter 6.3.3, "Fill with Sensor", on page 154

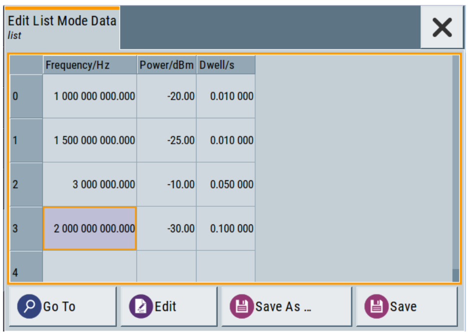
6.3.2 List Editor

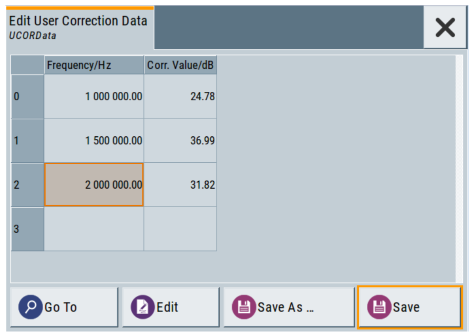
The "User Correction" and "List Mode" dialogs provide a build-in list editor for defining frequency/level value pairs.

The list editors in these two dialogs are similar. The following description shows the "List Data Editor".

Access:

1. "Sweep" > "List Mode" > "List Mode Data" > "Edit List Mode Data"
2. "Level" > "User Correction" > "Edit User Cor. Data"





List mode data editor	*User correction data editor*

The editor is a table with RF frequency and power value pairs and standard navigation functions.
The "Edit List Mode Data" dialog has an extra column for defining variable dwell times.

All values in one row have to be defined. Rows with missing values are ignored and not saved. Values of incomplete rows get lost.

If you use **global dwell time in list mode**, consider also the following:

- The instrument uses the value set with Global Dwell Time for all list steps.
- To save the list, however, you must fill in the "Dwell / s " column in each row, although the values are not used for generating the signal.
  Tip: Use the Fill Table Automatically function to fill the dwell time column automatically.

Settings

Edit List Mode Data

Table with correction or list values.

"Frequency /Hz"
Sets the frequency values.

Remote command:
`[:SOURce<hw>]:LIST:FREQuency` on page 418
`[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency` on page 387

"Power /dBm" Sets the level values.

Remote command:
`[:SOURce<hw>]:LIST:POWer` on page 419
`[:SOURce<hw>]:CORRection:CSET:DATA:POWer` on page 388

"Dwell /s" In list mode, sets the dwell time values.

Remote command:
`[:SOURce<hw>]:LIST:DWELl:LIST` on page 417

Data handling keys

Standard functions for file and data handling.

Note: Save a list only after filling both columns (frequency and level), otherwise the entries are lost.

Goto ← Data handling keys

Selects a row for editing.

Edit ← Data handling keys

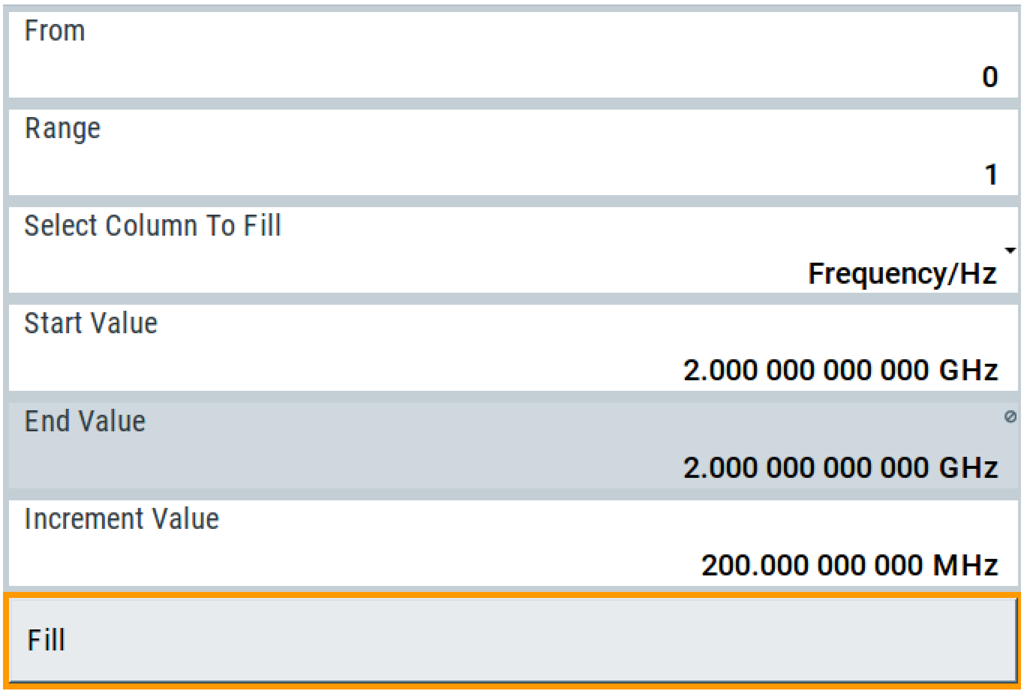
Enables you to insert, or delete a row or ranges within a list, and provides access to a dialog for automatic filling.

Fill with Sensor ← Data handling keys
In "UCOR" mode, opens a dialog to configure the settings for automatic filling of user correction data with an R&S NRP power sensor

See Chapter 6.3.3, "Fill with Sensor", on page 154

Save As/Save ← Data handling keys
Stores the list in a file with user-defined name and predefined file extension. To save a copy or create a file, use the "Save as" function.

Fill Table Automatically
Provides parameters for filling a table automatically with user-defined values.



The settings are interdependent; the affected parameters change accordingly if you set a value.

To fill the table, select "Fill".

Note: Save a list only after filling all columns and rows, otherwise the entries are lost.

"From / Range"
Defines the start line and number of the row to be filled.

"Select Column to Fill"
Selects the respective value, including the unit.

"Start / End Value"
Provides the default values corresponding to the selected column.

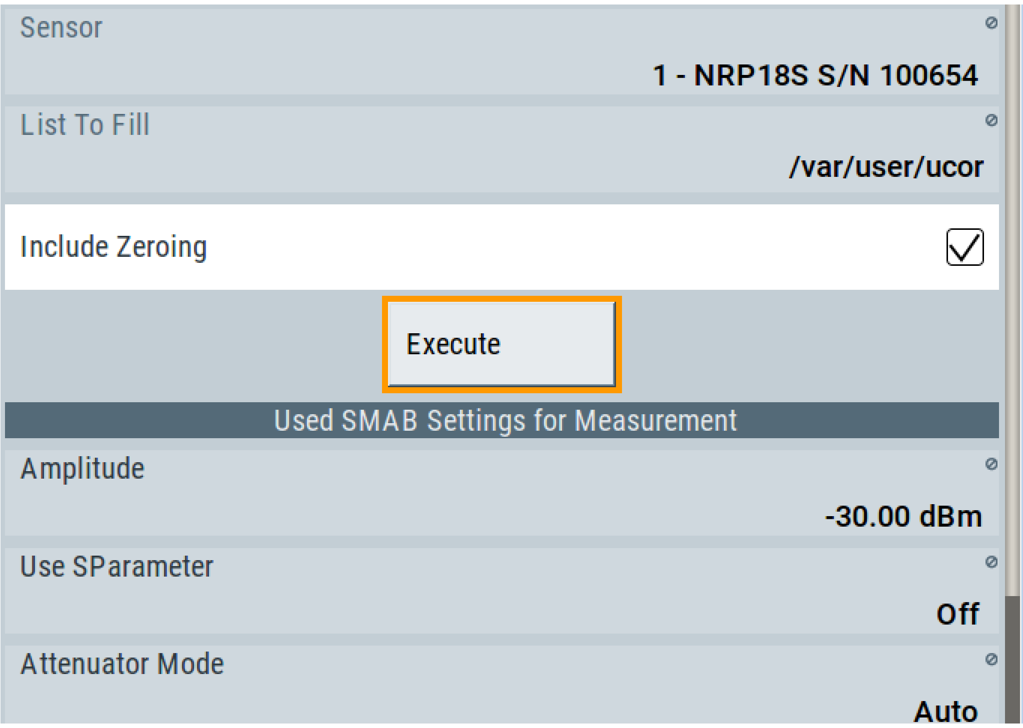
"Increment" Determines the step size.

"Fill" Fills the table.
Fill both columns and then save the list. Otherwise the entries are lost.

6.3.3 Fill with Sensor

Access:

1. Select "Level" > "User Correction".
2. Select "User Cor. Data > navigate to the file *.ucor > Select".
3. Select "Edit Cor. Data > Edit > Fill With Sensor".



This dialog contains parameters for filling a table automatically with sensor readings.

Settings are interdependent, the affected parameters change accordingly if you set a value.

To fill the table, select "Execute".

For information on power sensors an how to use them, see Chapter 6.5, "How to Calibrate the Power Level with an R&S NRP Power Sensor", on page 170.

Settings

Fill User Correction Data with Sensor

- "Sensor"
  Displays connected sensors for selection.
- "List To Fill"

Indicates the used list.

- "Include Zeroing"
  Performs a zeroing procedure before acquiring the user correction data to improve precision.
  No signal may be applied to the sensor during zeroing. RF output is temporarily switched off during that time.
  When unchecked, the zeroing procedure is skipped. However, the RF signal level might be blanked shortly. This setting is useful if blanking of RF is undesirable or the absence of power at the sensor cannot be guaranteed.
- "Execute"

The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

Remote command:
`[:SOURce<hw>]:CORRection:ZERoing:STATe` on page 389
`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` on page 388

Used SMAB 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 Path 1"
Displays the selected mode of the attenuator.

"Level range" Shows the level range.

Remote command:
n.a.

6.3.4 Import/Export List Files

Access:

1. Select one of the following:
   a) "Sweep" > "List mode".
   b) "Level" > "Level > User Correction".
   c) "Modulation > Pulse Modulation > Pulse Generator > Pulse Mode = Train".

2. Select "Import/Export".

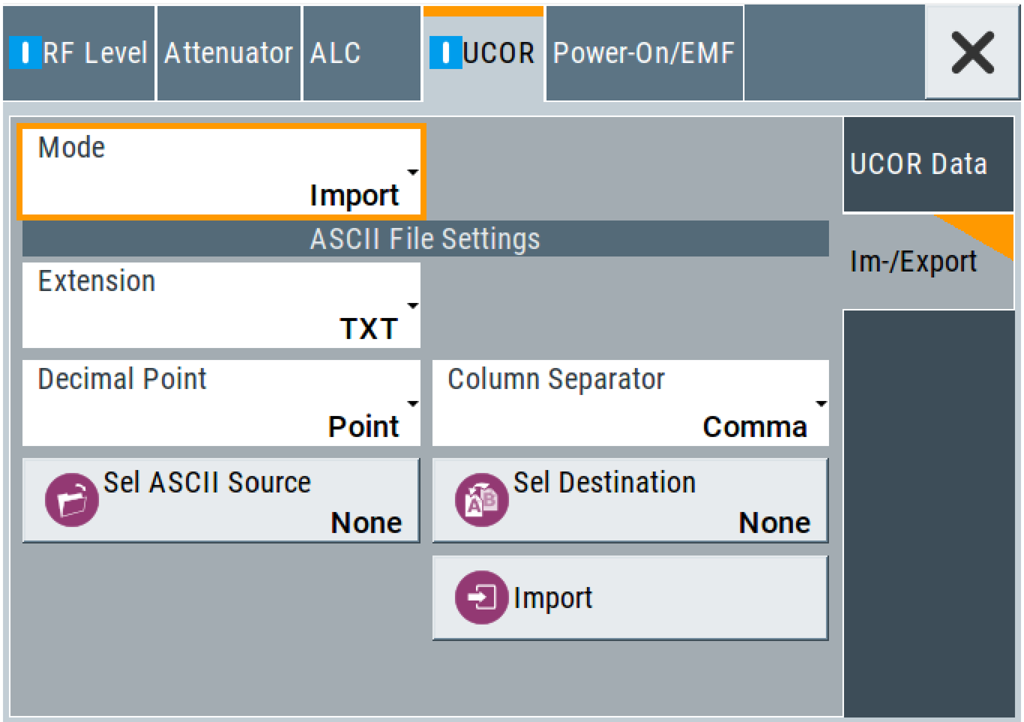


Figure 6-1: Im-/Export dialog (example with UCOR settings)

The "Import/Export" dialog contains all functions and settings to import externally created list data or to export it accordingly. You can process and store a list in the formats `*.txt` (ASCII), or `*.csv` (plain text with identical sequence of fields). The table separators and the decimal floating point numbers are customizable.

Settings

Mode

Selects import or export of a data list file. The provided parameters vary according to the selected mode.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:MODE` on page 425
`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 392
`[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE` on page 383

ASCII File Settings

Defines the format and the separators of the associated data file.

"Extension" Selects `*.csv` or `*.txt` format.

"Decimal Point" Sets "Point" (dot) or "Comma" as the decimal separator used in the ASCII data with floating-point numerals.

"Column Separator"
Sets the separator between the columns in an ASCII table.
Available are: "Tab", "Semicolon", "Comma" or "Space".

Remote command:
[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension on page 424
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal on page 425
[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn on page 425
[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 391
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal on page 391
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn on page 391
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 383
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal on page 383
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn on page 384

Select Source/Select Destination

In "Mode > Import", access the file select dialog that provides standard file handling functions.

Where:

- "Select ASCII Source": defines the file to be loaded (imported)
- "Select ASCII Destination": selects the filename the loaded file is saved as

Remote command:
[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog? on page 424
[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect on page 425
[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog? on page 390
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 391
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog? on page 384
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 384

Select Source / Select ASCII Destination

In "Mode > Export", access the file select dialog that provides standard file handling functions.

Where:

- "Select Source": selects the file to be exported
- "Select ASCII Destination": defines the filename and the file path the exported file is saved as

Remote command:
[:SOURce<hw>]:LIST:DEXChange:SELect on page 426
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 392
[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 384

Import / Export

Imports or exports the selected data list file, depending on the current mode.

Remote command:
`[:SOURce<hw>]:LIST:DEXChange:EXECute` on page 424
`[:SOURce<hw>]:CORRection:DEXChange:EXECute` on page 392
`[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute` on page 385

6.4 Using Power Sensors

The R&S SMA100B works with R&S NRP power sensors and thus supports various application tasks for improving the RF signal level. Using power sensors, you can for example determine attenuation characteristics of downstream equipment or cables. You can use the measured values to compensate the losses with internal control functions or with an external control circuit in real time.

R&S NRP sensors are highly accurate standalone measuring devices, suitable for a wide range of applications. The devices communicate directly with the signal generator, calculate the average or peak power internally, include S-parameter correction and return the results to the generator.

The R&S SMA100B works with any sensor of the R&S NRP series and can perform up to four power measurements simultaneously.

Check the firmware version of the R&S NRP sensors regularly. Update the firmware, if necessary.

See Chapter 6.4.5, "How to Update the Sensor Firmware", on page 169.

6.4.1 Connecting R&S NRP Power Sensors to the R&S SMA100B

R&S NRP sensors are connected to the R&S SMA100B in the following ways:

- Connection to the SENSOR connector
  – R&S NRP-ZK6 (six-pole interface cable) for R&S NRPxx power sensors
  – No additional cable for R&S NRP-Zxx power sensors (cable is fixed on the sensor)
- Connection to the USB connector

  Requires the following cables, depending on the used sensor type:
  – R&S NRP-ZKU (USB interface cable) for R&S NRPxx power sensors
  – R&S NRP-Z3 or R&S NRP-Z4 (USB adapter cables) for sensors of the R&S NRP-Zxx family

- Connection via R&S NRP-Z5 sensor hub
  The R&S NRP-Z5 USB sensor hub (high-speed USB 2.0) can host up to 4 R&S NRP sensors. It provides simultaneous internal and external triggering of all connected sensors.

  Requires additional cables, depending on the used output connector of the hub. Choose one of the following:
  – Short extension cable R&S NRP-Z2 for connection to the sensor connector. This six-pole connection provides the external trigger capability.
  – Standard USB cable (USB type A to USB type B) to any USB type A connector of the R&S SMA100B. This connection does not support external triggering.
- Connection via USB hub with external power supply unit

  Requires the following cables, depending on the used sensor type:
  – R&S NRP-ZKU (USB interface cable) for R&S NRPxx power sensors
  – R&S NRP-Z3 or R&S NRP-Z4 (USB adapter cables) for sensors of the R&S NRP-Zxx family
- Connection via LAN for R&S NRPxxxSN power sensors
  Using the Ethernet interface requires PoE (Power over Ethernet) to provide the electrical power.

  To establish the connection, you can use:
  – A PoE Ethernet switch, e.g. R&S NRP-ZAP1 and an RJ-45 Ethernet cable.
  – A PoE injector and an RJ-45 Ethernet cable.

For details, see the description R&S®NRP®Series Power Sensors getting started.

Detection and mapping

The R&S SMA100B automatically detects a connected R&S NRP power sensor and indicates it in the "NRP Power Viewer" and "NRP Sensor Mapping" dialogs.

By default, detected sensors are indicated as follows:

- A sensor connected at the SENSOR socket is assigned as "Sensor 1".
  If no sensor is connected to this socket, channel 1 remains unassigned.
- Sensors 2 to 4 are assigned to the sensors at the USB connectors, according to their sequence of connection.

You can change the default mapping in the NRP Sensor Mapping dialog.

6.4.2 NRP Sensor Mapping

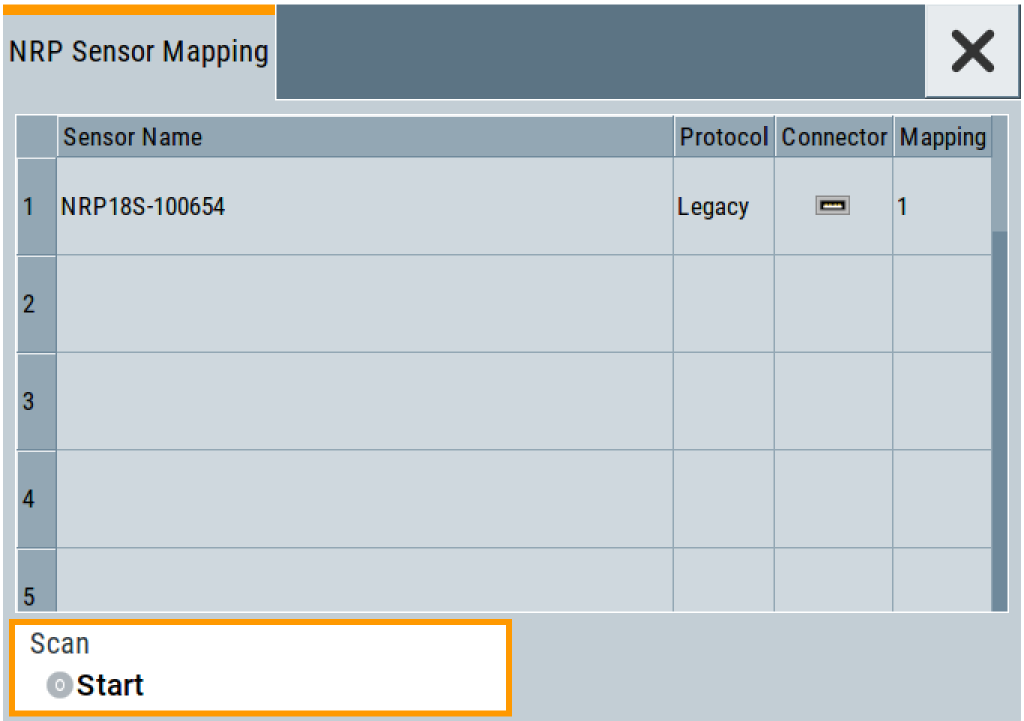
The "NRP Sensor Mapping" lists all R&S NRP sensors detected by the instrument.

Any R&S NRP sensor that supports the USB legacy protocol and is connected to one of the USB interfaces, is detected automatically and added to the list. Vice versa, the R&S SMA100B removes a sensor from the list, when it is disconnected.

R&S NRP sensors that are connected via LAN or use the USBTMC protocol are not automatically detected. They are detected by the scan search function.

Access:

► Select "Clk Syn/Power Sens" > "NRP Sensor Mapping".



The dialog lists all detected R&S NRP sensors for selection and mapping. You can also browse the network for sensors.
The detected sensors are characterized by the used protocol and the corresponding icon. In the "Mapping" column, you can assign the sensor to one of the available sensor channels. The list can contain several entries but the R&S SMA100B can only use up to four sensors simultaneously.
The remote commands required to define these settings are described in Chapter 12.14, "SENSe, READ, INITiate and SLISt Subsystems", on page 350.

Settings

Sensor Mapping List

Displays a list of all sensor entries with information on the sensor name, the used protocol, the connector and the assigned mapping.

If a sensor is connected via LAN or uses the USBTMC protocol, its protocol is indicated as "Visa".

Remote command:
`:SLISt[:LIST]?` on page 352
`:SLISt:ELEMent<ch>:MAPPing` on page 353

Scan

Scans the network and the USB connections for sensors connected via the VISA communication protocol, i.e. sensors that are addressed via LAN or USBTMC.

Sensors communicating via the USB legacy protocol are detected automatically.

Remote command:
`:SLISt:SCAN[:STATe]` on page 352

6.4.3 NRP Power Viewer

The R&S SMA100B features the power viewer function for measuring or monitoring signals with R&S NRP power sensors.

6.4.3.1 About

The R&S SMA100B can perform up to four power measurements simultaneously. The measured signals can be the RF output power or other selected signal sources.

About the measuring principle, averaging filter, filter length, and achieving stable results

A sensor measures the average signal power of the selected source continuously. The measurement results are displayed the "NRP Power Viewer" dialog.

The power viewer function uses **averaging filters** to reduce the fluctuations of the measurement result to the desired extent. Common sources of fluctuations are inherent noise of the measuring instrument, modulation of the measurement signal or influences from the superposition of adjacent carriers. Common method for achieving more stable display is the use of longer measurements. The term longer measurements do not mean that it takes longer to display a new result. The term refers to the time it takes for the result to settle when the power varies.

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. This approach is referred as a **two-step averaging process**.

The factor of 2 in the formula arises because the output signals from the microwave detector are chopped at the same rate as the time windows to suppress low-frequency noise. An independent measured value can only be obtained from two consecutive values.

The variable N in the formula indicates the **filter length**. The filter length then directly influences the measurement time. The filter length can be selected automatically or it can be manually set to a fixed value.

Follow the following general recommendation to find out the **optimum filter length**:

- Always start a measurement in auto mode ("Filter > Auto")
  Check if the measurement results are sufficient.
- If the power is not constant, select the filter length manually ("Filter > User")
  Trigger the "Auto Once" function to search for the optimum filter length for the current measurement conditions.

The estimated value is indicated as filter length.

- If the target measurement accuracy is known value, select "Filter > Fixed Noise"
  The averaging factor is selected automatically and so that the sensor's intrinsic noise (two standard deviations) does not exceed the specified noise content.
- Different sensor types achieve the same filtering result with different filter lengths and time window values.

  The time window length depends on the sensor type:
  – For most sensors, it is fixed to 20 ms.
  – For the R&S NRP-Z81 sensor, it is 10 μs.
    The R&S NRP-Z81 uses filter length that is 1000 times larger than the filter length for other sensors.

About zeroing

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).

Related settings and functions

- Measurements-related settings, like results, filter, filter length:
  Chapter 6.4.3.2, "NRP Power Viewer Settings", on page 163
- Sensor-specific information and sensor software update:
  Chapter 6.4.4, "NRP Info Update", on page 168
- Software version of the connected power sensor:
  `:SENSe<ch>[:POWer]:TYPE?` on page 361
- Acquisition of level correction data:
  Chapter 6.3, "User Correction", on page 148

Additional information

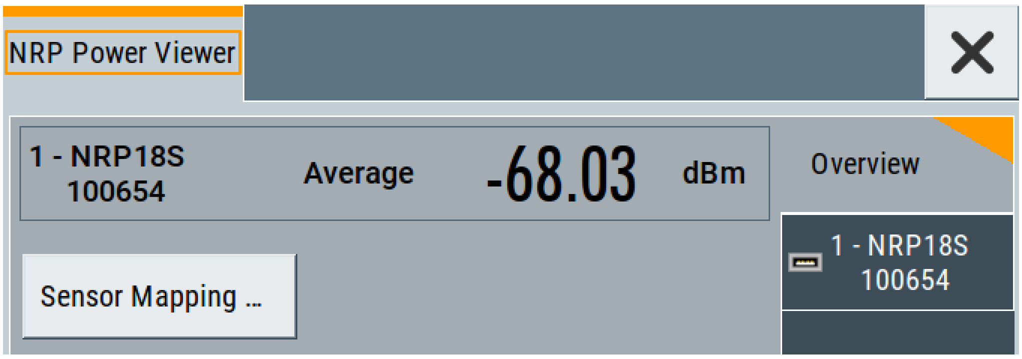
See Rohde & Schwarz website http://www.rohde-schwarz.com in section "Power Meters & Voltmeters" for:

- R&S NRP power sensor manual
- Information on the R&S NRP-Z5 sensor hub and the available accessories.

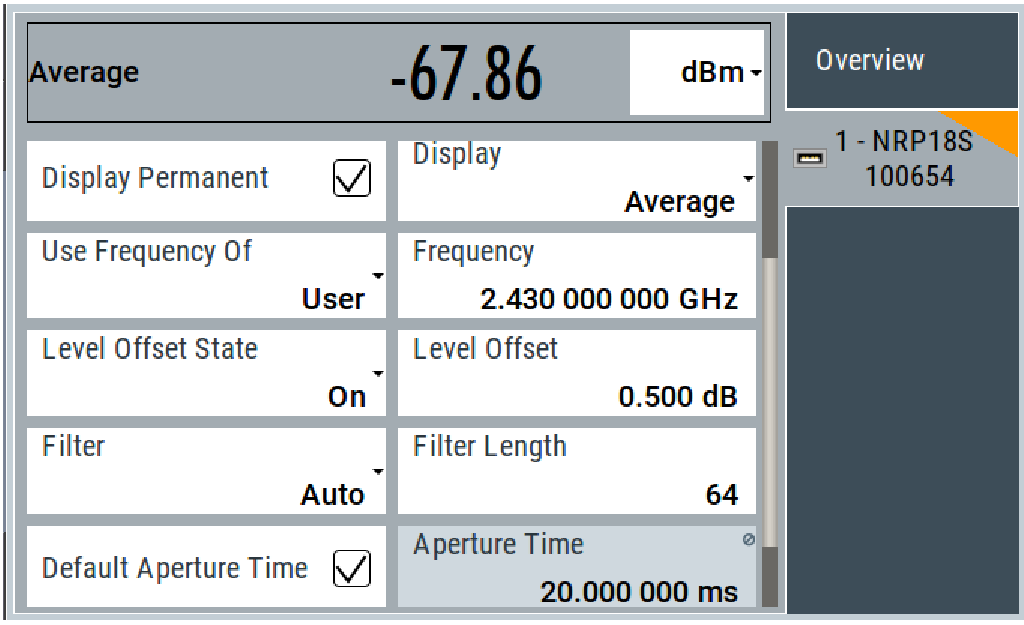
6.4.3.2 NRP Power Viewer Settings

Access:

► Select "Clk Syn/Power Sens > NRP Power Viewer".



The dialog contains all parameters for configuring the sensor settings, like average or peak display, reference source, filter and level offset. It automatically displays a separate tab per detected sensor.



The remote commands required to define these settings are described in Chapter 12.14, "SENSe, READ, INITiate and SLISt Subsystems", on page 350, including the triggering of the measurement and the retrieval of measurement results.

See also Chapter 6.5, "How to Calibrate the Power Level with an R&S NRP Power Sensor", on page 170.

Settings

Sensor type and serial number
Indicates the type and the serial number of a connected R&S NRP power sensor.

The displayed Level (Peak) / Level (Average) values correspond to the particular sensor.

Remote command:
`:SENSe<ch>[:POWer]:TYPE?` on page 361
`:SENSe<ch>[:POWer]:SNUMber?` on page 360

Level (Peak) / Level (Average)
Indicates the measured peak or average level value.

You can also change the unit for the results display: Watt, dBm or dBµV.

Note: Peak level measurements are provided if the power sensor supports this feature.

Remote command:
`:READ<ch>[:POWer]?` on page 353
`:SENSe<ch>:UNIT[:POWer]` on page 354

Sensor Mapping
Access the NRP Sensor Mapping dialog.

Connected sensor settings
One tab per detected sensors.

State ← Connected sensor settings
Activates level measurement.

Remote command:
:INITiate<ch>[:POWer]:CONTinuous on page 353
To query the availability of a sensor at a given connector, use the command :SENSe<ch>[:POWer]:STATus[:DEVice]? on page 360.

Zero ← Connected sensor settings
Activates the auto zero function.

For details, see "About zeroing" on page 162.

Remote command:
:SENSe<ch>[:POWer]:ZERO on page 361

Display ← Connected sensor settings
Sets the display mode for power readings.

Permanent ← Display ← Connected sensor settings
Activates the permanent indication of the power measurement result in the home screen.

You can activate the permanent display for several sensors.

Remote command:
:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe on page 356

Display ← Display ← Connected sensor settings
Sets the display of results on mean or peak power.

Remote command:
:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority on page 356

Use Frequency Of ← Connected sensor settings
Selects the source for measurement.

"RF" The sensor measures the power of the RF signal at the current frequency. It considers the correction factor and uses the level setting of the instrument as reference level. Frequency variations are automatically routed to the sensor.

"User" Selects any freely selectable signal source, for example to measure the amplifier gain with 2 sensors.
Set the parameter Frequency to the measurement's frequency.

Remote command:
:SENSe<ch>[:POWer]:SOURce on page 360

Frequency ← Connected sensor settings
Defines the frequency value if "Source > User" is used.

Remote command:
:SENSe<ch>[:POWer]:FREQuency on page 359

Level Offset State,Level Offset ← Connected sensor settings
Activates and defines a level offset which is added to the measured value. The level offset value is always expressed in dB, irrespective of the selected unit for result display.

This function allows you to consider for example an attenuator in the signal path.

Remote command:
`:SENSe<ch>[:POWer]:OFFSet` on page 359
`:SENSe<ch>[:POWer]:OFFSet:STATe` on page 359

Filter ← Connected sensor settings
Selects the way the length of the used filter is defined.

See also "About the measuring principle, averaging filter, filter length, and achieving stable results" on page 161.

"Auto" The filter length is selected automatically and adjusted to the measured value. The value is indicated with the parameter Filter Length
With high signals, the filter length and therefore the measurement time can be short.
With low signal levels, the filter length and therefore the measurement time is increased to reduce noise.

"User" The filter length is defined manually, with the parameter Filter Length.
As the filter length works as a multiplier for the time window, constant filter length results in a constant measurement time.
Values 1 and 2N are allowed.

"Fixed Noise" The averaging factor is selected so that the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content.
Set the noise content value with the parameter Noise/Signal Ratio.
To avoid long settling times when the power is low, limit the averaging factor with the parameter Timeout.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:TYPE` on page 358

Filter Length ← Connected sensor settings
For "Filter > Auto or User", indicates the used filter length.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?` on page 356
`:SENSe<ch>[:POWer]:FILTer:LENGth[:USER]` on page 357

Noise/Signal Ratio ← Connected sensor settings
For "Filter > Fixed Noise", sets the noise content.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio` on page 357

Auto Once ← Connected sensor settings
Searches the optimum filter length for the current measurement conditions. The result is indicated with the parameter Filter Length.

See also "About the measuring principle, averaging filter, filter length, and achieving stable results" on page 161.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:SONCe` on page 358

Timeout ← Connected sensor settings
For "Filter > Fixed Noise", sets a time limit for the averaging process.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe` on page 357

Default Aperture Time ← Connected sensor settings
The sensor default setting is sufficient. Disable this parameter to specify a user-defined aperture time per sensor, if for example the readings vary.

To obtain stable readings, set the Aperture Time exactly to one modulation period.

Remote command:
`:SENSe<ch>[:POWer]:APERture:DEFault:STATe` on page 354

Aperture Time ← Connected sensor settings
If "Use Default Aperture Time > Off", defines the acquisition time per sensor.

For example, to obtain a sufficient low average value, set the aperture time exactly to one modulation period.

Remote command:
`:SENSe<ch>[:POWer]:APERture:TIMe` on page 355

S-Parameter ← Connected sensor settings
Lists the S-Parameter correction data files retrieved for the connected power sensor. To activate the correction data, select the corresponding file.

S-parameter correction compensates for the losses and reflections introduced by a component – such as an attenuator, directional coupler, or matching pad – that is attached to a power sensor. Using S-parameters instead of a fixed offset increases measurement accuracy by accounting for the interaction between the sensor and the component. This shifts the sensor's reference plane from the sensor's RF connector to the input of the device that is being applied externally.

The S-Parameter table can be changed with the S-Parameters tool, provided as part of the free R&S NRP Toolkit software. For more information, refer to the manual of the connected R&S NRP power sensor.

Remote command:
`:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe` on page 355
`:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST?` on page 355
`:SENSe<ch>[:POWer]:CORRection:SPDevice:SELect` on page 355

Enable Logging ← Connected sensor settings
Activates recording of R&S NRP power sensor readings in a log file.

There is 1 log file per sensor. The log files are created automatically and filled in continuously. They are text files with predefined filename SensLog<n>.txt, where <n> indicates the connected sensor. Log files are stored on the hard disk, in the directory /var/user/temp/SensorLogging.

Each log file contains the measured value (2 readings when you work with peak sensors), the sensor type, and the measurement time (timestamp). Logged data is not overwritten. When a new measurement is started, the collected logging data is appended in the log file.

Check the used disc space regularly and remove log files to maintain storage capacity.

Note: The logging function is intended for measurements with long time intervals. It is suitable source for data reconstructions if the connection to the sensor was interrupted.

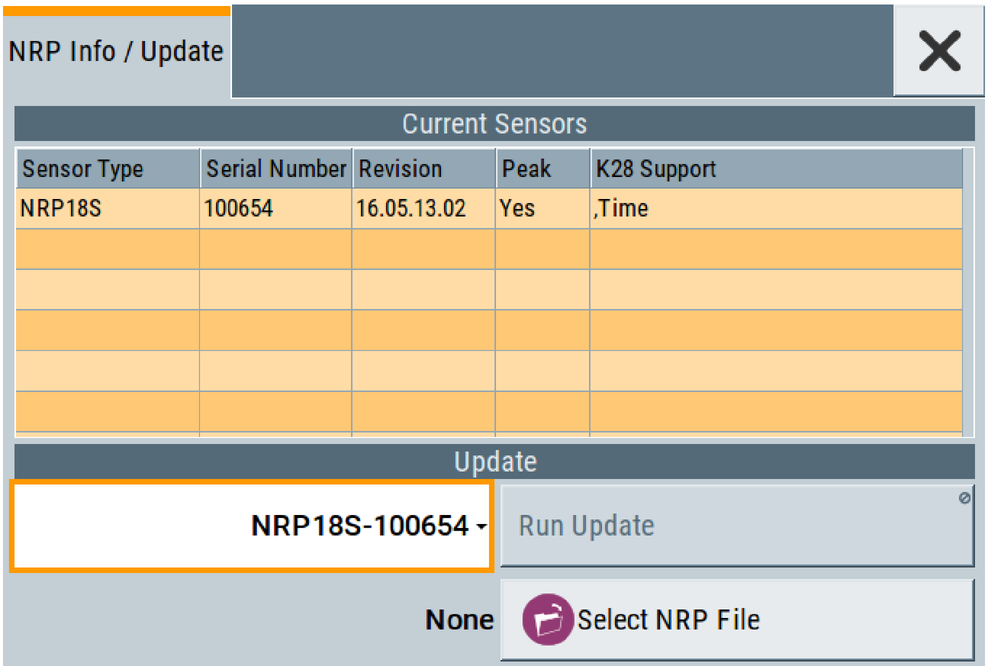
Remote command:
:SENSe<ch>[:POWer]:LOGGing:STATe on page 359

6.4.4 NRP Info Update

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

Access:

► Select "System Config > Setup > Instrument Assembly > NRP Info/Update".



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

The remote commands required to configure the display and keyboard are described in Chapter 12.14, "SENSe, READ, INITiate and SLISt Subsystems", on page 350.

Settings

Current Sensors

Shows the sensors that are connected to the R&S SMA100B with information on serial number, the revision state, and some characteristic features.

Remote command:
`:SENSe<ch>[:POWer]:TYPE?` on page 361
`:SENSe<ch>[:POWer]:SVERsion?` on page 361
`:SENSe<ch>[:POWer]:SNUMber?` on page 360

Update

Provides all functions needed to run the sensor update.

Note: Download the required update file before you start the update.
Follow the instructions in Chapter 6.4.5, "How to Update the Sensor Firmware", on page 169.

- Selection field
  Selects the sensor to be updated.
- "Select NRP File"
  Provides access to the file system to select the update file. The selected file is indicated to the left of the button.
- "Run Update"
  Starts the update.
- "Rescue"
  Appears if the update process is interrupted.

Note: Interrupted update. If the sensor is accidentally removed during the update process or if the update is interrupted, restart the update as described in Chapter 6.4.5, "How to Update the Sensor Firmware", on page 169.

6.4.5 How to Update the Sensor Firmware

To update the sensor firmware

1. Open the Rohde & Schwarz website http://www.rohde-schwarz.com in section "Power Meters & Voltmeters".
2. Select the sensor type, e.g. the R&S NRP33SN-V.
3. Select "Downloads > Firmware" and the firmware provided for your sensor.
4. Save the firmware in the `/var/user/temp/` directory.
5. Connect the sensor to the R&S SMA100B.

6. Select "System Config > Setup > Instrument Assembly > NRP Info/Update".
7. Select the sensor in the left sensor selection field.
8. Select the update file with "Select NRP File".
9. Activate "Run Update".

   The update starts and a progress bar indicates the state.

To restart an interrupted update

If an update has been interrupted, proceed as follows:

1. Disconnect all other sensors form the instrument.
2. Do not reconnect the sensor, but keep it ready for connection.
3. In the "NRP Info/Update" dialog, select "Rescue".
4. Activate "Run Update".
5. Confirm the query in message box.
6. Connect the sensor within 4 seconds

   The update starts and a progress bar indicates the state.

6.5 How to Calibrate the Power Level with an R&S NRP Power Sensor

Using a R&S NRP and the user correction function of the instrument, you can achieve a stable output level of high accuracy over a specified frequency range. The R&S SMA100B utilizes the readings of the power sensor and creates a correction value table for controlling the output level during operation.

To connect the R&S NRP to the R&S SMA100B

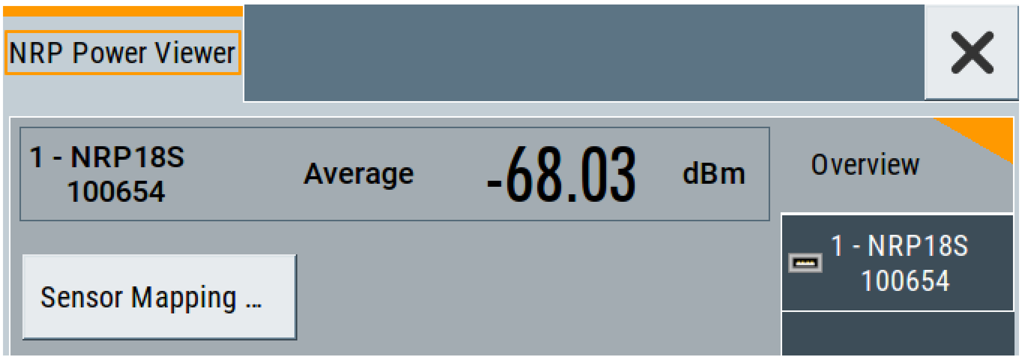
1. Connect the power sensor.
   See Chapter 6.4.1, "Connecting R&S NRP Power Sensors to the R&S SMA100B", on page 158.
2. Select "Clk Syn/Power Sens" > "NRP Sensor Mapping".
3. If the sensor is not detected automatically, select "Scan > Start".

   The instrument scans the network and the USB connections for connected sensors and lists all detected R&S NRP sensors in the mapping table.
4. In the "Mapping" column, assign the sensor to a sensor channel (see Chapter 6.4.2, "NRP Sensor Mapping", on page 159
5. Close the dialog.

To configure and calibrate the R&S NRP in the R&S SMA100B

Provided the power sensor is connected to the R&S SMA100B and is assigned to a sensor channel, we recommend that you calibrate and configure the power sensor in the "NRP Power Viewer" dialog.

1. Select "Level" > "RF ON > Off"
2. Select "Clk Syn/Power Sens" > "NRP Power Viewer".



3. If several power sensors are connected, select the tab of the sensor you want to use.
4. Select "Zero" to start the automatic calibration function.
   Note: Always turn the RF power off or disconnected from the sensor before zeroing, since the function calibrates the power sensor at zero signal power.

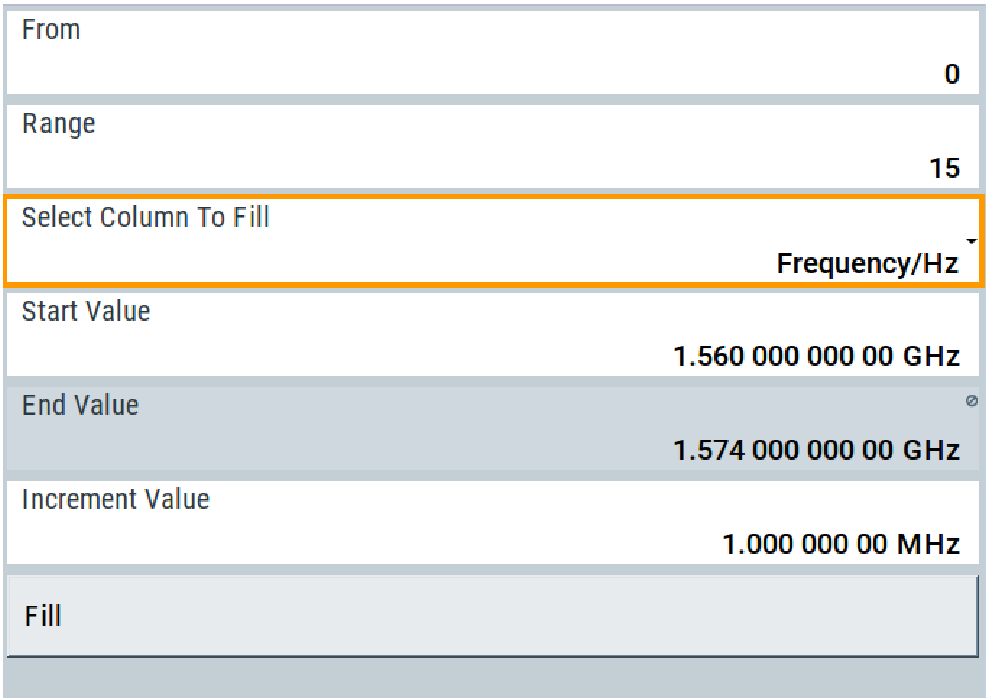
   The zeroing process takes a few seconds, depending on the power sensor type.
5. Configure additional parameters for the selected sensor as required.
6. Select "State > On".
7. Close the dialog.

To create user correction data with an R&S NRP and the R&S SMA100B

We assume, that the power sensor is connected, assigned and ready for operation.

1. Select "Level" > "User Correction".
2. Select "UCOR Data > User Cor. Data".
3. Create a file: "New > Filename" and confirm with "OK".
4. Select the new file with "Select".
5. Select "Edit User Cor. Data".
6. Select "Edit > Fill".

   The "Fill Table" dialog enables you to fill in the values of the columns automatically.
7. To fill in the frequency column:



a) Select "Select Column To Fill > Frequency / Hz"
b) Select "Range > e.g. 15" to determine the number of values.
c) Select "Start Value > e.g. 1.56 GHz".
d) Select "Increment Value > e.g. 1 MHz", to determine the frequency steps.
e) Select "Fill", to insert the values

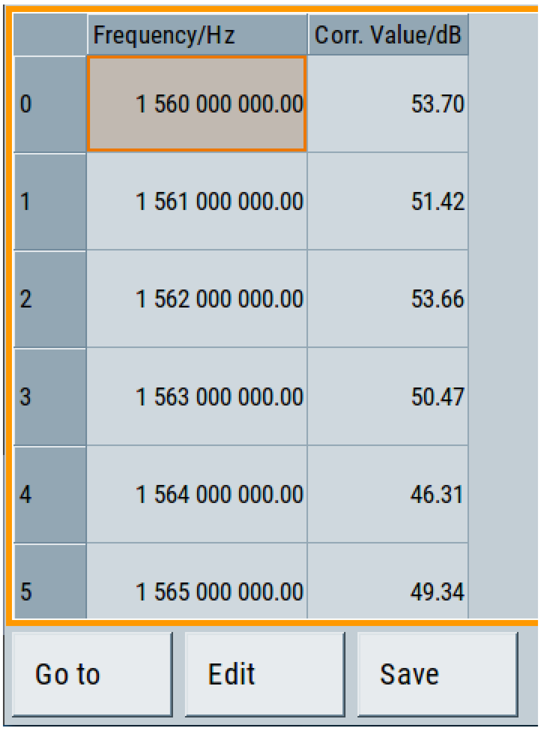
The table with user correction values contains the automatically calculated frequency values.
The function also fills the column of the "Power / dB" values with a predefined value, since empty cells lead to the data loss of the entire line.

8. Select "Fill with Sensor".

   The "Fill User Correction Data With Sensor" dialog provides an overview of the sensor configuration.

9. Select "Execute".

   The R&S SMA100B successively sets each frequency point, reads the measured power of the sensor and fills in the value in the correction table.



10. Select "Save" to save the data in the file.
11. Close the dialog.

To perform power leveling calibration with user correction data

We assume that a user correction file is available in the user directory of the R&S SMA100Bor on a memory stick or in a shared directory.

If you have created and saved the file immediately before this step, the file is loaded in the "User Correction" dialog automatically. Otherwise you can load a previously saved file.

1. Select "Level" > "User Correction".
2. Select "UCOR Data > User Cor. Data", if there is no file loaded already.
3. Select the directory and file you want to use.
4. Load the file with "Select".
5. To view the file content, select "Edit User Cor. Data".
6. Select "UCOR Data > State > On" to apply the user correction values.

   When you activate the RF signal, you get a constant signal level within the frequency range that is covered in the user correction file.

7 Reference Oscillator

The R&S SMA100B is equipped with an internal reference oscillator that generates a reference frequency of 1 GHz. It is used as internal reference source for the synthesizer. Alternatively, you can apply an external reference signal. The R&S SMA100B can process external reference frequency in the range 1 MHz to 100 MHz and the 1 GHz reference frequency.

Regardless of the used reference source (internal or external), the R&S SMA100B always outputs the reference frequency at the output connector. You can use it, for example to synchronize further connected instruments. For an overview of typical test situations, see Chapter 7.2, "Using the Reference Frequency for Instruments Synchronization", on page 174.

The reference oscillator settings are not affected by an instrument preset (PRESET key or `*RST`) and the "Save/Recall" function. They are reset only by factory preset.

The remote commands required to define these settings are described in Chapter 12.15.11, "SOURce:ROSCillator Subsystem", on page 439.

7.1 Required Options

R&S SMA100B base unit equipped with the following options:

- Reference frequencies 1 MHz to 100 MHz (R&S SMAB-K704)
- Ultra low noise 1 GHz (R&S SMAB-K703)

For more information, see data sheet.

7.2 Using the Reference Frequency for Instruments Synchronization

Test setups with two or more instruments often require that the instruments use a common reference frequency. Depending on the availability of external reference frequency source and its quality, the instruments are connected and configured in different ways.

This section gives an overview of the possible test setups and the related settings. The following situations are considered:

- External reference source is not available or the **built-in reference oscillator** is of better quality than the external source
(see "Distributing the internal 10 MHz reference signal to further instruments" on page 175)
- **Clean external reference source** with quality exceeding the quality of the built-in reference oscillator
(see "Using external reference source" on page 176)

- **Interfered or noisy external reference signal**
  (see "Deriving 10 MHz form the external reference frequency" on page 177)
- **1 GHz reference coupling** for phase coherence of the RF signals with reasonable long-term phase stability
  (see "Sharing the 1 GHz reference frequency to obtain phase-coherent signals" on page 176)

Connectors overview

Use the "Show Connector" function to indicate the connector on the front/real panel:

- REF IN/REF OUT
- REF IN/REF OUTRef In/Out 1GHz
- "EFC" on page 42

Distributing the internal 10 MHz reference signal to further instruments

The internal reference oscillator provides the reference frequency:

- Internal f_{ref} = 10 MHz (10 MHz at connector REF OUT)
- Source = "Internal"
- Reference Output/1GHz Reference Output = "10 MHz"
- Optional:
  – External Tuning Active = "On"
  – External Tuning Slope = "Low"

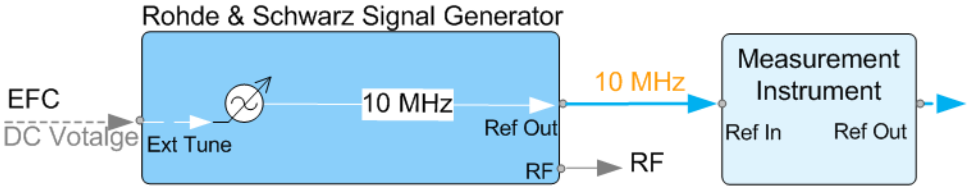


Figure 7-1: Synchronizing instruments using the internal 10 MHz reference signal of the R&S SMA100B

EFC = External frequency control
EFC,REF IN,REF OUT = Connectors

In phase noise measurement systems, for example, you can additionally use the EFC (external frequency control) function and shift the frequency.

EFC is a function that transforms an external tuning voltage into frequency shift, where the value range of the resulting frequency is a technical characteristic listed in the data sheet. See the data sheet also for information on the sensitivity, input voltage range, impedance and maximum bandwidth for external tuning signal.

Consider the following interdependency:

- EFC in combination with an external PLL
  If the EFC is applied in combination with an external PLL (phase locked loop), the PLL bandwidth must be smaller than the bandwidth of the external tuning signal.
- FM-DC mode

If the measurement requires higher PLL bandwidth, we recommend 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 selected FM deviation.

Sharing the 1 GHz reference frequency to obtain phase-coherent signals

Compared to 10 MHz, a 1 GHz reference signal significantly improves the achievable phase stability between two signal sources. Because the synchronization increases by a factor of 100, the relative phase fluctuations between the sources can be reduced.

1 GHz at connector REF IN 1GHZ and 1 GHz at REF OUT 1GHZ

- External f_{Ref} = 1 GHz
- Source = "External"
- External Reference Frequency = "1 GHz"
- 1GHz Reference Output = "1 GHz"

Using external reference source

If you have a clean external reference signal with 10 MHz or 100 MHz frequency for example, you can **directly pass it to the output**. The signal quality remains the same.

10 MHz/100 MHz at connector REF OUT and REF IN

- External f_{Ref} = 10 MHz or 100 MHz
- Source = "External"
- Reference Output = "10 MHz/100 MHz" or "Input Signal (loop through)"
- Set the synchronization bandwidth according to the requirements of the application.

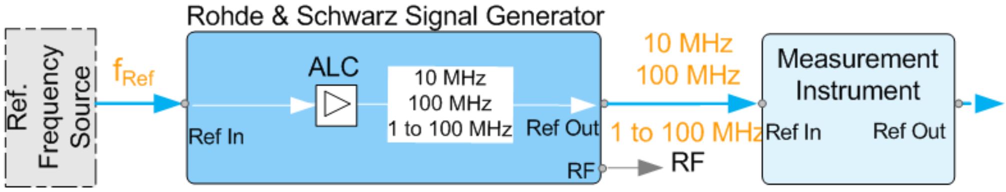


Figure 7-2: Synchronizing instruments with a 10 MHz external reference signal

Ref. Frequency Source = e.g. Rohde & Schwarz signal analyzer
f_{Ref} = 10 MHz/100 MHz/1 to 100 MHz external reference frequency
REF IN,REF OUT = Connectors

You can forward any external reference frequency between 1 MHz and 100 MHz directly to the output in the same way:

- External f_{Ref} = 1 MHz to 100 MHz
  (**1 MHz to 100 MHz at connector REF IN and REF OUT**)
- Source = "External"
- Variable Reference Frequency = "Variable"
- External Reference Frequency = current external frequency
- Reference Output = "Input Signal (loop through)" or specify the reference frequency the synchronized instrument supports

- Set the synchronization bandwidth according to the requirements of the application.

Deriving 10 MHz form the external reference frequency

10 MHz reference frequency can be derived from the following external reference signals:

- 100 MHz and 1 GHz external reference signals
- External reference signal between 1 MHz and 100 MHz
- If the external reference signal is interfered (noisy)

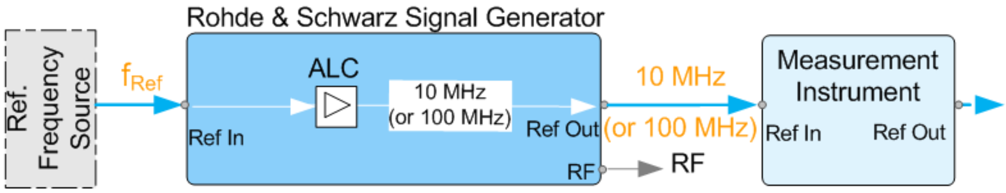


Figure 7-3: Synchronizing instruments with 10 MHz (derived from an external reference frequency)

Ref. Frequency Source = e.g., Rohde & Schwarz signal analyzer
f_{Ref} = 10 MHz/100 MHz/1 to 100 MHz/1GHz* external reference frequency
* = 1 GHz uses REF IN 1 GHZ connector
REF IN,REF OUT = Connectors

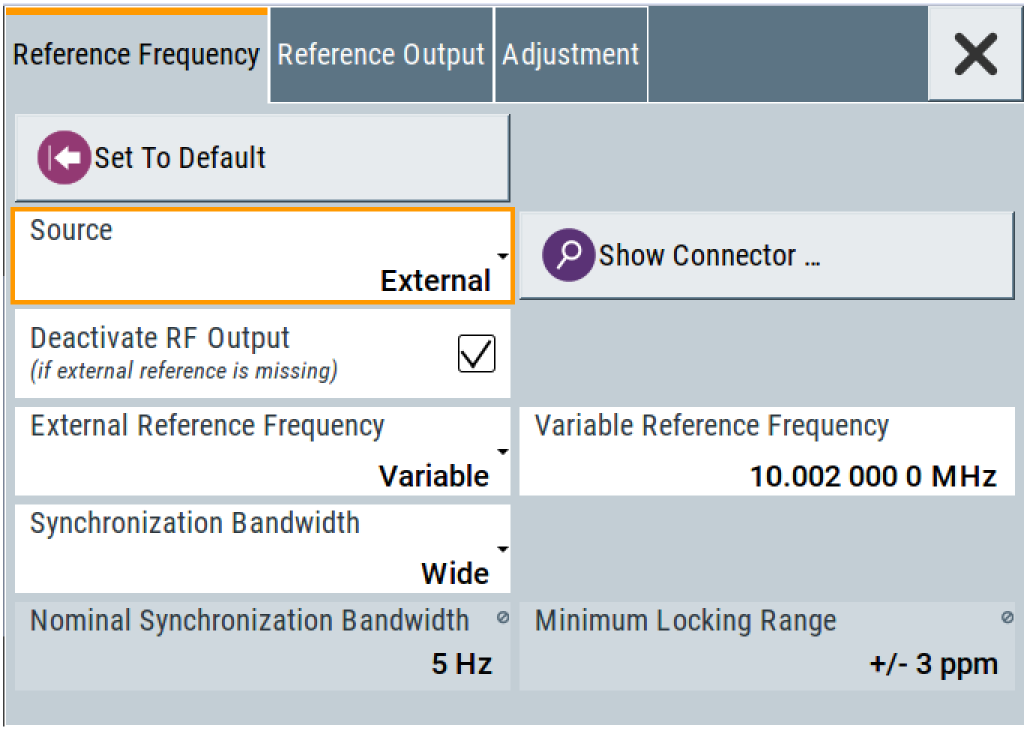
1 GHz/1 to 100 MHz at connector REF IN 1 GHZ/REF IN and 10 MHz at REF OUT

- E.g., External Ref. f_{ref} = 100 MHz
- Source = "External"
- External Reference Frequency = "100 MHz"
- Reference Output/1GHz Reference Output = "10 MHz"
- Synchronization Bandwidth = "Narrow"

7.3 Reference Frequency Settings

Access:

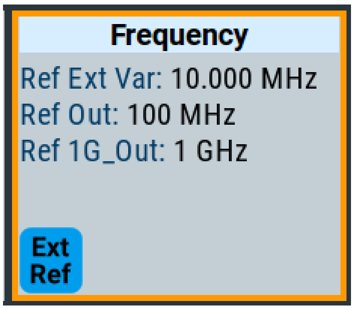
1. Select one of the following:
   - "Frequency" > "Reference Freq"
   - "System Config" > "Setup" > "Reference Freq"



In the "Reference Frequency" tab, you can select the signal source of the reference frequency and define the frequency of an external reference signal.

2. Observe the information on the home screen, "Frequency" tile.

   The "Frequency" tile indicates the current reference oscillator configuration, incl. the reference oscillator source, external reference frequency (rounded value) and output connector.



The remote commands required to define these settings are described in Chapter 12.15.11, "SOURce:ROSCillator Subsystem", on page 439.

Settings:

Set to Default

Calls the default settings.

Remote command:
[:SOURce]:ROSCillator:PRESet on page 440

Source

Selects the reference frequency source.

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

"External" Uses an external reference signal.
The frequency of the external reference signal must be set with the parameter "External Reference Frequency".
See "External Reference Frequency" on page 179.

Remote command:
[:SOURce]:ROSCillator:SOURce on page 440

Show Connector

Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

Deactivate RF Output (if external reference is missing)

Turns off the RF output 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 RF output is deactivated.

Remote command:
[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] on page 441

External Reference Frequency

Sets the frequency of the external reference signal.

"Variable" Option: R&S SMAB-K704
The external reference signal has an arbitrary frequency, within the permissible range from 1 MHz to 100 MHz.
Set the output frequency with the paramaters in the Reference Output dialog.

"10 MHz, 100 MHz, 1GHz"
Selects the external reference frequency.

Remote command:
[:SOURce]:ROSCillator:EXTernal:FREQuency on page 441

Variable Reference Frequency
Requires R&S SMAB-K704

Sets the variably settable external reference frequency.

Remote command:
[:SOURce]:ROSCillator:EXTernal:FREQuency:VARiable on page 442

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

The resulting bandwidth is indicated with the parameter Nominal Synchronization Bandwidth.

"Narrow" The internal reference oscillator is synchronized to the external signal with small bandwidth (< 1 Hz). This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.

"Wide" This mode is the recommended standard mode and for precise reference sources of high spectral purity.

Note: If the frequency of the external reference signal is outside the locking range of the internal reference oscillator, spurs due to the difference of the internal and external reference frequency are generated in the reference PLL.
An error message is displayed.

For more information, see data sheet.

Remote command:
[:SOURce]:ROSCillator:EXTernal:SBANdwidth on page 442

Nominal Synchronization Bandwidth
Indicates the nominal synchronization bandwidth for the selected external reference frequency and synchronization bandwidth.

Minimum Locking Range
Indicates the minimum locking range, depending on the selected external reference frequency and synchronization bandwidth.

External Tuning Active
For "Source > Internal", activates the EFC (external frequency control).

EFC is a function that transforms an external tuning voltage into frequency shift, where the value range of the resulting frequency is a technical characteristic listed in the data sheet.

See the data sheet also for information on the sensitivity, input voltage range, impedance and maximum bandwidth for external tuning signal.

Remote command:
[:SOURce]:ROSCillator:INTernal:TUNing[:STATe] on page 441

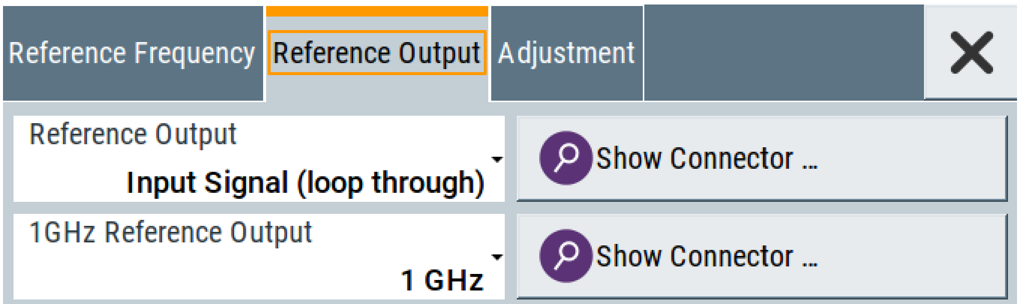
External Tuning Slope
Sets the sensitivity of the external tuning volatge.

Remote command:
[:SOURce]:ROSCillator:INTernal:TUNing:SLOPe on page 441

7.4 Reference Output Settings

Access:

1. Select "Frequency" > "Reference Freq"
2. Select "Reference Output".



In the "Reference Output" tab, you can set the reference frequency value at the output connectors.
The remote commands required to define these settings are described in Chapter 12.15.11, "SOURce:ROSCillator Subsystem", on page 439.

Settings:

Reference Output/1GHz Reference Output
Selects the signal that is to be output as frequency reference for downstream instruments.

"Off" Disables the reference signal output.

"10 MHz/100 MHz"
Derives a signal with 10 MHz or 100 MHz frequency from the internal reference oscillator and forwards this signal to the output.

"1GHz" Outputs a 1 GHz signal.

"Input Signal (loop through)"
Forwards the supplied reference frequency to the output directly.

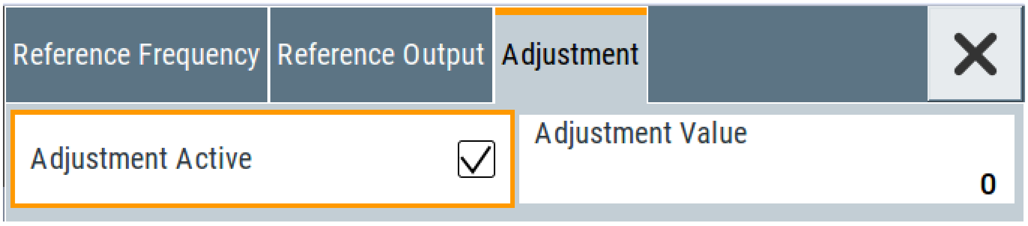
Remote command:
[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE on page 442
[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE on page 443

Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

7.5 Adjustments Settings

Access:

1. Select "Frequency" > "Reference Freq"
2. Select "Adjustment".



Settings:

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.
Enter the value in the Adjustment DAC Value field.

Remote command:
`[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]` on page 444

Adjustment DAC Value
Sets a user-defined adjustment value 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:
The value is not affected by an instrument preset (PRESET key or `*RST`) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:
`[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue` on page 443

8 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.

Output connectors

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 SYNC and CLK SYNC N connectors.

Required options

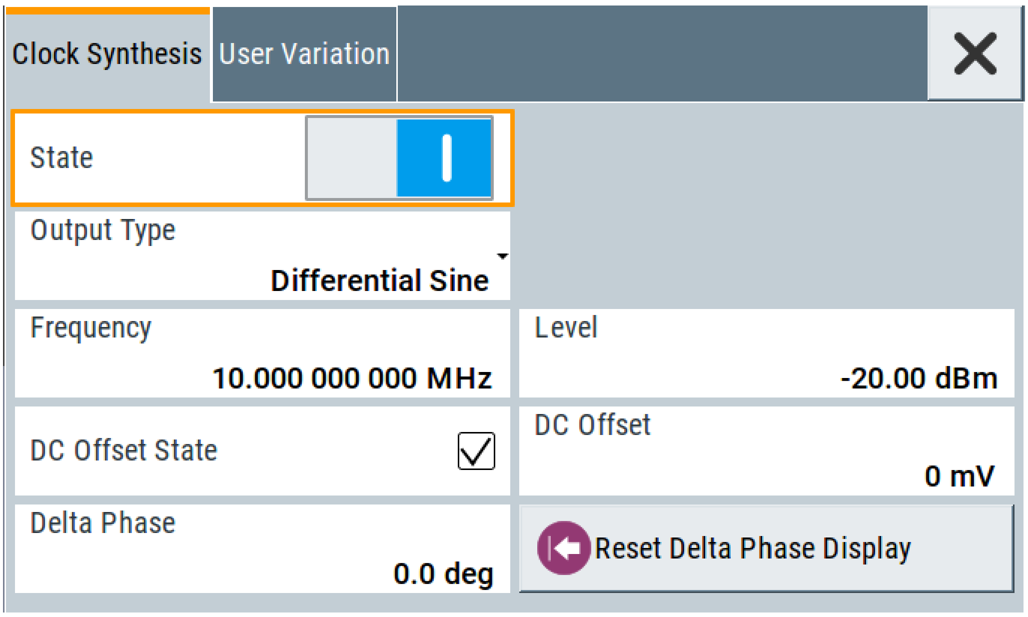
- Option frequency R&S SMAB-B10x
- Option differential clock synthesis up to 3 GHz R&S SMAB-B29
- Option clock synthesis extension 6 GHz R&S SMAB-K722 (requires at least R&S SMAB-B106)

For more information, see data sheet.

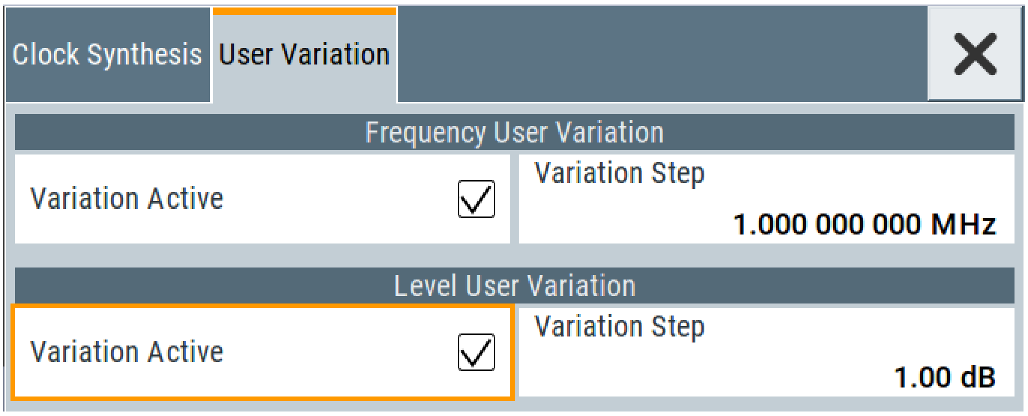
Settings

Access:

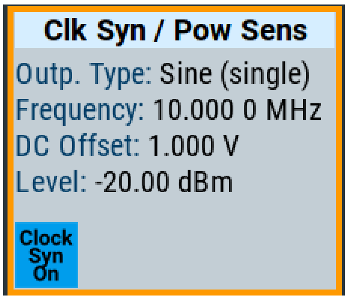
1. Select "Clk Syn/Power Sens > Clock Synthesis".



2. Select "User Variation" to set the step width to be used when setting the clock frequency using the rotary knob.



3. Observe the information on the home screen, "Clk Syn/Power Sens" tile.



The "Clk Syn/Power Sens" tile indicates that clock synthesis is activated and gives an overview of the key parameters.

Settings

State

Activates/deactivates generation of a system clock.

The signal is output at the CLK SYNC connector.

Remote command:
`:CSYNthesis:STATe` on page 328

Output Type

Defines the shape of the generated clock signal.

"Single-Ended/Differential Sine"
Sine signals with user-definable amplitude.

"Differential Square"
Squared signal with fixed amplitude.

"CMOS" CMOS-like signal with user-definable amplitude and limited frequency range.

Remote command:
`:CSYNthesis:OTYPe` on page 328

Frequency
Sets the frequency of the generated clock signal.

Output Type	Min. frequency	Max. frequency
Single-ended sinus Differential sinus	100 kHz	6 GHz
Differential square	10 MHz	6 GHz
CMOS	100 kHz	200 MHz

Remote command:
`:CSYNthesis:FREQuency` on page 328

Level
For Output Type = "Single-Ended/Differential Sine", sets the amplitude of the generated clock signal.

Remote command:
`:CSYNthesis:POWer` on page 329

DC Offset State
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.

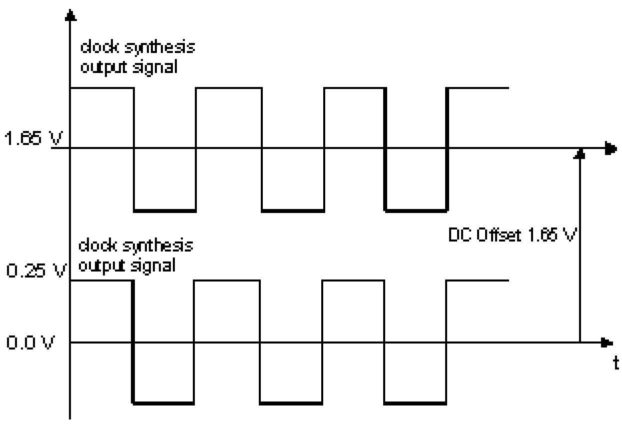


Figure 8-1: Example: DC offset = 1.65V and Output Type = Differential Square

Remote command:
`:CSYNthesis:OFFSet:STATe` on page 329

DC Offset
Sets the value of the DC offset for both clock synthesis signal outputs.

Remote command:
`:CSYNthesis:OFFSet` on page 329

Voltage
For Output Type = "CMOS", sets the high-level of the output signal.

Remote command:
`:CSYNthesis:VOLTage` on page 330

Delta Phase
Shifts the phase of the generated clock signal.

Remote command:
`:CSYNthesis:PHASe` on page 330

Reset Delta Phase Display
Resets the parameter Delta Phase.

User Variation
Defines and activates a user-defined step width for varying the frequency or level with the rotary knob.

If disabled, the step width varies in steps of one unit at the cursor position.

Variation Active ← User Variation
Activates the set user-defined step width.

Remote command:
`:CSYNthesis:FREQuency:STEP:MODE` on page 331
`:CSYNthesis:POWer:STEP:MODE` on page 331

Variation Step ← User Variation
Sets the user-defined step width.

Remote command:
`:CSYNthesis:FREQuency:STEP` on page 331
`:CSYNthesis:POWer:STEP[:INCRement]` on page 331

9 File and Data Management

The R&S SMA100B uses files to save all instrument data. The instrument allows you to store and to load instrument settings, and to import and to export user data for processing in another instrument or later. Finally, you can create a screenshot of the current settings displayed on the screen and save it as a file.

This section focuses on the functions provided for managing of user data files and covers the topics listed below.

For information on the related remote control commands, refer to Chapter 12.5, "MMEMory Subsystem", on page 311.

For information on how to save the displayed setting in a file, refer to Chapter 9.10, "Creating Screenshots of Current Settings", on page 211.

9.1 About the File System

Depending on the contained information, two file groups can be distinguished: system and user files.

Due to security reasons, system files and the system directory are protected and therefore not accessible.

The scope of this section is only the files with user data.

This section is an overview of the R&S SMA100B file system and covers the following topics:

- "Types of user data" on page 188
- "File storage location" on page 188
- "File handling" on page 189
- "File naming conventions" on page 189
- "File extensions" on page 189
- "File contents" on page 190

Types of user data

Depending on the **content**, the **user data** can be roughly divided into the following data types:

- *Settings*, e.g. the current instrument settings, can be stored and loaded later or used in other instrument of the same kind.
  See Chapter 9.4, "Saving and Recalling Instrument Settings", on page 196
- *SCPI scripts*, a series of commands that can be run to perform a task.
  See Chapter 9.6, "Exporting Remote Command Lists", on page 202
- Externally or internally generated *lists*, e.g. user correction lists, or data lists can be loaded in the instrument.
  See Chapter 9.7, "Loading, Importing and Exporting Lists", on page 203 and Chapter 9.5, "Accessing Files with User Data", on page 200

Depending on the **data storage method**, user data can be:

- *Persistent*, i.e. user files that are recorded on the data storage.
  Data is preserved when instrument is powered off and can be accessed and modified subsequently.
- *Temporary*, i.e. volatile data that the instrument retains while it is powered on.
  Volatile data is immediately lost when the R&S SMA100B is switched off.

File storage location

Without any additional measures, the R&S SMA100B stores user files on the internal memory, or if selected, on a memory stick.

Both, the user directory `/var/user` on the internal memory or the `/var/usb` directory, can be used to **preserve** user-defined data. Any directory structure can be created.

The `/var/volatile` directory serves as a RAM drive and can be used to protect sensitive information. The data is available **temporarily**.

If option R&S SMAB-B85 is installed, the R&S SMA100B maps the user directory to the removable memory. If a memory is mounted, user data is saved there. Otherwise user data is redirected to the volatile memory.

Default storage location

The R&S SMA100B stores user data in the user directory.

Depending on the installed options, the user directory is physically located on the internal memory or on the Removable memory.

In the file system, user directory is always indicated as **`/var/user`**.

In manual control, you access this directory via the "File Manager", see Chapter 9.8, "Using the File Manager", on page 203. In remote control, you can query it with the command `:SYSTem:MMEMory:PATH:USER?`.

To query and change the default directory used for mass storage, use the command `:MMEMory:CDIRectory`.

File handling

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.

See Chapter 9.8, "Using the File Manager", on page 203.

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 and assigns the `/usb/` drive to it.
- Connect the instrument to a LAN.
  An instrument connected to a LAN supports two standard file transfer methods from a remote client:
  – FTP (file transfer protocol)
  – File sharing according to the SAMBA/SMB (server message block) protocol.

  Both file transfer methods access the folder `/var/user/share`.
  For step-by-step description, see Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 206.

File naming conventions

To enable files to be used in different file systems, consider the following file naming conventions:

- The *filename* can be of any length and *is case-sensitive*, i.e it is distinguished between uppercase and lowercase letters.
- All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the filename).
- Avoid using special characters.
- Do not use slashes "\" and "/". These symbols are used in file paths.
- Avoid using the following filenames: `CLOCK$`, `CON`, `COM1 to COM4`, `LPT1 to LPT3`, `NUL` or `PRN`
  They are reserved by the operating system.

File extensions

The R&S SMA100B distinguishes the files according to their extensions; each type of file is assigned a specific file content and also a specific file extension. The extension is usually of no consequence to you since access to the files occurs in the individual dialogs where only the relevant type of file is available. For example, files with user correction data can only be saved and loaded in the "UCOR" dialog.

See Chapter C, "Extensions for User Files", on page 534 for an overview of the supported file extensions.

File contents

To maintain the file size and to accelerate the loading and processing times, not all instrument settings but rather the settings in state different than the preset one are stored. Considered is also configuration data for the operating elements and lists with user data, e.g. dialog positions and a list of user correction data. However, if a list data is part of the instrument settings, a reference to this list is stored, not the list itself.

This approach ensures that the created files contain only relevant information and allows you to transfer instrument settings even between different equipped signal generators. During the recall process, the instrument interprets only the relevant settings; all non-referenced parameters are set to their preset values. Error messages indicate the settings which cannot be implemented, like referencing non-existing lists or the attempt to activate settings which are not supported by the instrument.

Network settings and remote settings cannot be saved and restored.

9.2 Restoring the (Default) Instrument Configuration

The R&S SMA100B has various options to set default settings, see Figure 9-1. You can preset the R&S SMA100B to an initial state at any time as a known starting point for configurations. It is often useful as a first step in troubleshooting when unusual results arise.

The graph on Figure 9-1 shows the impact of the particular reset functions.

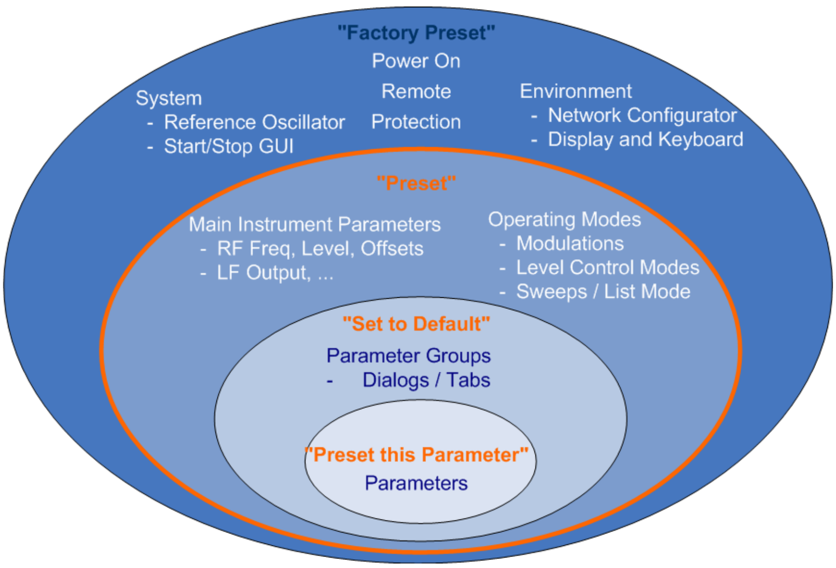


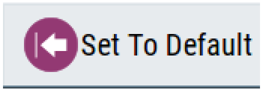
Figure 9-1: Parameter and operating modes, reset by the respective preset functions

Overview of the characteristics of the preset functions

Select the preset option that most fits to your particular application:

- PRESET
  It is the most frequently used function.
  A Preset executes a defined instrument setup to provide an initial instrument state as a basis for a new configuration. It resets all parameters and switching states, including also the states of inactive operating modes.
  Network, remote access or system settings are retained.

▶ To execute a preset, press the PRESET key at the front panel.

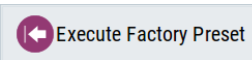


- "Set to Default"
  Set To Default relates to individual dialogs or tabs and resets the associated settings of the corresponding dialog. All other settings are retained.

▶ To reset the grouped settings, click "Set To Default".

- "Preset this parameter"
  Sets a single parameter to its default value.

▶ To reset an individual parameter: Open its context-sensitive menu and select "Preset this parameter...".



- "Factory Preset"
  A factory preset is the most profound preset function that resets almost all instrument settings, including reference oscillator, network and remote access settings.
  Retained are the following settings:
  – Security, password, and settings protected by these passwords
  – User-defined data, like setups or data lists
  – Settings that relate to an integration of the instrument in a measurement setup.

▶ To restore the factory defaults, select System Config > Setup > Settings > Factory Preset.

  Note: Perform a "Factory Preset" only if it is necessary. After a "Factory Preset", the network connection to the instrument no longer exists.

Presetting the instrument to a user-defined instrument state

The reset functions set the parameters and operating modes to default values predefined by the factory. Alternatively to these default settings, you can:

- Define user-specific recall settings to be restored after a preset
  (see Chapter 9.2.3, "How to Recall User Settings Automatically after Preset", on page 193)
- Store and reload user-defined instrument states
  (see Chapter 9.4.2, "How to Save and Recall Instrument Settings", on page 199)

Mark / Do not mark parameters changed from preset

To survey the current state of the settings concerning default values, the R&S SMA100B offers a feature that visually identifies deviations from the default values.

For more information, see Chapter 9.2.2, "How to Identify Parameters Which Are Not in a Preset State", on page 193.

9.2.1 Preset, Set to Default and Factory Preset Settings

Preset

Resets all parameters and switching states, and closes all opened dialogs.

Consider also the following possibilities:

- You can define the settings that are restored when you preset the instrument (see Chapter 9.2.3, "How to Recall User Settings Automatically after Preset", on page 193)
- You can reset the instrument to the factory state (see "Execute Factory Preset" on page 192)

See also Table 9-1 that contains the key parameters that are reset by the corresponding preset functions.

Remote command:
`*RST` on page 308

Set To Default

Resets the associated settings of the corresponding dialog or tab.

Preset this Parameter

Restores the default value of a single parameter.

Execute Factory Preset

Resets the instrument to its factory settings.

Note: "Factory Preset" retains all security settings and does not delete any user files like setups or user data.
See also Table 9-1 that contains the key parameters that are reset by the corresponding preset functions.

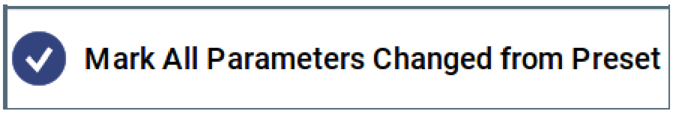
Remote command:
`:SYSTem:FPReset` on page 311

9.2.2 How to Identify Parameters Which Are Not in a Preset State

To recognize the current state of the settings related to their default values at the first glance, enable a function that visually identifies parameters in states different than preset.

To activate this display:

1. Open the context-sensitive menu (touch and hold the screen anywhere in the GUI of the R&S SMA100B).
2. Select "Mark all parameters changed from preset".



If enabled, the corresponding settings are marked.

Example:

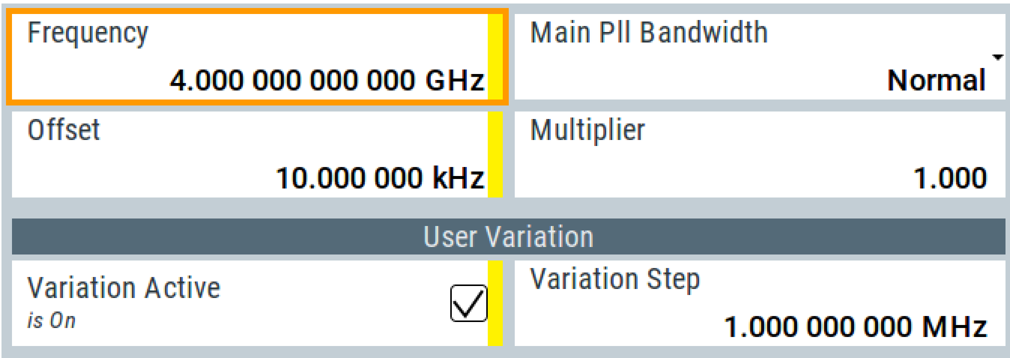


Figure 9-2: Labeled parameters show that the value deviates from its default

Frequency	= changed (default = 1 GHz)
Offset	= changed (default = 0 kHz)
Multiplier	= unchanged
Variation active	= changed (default = enabled)
Variation step	= unchanged

9.2.3 How to Recall User Settings Automatically after Preset

You can define the settings that are restored when you preset the instrument.

1. Configure the settings as required. Save them as described in Chapter 9.4.2, "How to Save and Recall Instrument Settings", on page 199.
2. Save the settings as a file with the predefined filename `UserPreset.savrcltxt`. Save this file in the directory `/var/user/`.

The filename `UserPreset.savrcltxt` and the directory `/var/user/` are mandatory.

Now when you press the PRESET key or send the `*RST` command to the instrument, the defined settings are restored.
An "Info" message confirms, that a file with user-defined preset setting is loaded.

9.2.4 Reference

See Table 9-1 for an overview of the main generator settings that are affected by the corresponding preset functions. While the regular PRESET key primarily resets the signal relevant parameters of the instrument, the "Factory Preset" affects almost all instrument settings.

For information on the default values of further parameters, refer to the description of the corresponding remote commands.

Table 9-1: Key parameters affected by preset and factory preset

Parameter	Preset value	Preset	Factory Preset
RF frequency	1 GHz	x	x
RF level (RF output)	off	x	x
RF OFF mode	-	-	x
Offsets	0	x	x
Modulation state	off	x	x
Uninterrupted level settings	off	x	x
Level attenuator mode	auto	x	x
Level ALC (internal level control)	auto	x	x
Level UCOR (user correction)	off	x	x
LF output state	off	x	x
Sweep state	off	x	x
List mode state	off	x	x
Reference frequency settings (reference oscillator)	-	-	x
Power on settings (Level/EMF)	-	-	x
Network settings	-	-	x
Hostname	-	-	x
GPIB address	-	-	x
Start/Stop display update	-	-	x
Display and keyboard settings	-	-	x
Password and settings protected by passwords (e.g. disabled LAN or USB)	-	-	-

Parameter	Preset value	Preset	Factory Preset
Security settings	-	-	-
User files (setups[2]), data lists, etc.)	-	-	-

- [2]) `UserPreset.savrcltxt` is renamed as `UserPresetInactive.savrcltxt`; an existing file with the same name is overwritten.

If the default values in the "Remote Access" dialog had been changed, a factory preset via remote control (`:SYSTem:FPReset`) terminates the connection to the instrument.

Security settings are never reset.

Resets all parameters and switching states, and closes all opened dialogs.

9.3 Protecting Data

During operation, the R&S SMA100B saves user data permanently in the user directory, see "File storage location" on page 188.

To protect any classified data and to avoid saving any sensitive data on the R&S SMA100B permanently, you can:

- Install the option **removable memory** R&S SMAB-B85
  This option ensures that user data is never saved on the internal memory.
  – Per default, if removable memory is **mounted**, user data is **saved permanently and only on it**.
    You can access data saved on the removable memory just as data stored in the `/var/user/`.
  – If volatile mode is activated or there is **no memory mounted or it is removed** during operation, user data is stored **temporary in the volatile memory** of the instrument.
    This data is lost once the instrument is switched off.
- Store user files **temporary in the `/var/volatile` directory**, which remains available only until the instrument is switched off.
  You can access data saved in volatile memory just as data stored permanently in the `/var/user/`.
  See also Chapter 9.8.2, "How to Display All Saved Files", on page 205.
- Activate the **volatile mode** so that no user data can be written to the internal memory permanently.
  The removable memory is protected, too.
  Instead, you can only save user data:
  – Temporary in the volatile memory
  – On a connected external storage device, such as a memory stick

See also:
- "Default storage location" on page 188
- "Volatile Mode" on page 233
- Chapter 9.9.4, "Using a USB Storage Device for File Transfer", on page 210

9.4 Saving and Recalling Instrument Settings

Possibly you would like to restore or repeat a signal generation you performed under specific conditions on the instrument. Or, in a test setup with more than one signal generators, you want to transfer the used settings to another R&S SMA100B. Some test setups also require similar settings in all instrument paths. In these cases, you can save and recall instrument and user settings, and possibly other related data.

In each of these cases, you can create a file with the complete instrument settings or you can choose to save only the settings belonging to a particular digital standard. The instrument uses a similar save/recall principle; both ways are scope of this section.

Save/Recall the complete instrument settings

Two different methods are available for managing *complete instrument settings*:

- Immediate (quick) Save/Recall
  A defined set of instrument settings are saved or recalled quickly in just one step, without defining a filename or storage location. This function enables a fast switching between different instrument settings.
- Save/Recall in files with user-defined names
  The defined set of instrument settings are stored to a definable storage location. The file extension is `*.savrcltxt`.
  Settings files created in this way are visible in the file system and accessible with the supported methods for file handling.

In the general case, a recall process replaces the instruments settings with the saved values. An exception is the frequency and level settings. During recall of the instrument settings, it is possible to retain the current settings or to overwrite them with the stored values.

Accessing and recalling instrument setups

For quick access to a stored instrument setup file, assign the appropriate action to the USER key.

See Chapter 10.2.3, "Assigning Actions to the User Key", on page 225.

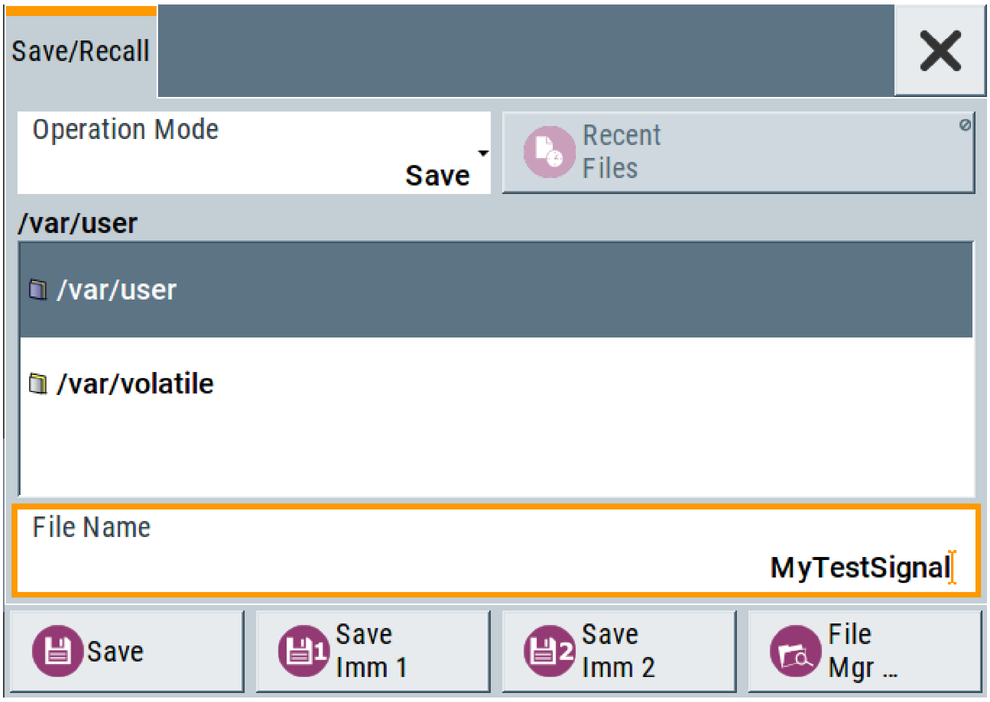
9.4.1 Save/Recall Settings

To access the dialog for storing and loading the complete instrument settings

1. Select "System Config > Save/Recall".

2. Select "Operation Mode > Save or Recall" to access the corresponding settings.

   The provided settings for both operations are similar and closely related.



Settings:

Operation Mode

Accesses the settings for storing ("Save") and loading ("Recall") of the instrument settings, or for exporting created SCPI files ("SCPI-Export").

See Chapter 9.6, "Exporting Remote Command Lists", on page 202.

Directory, File List and Filename

Note:

You access this generic standard function each time you perform one of the following:

- Store or load (settings) files
- Define a folder in that these files are stored
- Navigate through the file system.

The dialog name changes depending on the context. The provided functions are self-explanatory and similar.

With the provided settings, you can perform the following:
- To navigate through the file system, use the directory tree.
- To create a file, load and store files, use the dedicated functions "New", "Select", Save, and Recent files.
- To access the general data list editor, use the "Edit button (see also Chapter 5.7, "List Editor", on page 138).
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Chapter 9.8, "Using the File Manager", on page 203).

Remote command:
To list all files in a directory:
`:MMEMory:CDIRectory` on page 317
`:MMEMory:CATalog?` on page 316
`[:SOURce]:CORRection:CSET:CATalog?` on page 390

Recent files
Displays the files last used.

Save
Saves the current instrument settings or the settings belonging to a digital standard under the defined filename.

Remote command:
`:MMEMory:STORe:STATe` on page 320

Save Immediate x
Stores the current instrument setting in one of the 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 308

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

Remote command:
`[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL` on page 395

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

Remote command:
`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL` on page 438

Recall
Restores the selected configuration.

During recall, the instrument considers all related settings, for example sweeps in active state or lists. An error message indicates the settings which cannot be implemented.

Remote command:
`:MMEMory:LOAD:STATe` on page 319

Recall Immediate x
Loads the selected configuration from one of the intermediate memories. A message appears if no instrument configuration is stored in this memory.

Remote command:
`*RCL` on page 308

File Manager
Accesses the "File Manager" dialog, see Chapter 9.8, "Using the File Manager", on page 203.

9.4.2 How to Save and Recall Instrument Settings

Instrument settings can be saved to a file and loaded again later, so that you can repeat the tests with the same settings.

Accessing and recalling instrument setups
For quick access to a stored instrument setup, assign the appropriate action to the USER key.
See Chapter 10.2.3, "Assigning Actions to the User Key", on page 225.

To save and recall instrument settings quickly

1. Select "System Config > Save/Recall" > "Operation Mode > Save".
2. Select "Save Immediate 1".

   The instrument saves its settings in the intermediate memory 1. The filename and the storage location cannot be changed.
3. Adapt the instrument settings as required. Select "Save Immediate 2"
4. To restore the settings, select the "Operation Mode > Recall"
5. Select "Recall Immediate 1"

   The instrument is restored to the previous state.
6. Select "Recall Immediate 2" to switch to the settings stored in the second file.

To save complete instrument settings

1. Select "System Config > Save/Recall" > "Operation Mode > Save".
2. Navigate in the file selection dialog and select a filename and storage location for the settings file.

3. Select "Save".

   A file with the defined name and path and the extension `*.savrcltxt` is created.

To restore instrument's configuration

Save the configuration as described in "To save complete instrument settings" on page 199.

1. To restore settings, select "System Config > Save/Recall" > "Operation Mode > Recall".
2. To retain the current frequency and level settings, enable "Save/Recall > Exclude Frequency/Level"
3. Navigate in the file selection dialog and select the filename and storage location of the settings file.

   The settings are restored, but the frequency and level settings are retained; you can repeat the signal generation with the same settings.
   See also Chapter 9.2.3, "How to Recall User Settings Automatically after Preset", on page 193.

9.5 Accessing Files with User Data

Signal generation in list mode, the generation of pulse train signals or applying user correction values use data from list files. Whenever a list file is required as a data source, the instrument provides direct access to the standard "File Select" function. This function enables you to select, create and edit the list files.

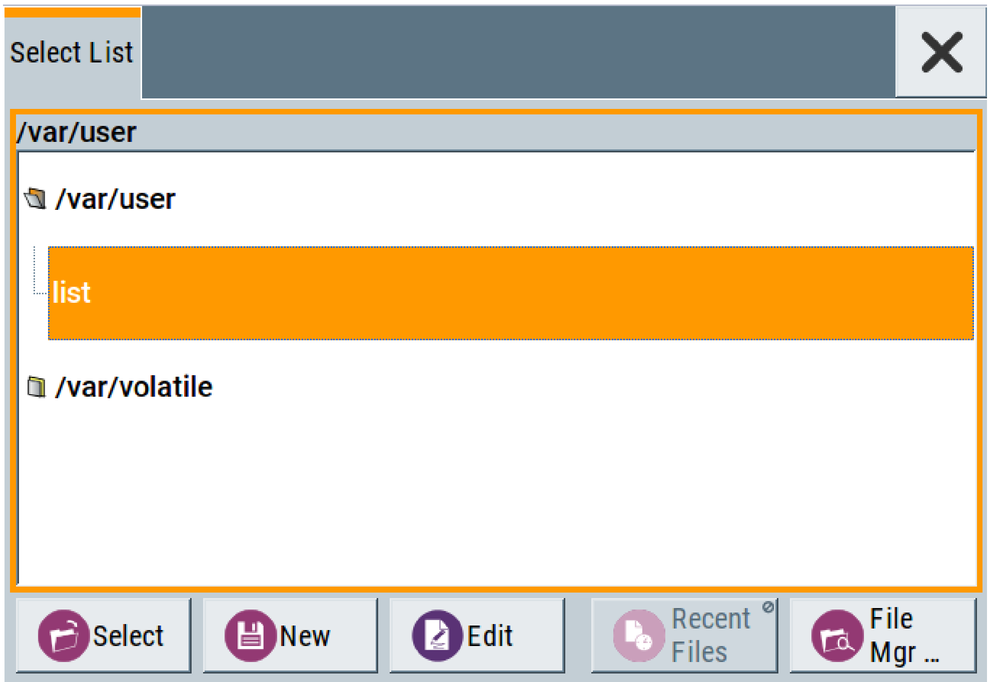
9.5.1 File Select Settings

The "File Select" dialog opens automatically each time the signal generation requires list file as data source.

To access a loadable data list file

1. Select ""Sweep" > List Mode Data > List Mode Data".

   A "File Select" dialog for loading, creating and modifying a file is displayed.



Tip: The name of the dialog is context-sensitive and differs depending on the particular function this dialog is from. However, the provided functions are similar.

2. To load an existing file:
   Navigate through the file system.
   Select the file and confirm with "Select".
3. To create a file, for example if there is no data list file specified:
   Navigate through the file system.
   Select "New" and specify the filename.

   A new empty file is created and saved in the selected folder.
4. To edit an existing or newly created file:
   Navigate through the file system.
   Select the file and select "Edit".

   The standard "Data List Editor" dialog opens
5. Edit the file content.
   Confirm with "Save".

Settings:

Directory, File List and Filename

Note:

You access this generic standard function each time you perform one of the following:

- Store or load (settings) files
- Define a folder in that these files are stored
- Navigate through the file system.

The dialog name changes depending on the context. The provided functions are self-explanatory and similar.

With the provided settings, you can perform the following:

- To navigate through the file system, use the directory tree.
- To create a file, load and store files, use the dedicated functions "New", "Select", Save, and Recent files.
- To access the general data list editor, use the "Edit button (see also Chapter 5.7, "List Editor", on page 138).
- To perform standard file management functions, like create directories, move, copy, delete files and/or directories, use the standard "File Manager" function (see Chapter 9.8, "Using the File Manager", on page 203).

Remote command:
To list all files in a directory:
`:MMEMory:CDIRectory` on page 317
`:MMEMory:CATalog?` on page 316
`[:SOURce]:CORRection:CSET:CATalog?` on page 390

Functions for handling of data lists
Provided are the following standard functions for file handling:

"Select" Select and load the file.

Remote command:
`[:SOURce<hw>]:LIST:SELect` on page 423
`[:SOURce<hw>]:PULM:TRAin:SELect` on page 382
`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 388

"New" Creates file with the specified "Filename".
To confirm, select "OK"; use "Cancel" to undo the operation.
To edit the file content, select "File Select > Edit".

"Edit" Accesses the "Data List Editor" and loads the selected file for editing

Recent files
Displays the files last used.

File Manager
Accesses the "File Manager" dialog, see Chapter 9.8, "Using the File Manager", on page 203.

9.6 Exporting Remote Command Lists

To set specific instrument settings or perform tasks automatically, you can create scripts that contain the settings in the form of remote control command sequences.

You can record or manually create SCPI lists, or generate a list of the current instrument state in one step, see Chapter 11.14, "How to Record / Create SCPI Lists", on page 290.

Completed scripts are stored in files and possibly converted to different formats, depending on the used language of the source code.

The R&S SMA100B supports the following commonly used languages:

- Plain SCPI: `*.txt`
- MATLAB: `*.m`
- NICVI: `*.c`

It is also possible to convert the SCPI command list to a user-specific language, see Chapter 11.15, "How to Convert and Save SCPI Lists", on page 293.

9.7 Loading, Importing and Exporting Lists

The R&S SMA100B provides built-in editors for creating list files, for example for the list mode or lists with user correction data. You can also create or evaluate them with an external application. The instrument provides interfaces with the following functionality:

- Import and export list files in a standard ASCII format file

Lists are saved and loaded in the corresponding dialogs. For example, the user correction data list is created and stored in the "User Correction" dialog.

9.8 Using the File Manager

The "File Manager" is a tool similar to a standard Windows Explorer. It helps you manage mass storage media and files stored on the R&S SMA100B.

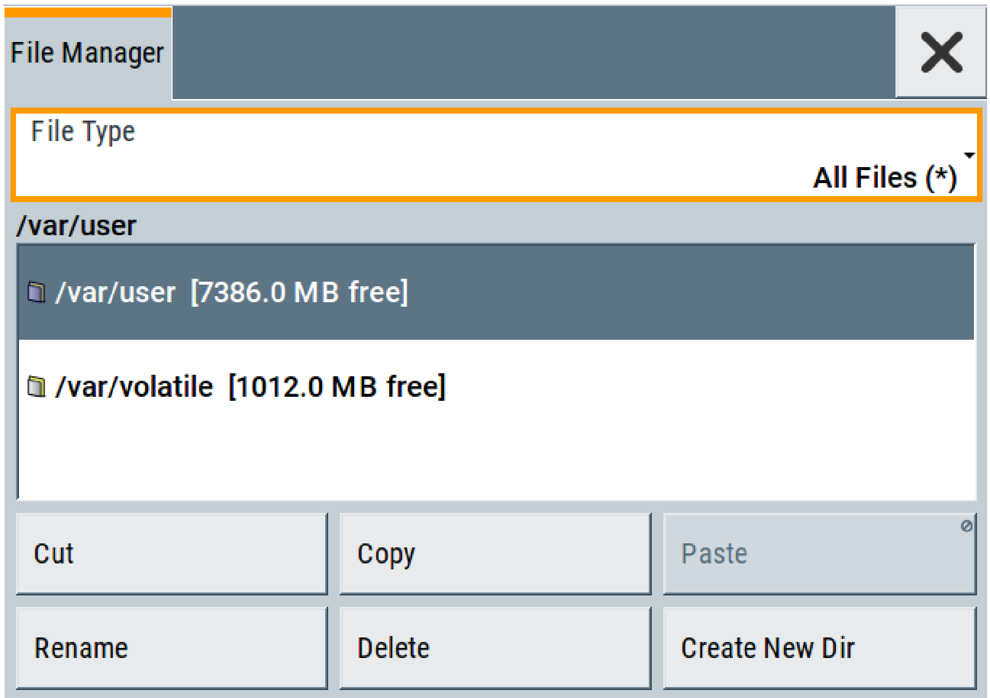
You can perform the following tasks:

- Copying multiple files from disk to other media
  See Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 206
- Copying files into another directory
  See Cut, Copy&Paste and Delete
- Renaming and deleting files
- Creating directories
  See Create New Directory
- Displaying saved files
  See Chapter 9.8.2, "How to Display All Saved Files", on page 205

Access:

► Select "System Config > Save/Recall" > "File Manager".

Tip: Each "Save/Recall" dialog and each "File Select" dialog provides a quick access to the "File Manger", i.e. whenever you select data lists or files with user data.



The "File Manager" dialog provides all standard functions required for file management. It displays the contents of the selected folder on the R&S SMA100B and provides functions to rename, delete, copy, or move individual files.

9.8.1 File Manager Settings

Access:

► Select "System Config > Save/Recall" > "File Manager".

Settings:

File Type

Selects the file type to be listed. If a file type with a specific file extension is selected, only files with this extension are listed.

See Chapter C, "Extensions for User Files", on page 534 for an overview of the supported file extensions.

Directory and Filename
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 tree.

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

Remote command:
`:MMEMory:CDIRectory` on page 317

Cut, Copy&Paste and Delete
Standard file management functions.

Before a file is deleted, you have to confirm the delete operation.

Remote command:
`:MMEMory:DELete` on page 319
`:MMEMory:COPY` on page 317

Rename
Renames the selected file or directory.

Remote command:
`:MMEMory:MOVE` on page 320

Create New Directory
Creates a folder and opens an edit dialog box to enter name and path (absolute or relative to the current directory) of the new folder.

Remote command:
`:MMEMory:MDIRectory` on page 319

9.8.2 How to Display All Saved Files

To display all files on the internal memory

1. Select "System Config > Save/Recall" > "File Manager".
2. Navigate to `/var/user/`.

To display all files on a connected USB flash drive

1. Select "System Config > Save/Recall" > "File Manager".
2. Navigate to `/var/usb/`.

To display all files in the volatile memory

1. Select "System Config > Save/Recall" > "File Manager".
2. Navigate to `/var/volatile/`.

9.9 How to Transfer Files from and to the Instrument

As explained in "File handling" on page 189, you access the file system of the R&S SMA100B via one of the following ways:

- Via the built-in "File Manager"
  See Chapter 9.8, "Using the File Manager", on page 203.
- On an instrument connected to a LAN:
  – Via one of the standard functions ftp or SMB (samba)
    See Chapter 9.9.2, "Accessing the File System of the R&S SMA100B via ftp", on page 207 and
    Chapter 9.9.3, "Accessing the R&S SMA100B File System via SMB (Samba)", on page 209
- Via a connected USB storage device
  See Chapter 9.9.4, "Using a USB Storage Device for File Transfer", on page 210

Mainly because of security reasons, the access to the file system of your R&S SMA100B can be denied, because one or all these access methods are deliberately disabled. Access to the file system via LAN and/or USB requires that the corresponding service is enabled and a write access to the file system is enabled. Refer to Chapter 9.9.1, "Removing File System Protection", on page 206 for description of the required steps.

This section provides an introduction to the topic. For comprehensive information, refer to the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

9.9.1 Removing File System Protection

Before you try to access the file system via ftp, SMB (samba) or USB, fulfill the following:

- Disable write protection on the file system
- Enable the corresponding service or interface

To enable write permission on the file system

1. Select "System Config > Setup > Security > Security > General"
2. Enable "Write Nonvolatile Memory"
3. Enter the "Security Password".
   The default password is *123456*. For more information, see Chapter 10.4, "Managing the Security Settings", on page 230.
4. Select "System Config > Setup > Maintenance > Shut Down"

5. Select "Reboot".

   The system reboots. The enabled settings are active.

To enable file transfer via ftp

1. Select "System Config > Setup > Security > Security > LAN Services".
2. Enable "LAN Interface"
3. Enable "FTP"
4. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 10.4, "Managing the Security Settings", on page 230.
5. Select "Accept".

To enable file transfer via SMB (samba)

1. Select "System Config > Setup > Security > Security > LAN Services"
2. Enable "LAN Interface"
3. Enable "SMB (Samba)"
4. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 10.4, "Managing the Security Settings", on page 230.
5. Select "Accept".

To enable file transfer via USB

1. Select "System Config > Setup > Security > Security > General"
2. Enable "USB Storage"
3. Enter the "Security Password".
   The default password is *123456*. For more information, refer to Chapter 10.4, "Managing the Security Settings", on page 230.
4. Select "Accept".

9.9.2 Accessing the File System of the R&S SMA100B via ftp

If the R&S SMA100B is connected to a LAN, you can use file transfer protocol (ftp) to access the file system and to transfer files from and to the instrument.

For information on how to set up a LAN connection, refer to:

- Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 26
- Chapter 11, "Network Operation and Remote Control", on page 243

To access the file system via ftp

We assume that the instrument and the remote PC are connected to a LAN.

1. Enable file transfer via ftp
2. Enable write permission on the file system
3. On the remote PC, start the Windows Explorer.
4. In the address field, enter `ftp://<"IP Address" of the Instrument>`, e.g. *ftp://10.113.10.91*.
   Tip: The R&S SMA100B indicates IP address on the screen.

   A log-on dialog opens and requests a password.

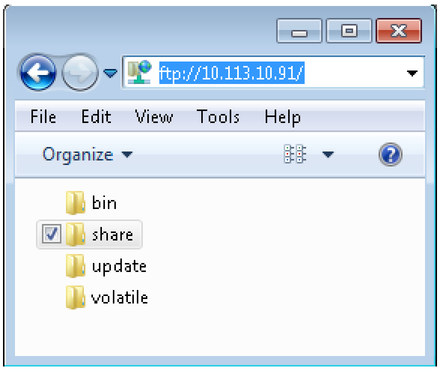
   The default user name and password is *instrument*.

   Tip:
   Default password

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

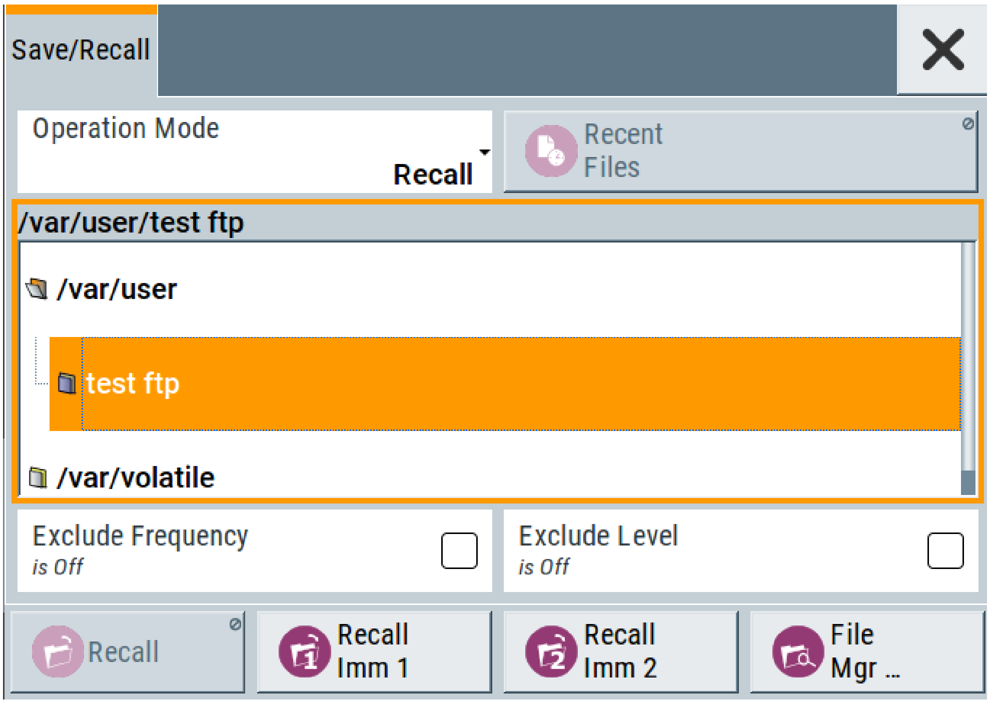
   We recommend that you change this password in the "Setup > Security > Password Management > Change User Password" dialog before connecting the instrument to the network.

   See Chapter 10.4.4, "Password Management", on page 238.
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, or storing files.
6. Open the `/var/user/share` directory and create a directory, e.g. `test ftp`.
7. Select ""System Config > Save/Recall"".
   Open the `/var/user` directory.

   The dialog displays the `/var/user/test ftp` directory.



9.9.3 Accessing the R&S SMA100B File System via SMB (Samba)

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

For information on how to set up a LAN connection, refer to:

- Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 26
- Chapter 11, "Network Operation and Remote Control", on page 243

To map the R&S SMA100B as a network drive to the remote PC

We assume that the instrument and the remote PC are connected to a LAN.

1. Enable file transfer via SMB (Samba)
2. Enable write permission on the file system
3. On the remote PC, start the Windows Explorer.
   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`
      For example: *10.113.10.91/share* or *//SMA100B-102030/share* (previous syntax: *//rssmw200a102030/share*).
      Tip: The R&S SMA100B indicates IP address on the screen.
   c) Select "Finish".

A log-on dialog opens and requests a user name and a password.

The default user name and password is *instrument*.

Tip:
Default password

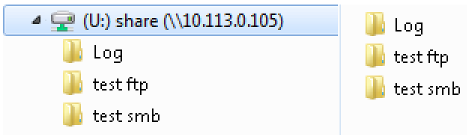
The FTP and SAMBA file access use the user "instrument" with default password "instrument".

We recommend that you change this password in the "Setup > Security > Password Management > Change User Password" dialog before connecting the instrument to the network.

See Chapter 10.4.4, "Password Management", on page 238.

4. Enter the user name and the password of your instrument.

   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 the `/var/user` directory, perform standard function like creating directory, or storing files.

9.9.4 Using a USB Storage Device for File Transfer

Alternatively to the file transfer possibility via LAN, you can use a USB storage device for direct file transfer from and to the instrument.

We recommend that you transfer files with user data (like lists or instrument setup files) to the instrument, rather than load and play them from a connected USB storage device.

To transfer a file with user data to the instrument

1. Connect a USB storage device, for example a USB memory stick to one of the USB interfaces of the instrument.

   The R&S SMA100B recognizes the connected USB storage device automatically.
2. Enable file transfer via USB
3. Enable write permission on the file system
4. Select "System Config > Save/Recall".

   The dialog displays the `/var/user` directory and the `/usb` drive.
5. In the "Save/Recall" dialog, select "File Manager".
6. In the directory tree, navigate to the `/usb` drive.
   Select the required file with user data.

7. Select "Copy".
8. In the directory tree, navigate to the `/var/user` directory.
   Select "Paste".

   The file with user data is transferred to the instrument.

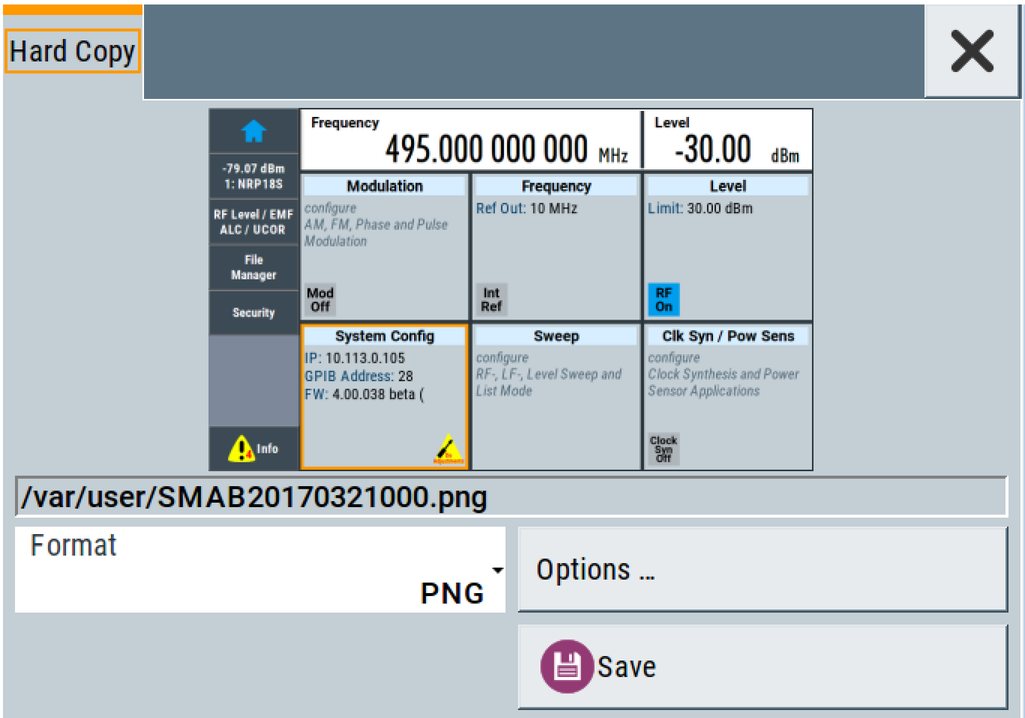
9.10 Creating Screenshots of Current Settings

The save/recall function enables you to store current settings in a file. To document the most important settings for a performed signal generation, you can also store a hard-copy of the current display.

9.10.1 Hard Copy Settings

Access:

► Select "System Config > Setup > User Interface > Hardcopy".



The remote commands required to define these settings are described in Chapter 12.11, "HCOPy Subsystem", on page 340.

Settings:

Format

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

Remote command:
`:HCOPy:IMAGe:FORMat` on page 342
`:HCOPy:DEVice:LANGuage` on page 342

Options...

Accesses Hard Copy Options dialog.

File...

In "Automatic Naming > Off" mode, accesses the standard file select dialog for selecting the filename and folder the hardcopy is stored in.

If you have enabled "Automatic Naming", the instrument displays the automatically generated filename.

Remote command:
`:HCOPy:FILE[:NAME]` on page 343

Save

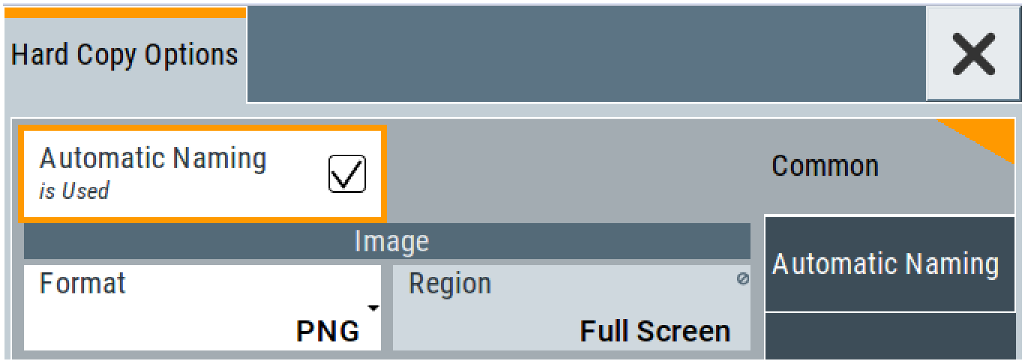
Saves a hardcopy of the current display as a file.

Remote command:
`:HCOPy[:EXECute]` on page 343

Hard Copy Options

Access: select "Hard Copy > Options...".

With the provided settings, you can customize the file format and the syntax of the automatically assigned filename.



Automatic Naming ← Hard Copy Options
If enabled, creates the output filenames automatically according to the rules set with the Automatic Naming settings.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO:STATe` on page 344

Image Settings ← Hard Copy Options
Provided are the following settings:

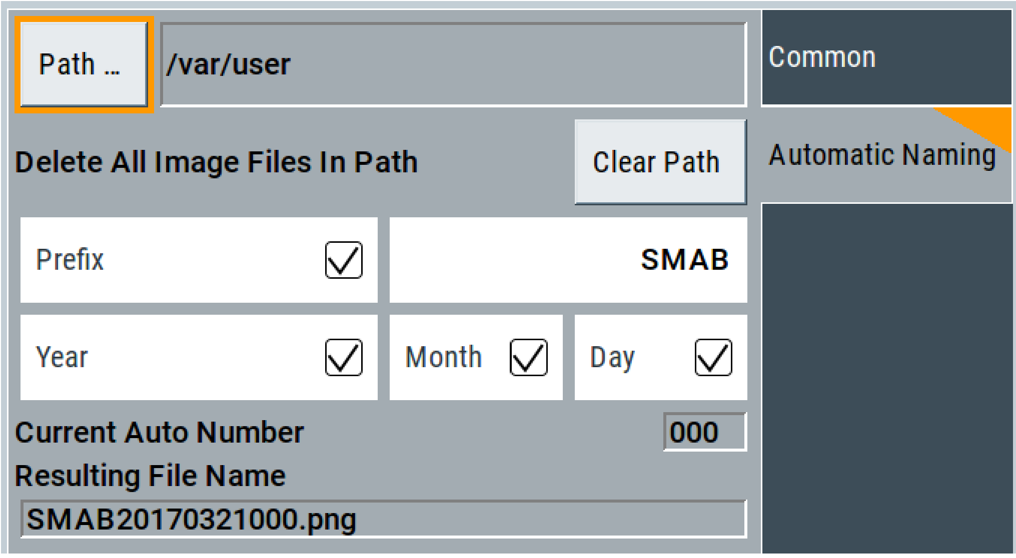
Format ← Image Settings ← Hard Copy Options
Selects the output file format, for example `*.bmp`, `*.jpg*.xpm` and `*.png`.

Remote command:
`:HCOPy:IMAGe:FORMat` on page 342
`:HCOPy:DEVice:LANGuage` on page 342

Region ← Image Settings ← Hard Copy Options
Displays the snapshot area.

Remote command:
`:HCOPy:REGion` on page 342

Automatic Naming ← Hard Copy Options



Provided are the following settings:

Automatic Naming ← Automatic Naming ← Hard Copy Options
If enabled, creates the output filenames automatically according to the rules set with the Automatic Naming settings.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO:STATe` on page 344

Path... ← Automatic Naming ← Hard Copy Options
Selects the directory.

Note: To select the destination path, specify also a filename. Otherwise an error message is displayed and selection is canceled.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO:DIRectory` on page 344

Clear Path ← Automatic Naming ← Hard Copy Options
Deletes all image files with extensions `*.bmp`, `*.jpg`, `*.png` and `*.xmp` in the directory set for automatic naming.

Before the command is executed, a warning message prompts you to confirm the deletion of the files.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar` on page 344

Prefix, Year, Month, Day ← Automatic Naming ← Hard Copy Options
Determines the rules for "Automatic Naming".

Per default, the automatically generated filename 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 activate or deactivate each component separately.

The "Resulting filename" indicates the current filename syntax.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix` on page 345
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe` on page 345
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe` on page 345
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe` on page 345
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe` on page 345

Current Auto Number ← Automatic Naming ← Hard Copy Options
Indicates the number which is used in the automatically generated filename.

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 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 filename is unique within the selected path. The current number is not in the save/recall file but is temporarily stored within the database. At the following save operation, the number is increased.

Remote command:
`:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?` on page 345

9.10.2 How to Store a Hardcopy of the Display

1. Select "System Config > Setup > User Interface > Hardcopy".
2. To define the output format, select "Format > JPG".
3. To enable the instrument to create output filenames, select "Automatic Naming > On".
4. Select "Options...".
5. In the "Hard Copy Options" dialog:
   a) To change the default directory the file is saved in, select "Automatic Naming Settings > Path" and define a path and a filename. For example, select the default directory `/var/user`.
   b) If necessary, disable or change some of the parameters in the "Automatic Naming Settings".
   c) Close the "Hard Copy Options" dialog.
6. In the "Hard Copy" dialog, select "Save".

   The instrument saves a hardcopy of the current instrument display as a `*.jpg` file. The filename is automatically created.
7. To print the hardcopy, connect the instrument to a LAN and:
   a) Transfer the file to a remote computer as described in Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 206.
   b) On the remote computer, navigate through the file system.

c) Print the selected file.
For more information, refer to the online help of the operating system.

10 General Instrument Functions

The general instrument functions include basic instrument settings, regardless of the selected operating mode and measurement. Some of these settings like screen display and peripherals are initially configured at the setup of the instrument, according to personal preferences and requirements. However, you can individually adjust the settings at any time, for example, if necessary for specific applications.

The following special functions help you in service and basic system configuration:

- Chapter 10.1, "Customizing the User Interface", on page 217
  Allows you to adjust the display and keyboard language settings.
- Chapter 10.3, "Managing Licenses and License Keys", on page 227
  If you have purchased an additional option for the R&S SMA100B, you can enable it using a license key.
- Chapter 9.2, "Restoring the (Default) Instrument Configuration", on page 190
  At any time, you can restore a default configuration to start a measurement at a defined instrument state, or set the instrument to factory preset.
- Chapter 13.3, "Performing Maintenance Tasks", on page 486
  Special functions like calibration routines and self-tests put your instrument to an initial state.
- Chapter 10.4, "Managing the Security Settings", on page 230
  Special security and protection functions protect your instrument from unauthorized use or activate specific test routines.

10.1 Customizing the User Interface

The R&S SMA100B provides basic alignments of instrument settings regarding the user interface, that means the touch panel (screen), the appearance of the displayed dialogs and graphics, and an external keyboard.

Start / stop display update

The operating system of the R&S SMA100B refreshes the displayed settings by default in almost real-time, to keep the display updated with the internally used values. However, you can turn off this function to reduce settling times when the instrument is remote controlled.

We recommend that you switch off the display update for optimum sweep performance with short dwell times and for fast settling times.

Consider that in this case the displayed values can differ from the operated values.

In detail described in the following paragraphs, you can:

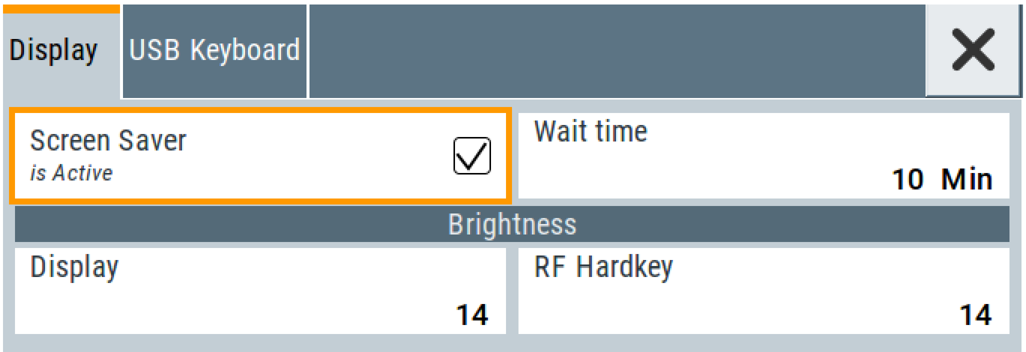
- Set display and keyboard language, see Chapter 10.1.1, "Display and Keyboard Settings", on page 218

- Set date and time for the system clock, see Chapter 13.3.1, "Date and Time Settings", on page 487
- Configure and activate aScreen Saver
- Deactivate display update to improve performance, see Chapter 10.1.2, "Display Update Settings", on page 219
- Determine the state of the RF signal, and the level display in the status bar when you turn on the R&S SMA100B, see Chapter 10.1.3, "Defining the RF Signal State On Power On ", on page 220.

10.1.1 Display and Keyboard Settings

Access:

► Select "System Config > Setup > User Interface > Display or Keyboard".



In the "Display/Keyboard" dialog, you can change regional and language options for the GUI and an external keyboard, and define the screen saver settings.

The remote commands required to configure the display and keyboard are described in Chapter 12.9, "DISPlay Subsystem", on page 334 and Chapter 12.12, "KBOard Subsystem", on page 346.

Screen Saver
Activates the screensaver.

If activated, the display including backlight is switched off after the selected Wait Time elapses and if no entries via touch panel, front panel, external mouse, or external keyboard are made

Remote command:
`:DISPlay:PSAVe[:STATe]` on page 335

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 335

Display
Adjusts the brightness of the display.

Increase the value to turn up the display brightness.

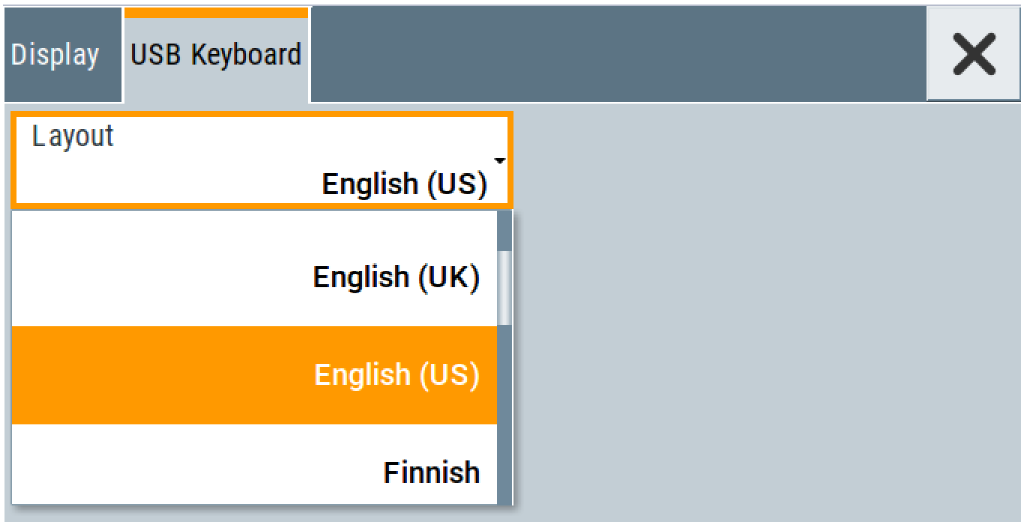
Remote command:
`:DISPlay:BRIGhtness` on page 336

RF Hardkey
Adjusts the brightness of the RF ON/OFF key.

Increase the value to change the contrast between the key and the front panel background color.

Remote command:
`:DISPlay:BUTTon:BRIGhtness` on page 336

USB Keyboard > Layout



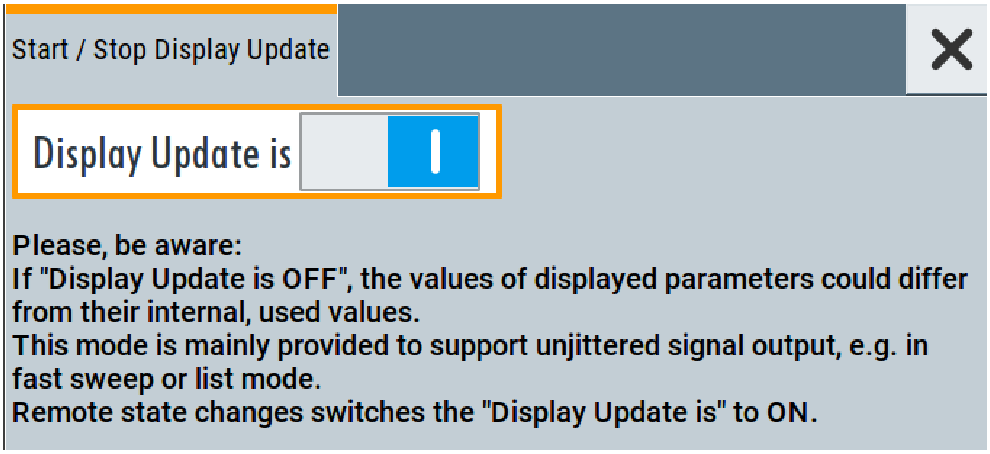
Selects the language of an externally connected keyboard via USB. The function assigns the corresponding keys automatically.

Remote command:
`:KBOard:LAYout` on page 346

10.1.2 Display Update Settings

Access:

► Select "System Config > Setup > User Interface > Start/Stop Display Update".



This dialog enables you, to deactivate updating the display.

The remote command to switch off the ddiplay update is described in Chapter 12.9, "DISPlay Subsystem", on page 334.

Display Update is

Disables the automatic refreshing of the displayed values.

Remote command:
`:DISPlay:UPDate` on page 336

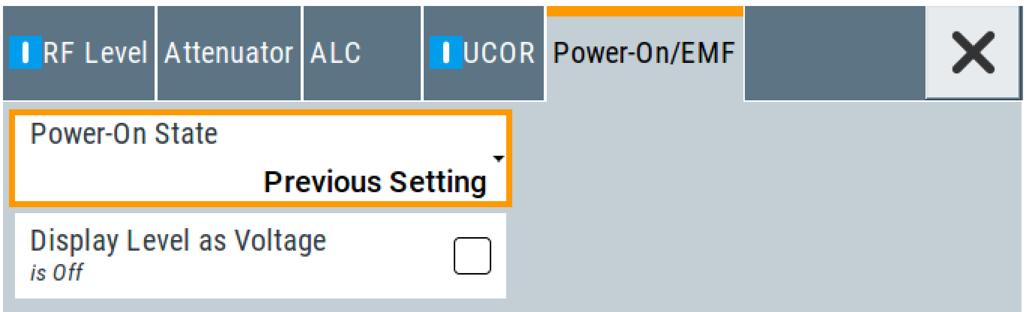
10.1.3 Defining the RF Signal State On Power On

As additional functions for the level settings, you can determine the state of the RF signal, and the level display in the status bar when you turn on the R&S SMA100B.

Power-On/EMF settings

Access:

► Select "Level" > "Power-On / EMF".



The "Power-On/EMF" dialog contains all settings for configuring the power-on behavior and the level display.

Settings:

Power-On State

Determines the RF signal output state when the instrument is switched on.

You can disable the RF output signal in general, or start it in the same state as it had been when it was switched off.

Remote command:
`:OUTPut<hw>[:STATe]:PON` on page 347

Display Level as Voltage of EMF

Activates display of the signal level as voltage of the EMF (no-load voltage).

If disabled, the level is displayed as a voltage over a 50 Ohm load.

Note:
The value is not affected by an instrument preset (PRESET key or `*RST`) and the "Save/Recall" function. It is reset only by factory preset.

Remote command:
`[:SOURce<hw>]:POWer:EMF:STATe` on page 433

10.2 Organizing Frequently Used Items as Favorites

The USER key is a key with customizable function. Per default, pressing the key opens the "User Menu" but you can add or remove actions, too. You can add actions to be executed or function to be accessed upon pressing this key.

User Menu and User Key

These two functions work similar to the favorites function of browser or other programs. They allow you to create a list of frequently used actions or to group frequently used settings in one single dialog.

Possible applications

The USER key is useful in the following situations:

- There are functions or tasks you have to perform in a defined order but they are distributed among several dialogs
- There are functions or tasks you have to perform more frequently than other but they are not accessible via a front panel key.
- The required functions are grouped in a dialog that is not directly accessible from the blocks on the home screen.
- Your task involves the frequently loading and executing of certain SCPI scripts. Refer to Chapter 11.14, "How to Record / Create SCPI Lists", on page 290 for information on how to create an SCPI script.
- A quick access to saved setups is required.

Dialog identification

To identify each dialog, the instrument uses a dedicated dialog ID. The dialog ID contains the dialog position on the display and the current active tab. The action that triggers the instrument to open a dialog uses this identification.

Save/Recall vs. recall setup

Sometimes, you would like to restore a signal generation you performed under specific conditions on the instrument and perform further configuration based on this particular instrument state. The R&S SMA100B provides two ways to achieve this, by the "Save/Recall" function and by the "Recall Setup" function.

- "Save/Recall"
  For a detailed description, refer to Chapter 9.4, "Saving and Recalling Instrument Settings", on page 196.
- "Recall Setup"
  If the "Recall Setup" is the only one user action assigned to the USER key, pressing this key triggers the R&S SMA100B to load *immediately* the user-defined preset file.

10.2.1 Using the User Menu for Fast Adjustments

By default, there is one predefined action assigned to the USER key.

1. Press the USER key.

   The "User Menu" dialog opens.
   If you execute this action for the first time, the dialog is empty.
2. Follow the instructions displayed in the "User Menu" dialog to build your own dialog with settings.
3. Alternatively, follow the following instructions:
   a) Open a dialog with settings you frequently use.
   b) Select a parameter.
   c) Open the context menu and select "Add to User Menu".

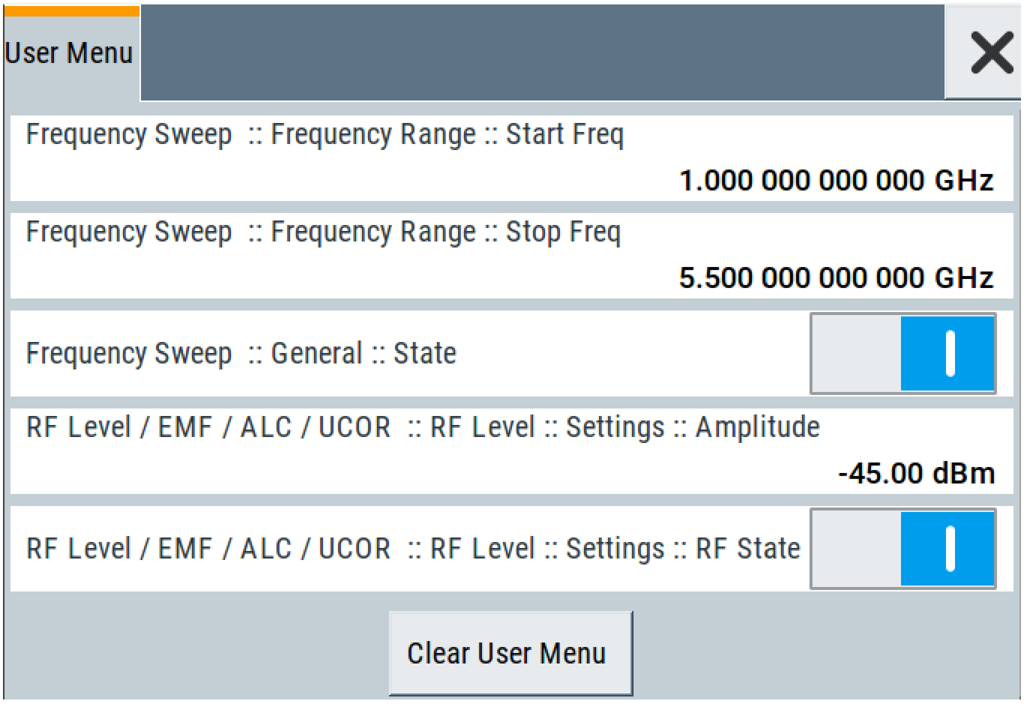
   

   d) A favorites icon indicates that the parameter is used in the "User Menu".

   e) Press the USER key.

   The "User Menu" dialog shows all parameters that you have added to the list.



4. To remove entry, select it, open the context menu and select "Remove from User Menu".

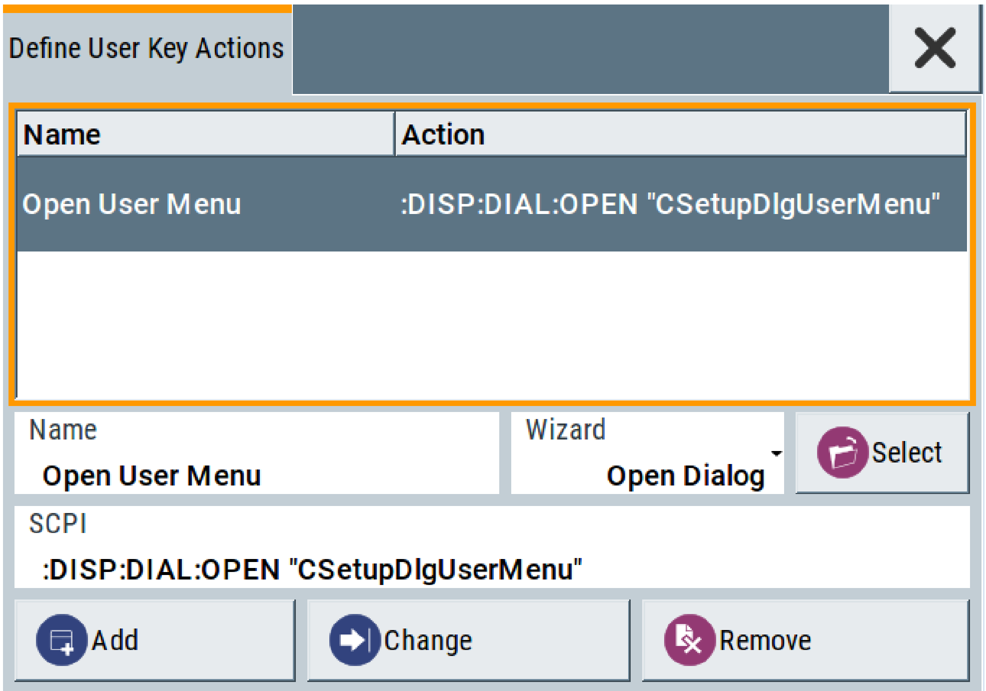
This function works in the same way in the "User Menu" and in the particular dialog the entry originally appears.

5. In the "User Menu", select "Clear User Menu" to remove all entries at once.

10.2.2 Define User Key Actions Settings

Access:

► Select "System Configuration > Setup > User Interface > Define User Key".



The dialog displays a list of the currently enabled actions and provides functions to define new, edit or remove existing actions. If no actions have been defined, the list is empty.

For an example, see Chapter 10.2.3, "Assigning Actions to the User Key", on page 225.

The remote commands required to define these settings are described in Chapter 12.9, "DISPlay Subsystem", on page 334.

Name
Enters a user-defined name for the action.

Wizard
Defines the action to be executed.

"Load SCPI Script"	Upon the selecting the action, the SCPI script is loaded and executed.
"Recall Setup"	Load a setup for quick access to the user-defined settings

"Open Dialog, with Position and Size/append to SCPI"
Quick access to the selected dialog.
Use the "Open Dialog, append to SCPI" function to define a sequence of several dialogs to be opened simultaneously or one after the other.
Tip: Use the command `:SYSTem:WAIT` to add a delay between the subsequent commands.

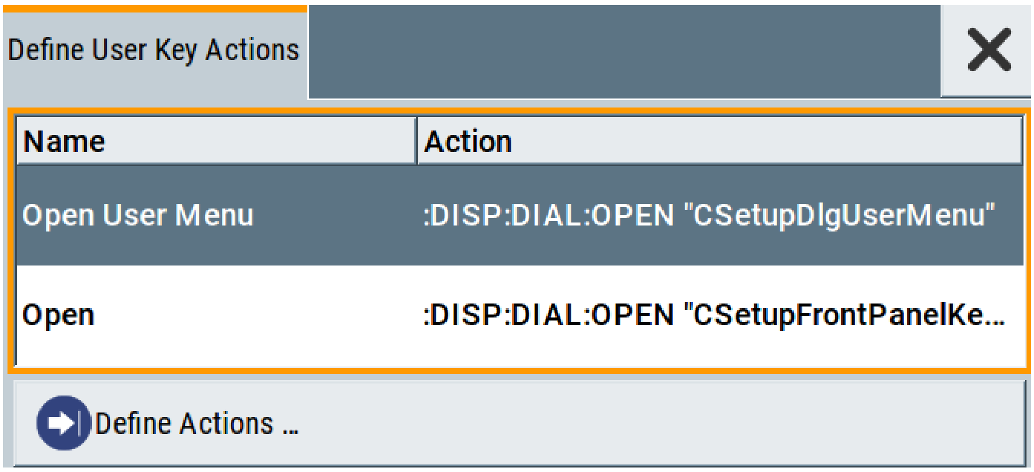
Select
Depending on the selected "Wizard", provides access to:
- The standard "File Select" function for loading of an SCPI script or setup file
- A list of the dialog IDs of all currently opened dialogs. The dialog ID is used for dialog identification in the remote control.
  See SCPI.

SCPI
For the currently selected action, displays the corresponding SCPI command with the associated parameter for dialog identification (dialog ID). The automatically displayed SCPIs are enabled for subsequent modification.

Remote command:
`:DISPlay:DIALog:OPEN` on page 338
See also `:DISPlay:DIALog:ID?` on page 337

Add, Change, Remove
Standard functions for managing of the actions.

Select Action to Execute > Define Action



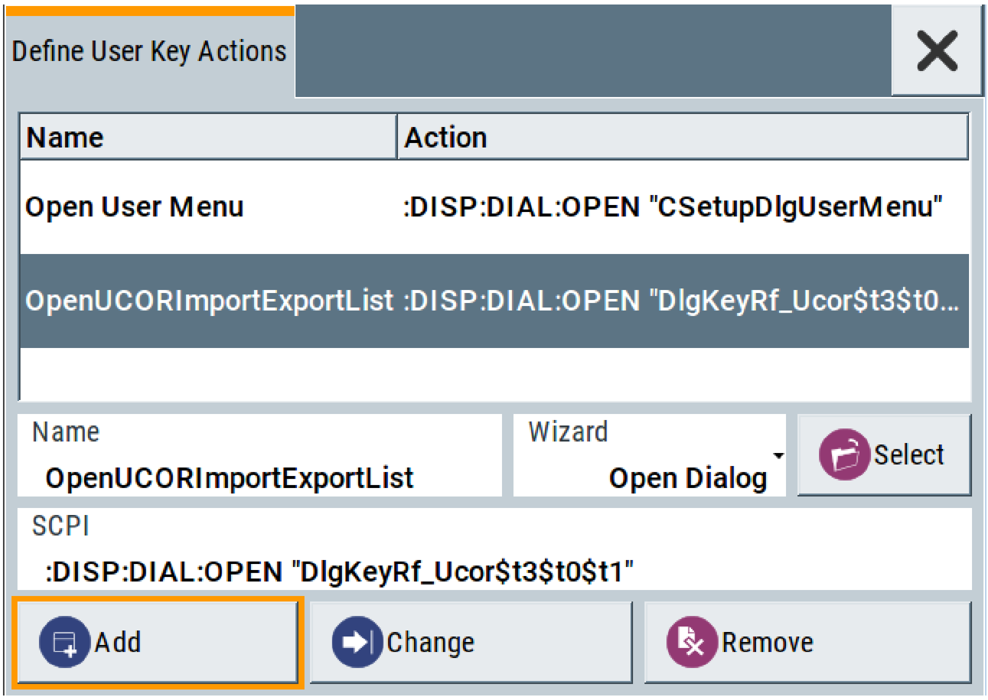
Accesses the "Define User Key Actions" dialog.

10.2.3 Assigning Actions to the User Key

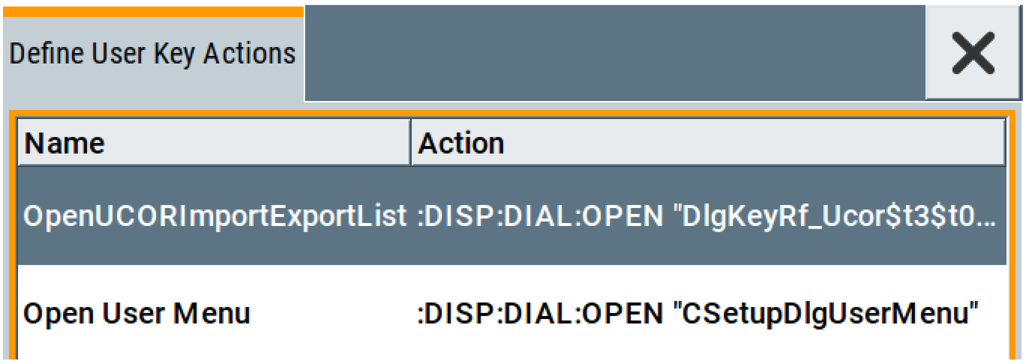
1. Open the dialog for that you are creating a quick access.
   For example, select "Level > UCOR > Import/Export"

2. Select "System Configuration > Setup > User Interface > Define User Key".
3. To create an action:
   a) Specify the "Name".
   b) Select "Wizard > Open Dialog"
   c) Select "Select" and select the dialog ID from the list

   The corresponding SCPI command is automatically displayed and can be later modified.
4. Select "Add" to store the new action in the list of user key actions.



5. To execute the created action, press USER.
   In the list of actions ("Select Action to Execute" dialog), navigate to the required action.
   In this example, this is "OpenUCORImportExportList".



   The action is executed. The dialog opens.

10.3 Managing Licenses and License Keys

An option is ready to operate after it is enabled with 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 before the corresponding option can be enabled for operation.

For reliable operation, a software option usually requires the latest firmware version. The required version is specified in the delivery. If your instrument works with a former firmware version, update the firmware before enabling the software option.

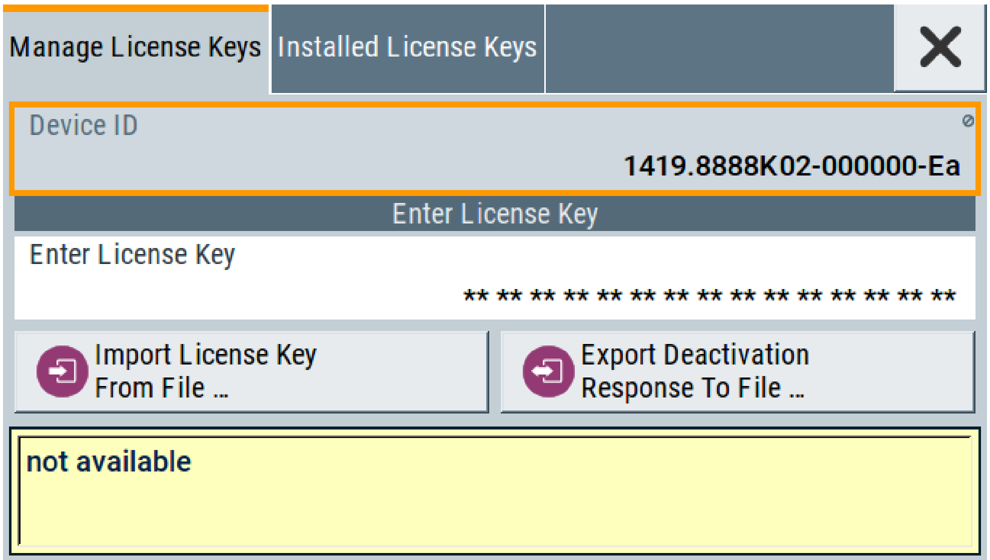
The firmware update is described in the R&S SMA100B service manual.

10.3.1 Manage License Keys Settings

This dialog is the central dialog for licenses registration and performing the required instrument-related steps during the process of unregistration.

Access:

► Select "System Config > Setup > Instrument Assembly > Manage License Keys".



In this dialog, you can activate licenses for newly purchased and/or newly registered options, perform the necessary steps to cancel a registration and/or to move licenses.

Settings

Device ID
Displays the instrument-specific identification number. The device ID is a 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.

Use this function also to import the deactivation key file generated by the R&S License Manager online tool (see How to Move a Portable License).

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.

If you have a portable unregistered option, you can register it later on another instrument (see How to Move a Portable License).

Info Line
Indicates status information on the performed actions.

Installed License Keys
Comprises information on the installed options.

Show Inactive ← Installed License Keys
Enables/disables the display of the inactive (expired) licenses in the 228.

Show Deactivated ← Installed License Keys
Enables/disables the display of the deactivated licenses in the Installed License Keys Table.

See How to Move a Portable License for information on how to activate deactivated licenses.

Installed License Keys Table ← Installed License Keys
Shows information on the currently installed options.

"Export License Key to File"
Opens a dialog to save the generated license key file. This file is required during the unregistration process.
If you have a portable unregistered option, you can register it later on another instrument (see How to Move a Portable License).

"Option" Displays the option short designation.
Tip: Open the Hardware Options/Software Options dialog to retrieve more information about the installed options.

"License Count"
Displays the number of the licenses for the selected option key.

"License Type" Displays the type of license.
A license type is a joint qualification applicability duration and the portability of a license. The following license types are provided: evaluation, permanent, portable, quantified, timed with duration of 1, 3, 6 or 12 months. A license can also be in the states deactivated and expired.
For time limited licenses, the left time of applicability is displayed too.

"Registration" (reserved for future use)

10.3.2 How to Move a Portable License

This example is intended to explain how to perform the required steps at the instrument.

Use a USB stick to transfer the license key files between the instruments and the browser.

We assume knowledge about the handling of the R&S License Manager online tool and the description of the whole process.

1. Open your browser. Enter https://extranet.rohde-schwarz.com/service.
   Select "Manage Licenses > Move Portable License".

   The first step requires the Device IDs of the source and target instruments.

2. To find out the Device IDs, proceed as follows:
   a) On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Device ID".
   b) On the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Device ID".
   c) In the browser, select "Manage Licenses > Move Portable License > Select Devices" and enter the Device IDs.

3. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Installed License Keys Table".
   Navigate to the portable license you want to move.
   Select the "Export License to File" column.

   A standard file manager dialog opens.

4. Enter a filename and save the exported license key, e.g.
   `k123_portable_key_to_move.xml`.

5. In the browser, select "Manage Licenses > Move Portable License > Select License (from file)" and select the exported license key.
   Check the selection, create the deactivation key, and save it to file.
6. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Import License Keys from File".
   Select the transferred deactivation key.
7. On the source instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Export Deactivation Response to File".
8. In the browser, go to "Manage Licenses > Move Portable License > Install Deactivation Key (from file)".
   Enter the deactivation response of the instrument.

   The license is deactivated for the source instrument.
9. In the "Manage Licenses > Move Portable License", go to step "Create License" to generate a license key for this portable option and the selected target instrument.
   Download the license key as a file and transfer it to the target instrument.
10. In the target instrument, select "System Config > Setup > Instrument Assembly > Manage License Keys > Import License Keys from File".
    Select the created license key file.

    The portable option is installed on the target instrument.

10.4 Managing the Security Settings

The protection function of the R&S SMA100B offers several levels to activate particular functions like self-test or tests for service purposes specifically.

Protection

The five protection levels are automatically active on startup, the protection levels, that means all protected functions are locked.

To unlock a protection level:

► In the "System Config > Setup > Security > Protection", enter the correct password.

To lock a protection level:

► Clear the corresponding checkbox.

Protection levels

The following functions are protected in the respective levels:

- Protection level 1
  Protects against accidental changes, like for example the clock and date, several internal adjustments functions and the self-test, as well as network settings or the instrument hostname.

You can access this level with the password 123456.

- Protection level 2
  Unlocks protected service functions. It is accessible to authorized personnel of Rohde & Schwarz service department only.
- Protection level 3 to 5
  Are reserved for factory internal use.

Security

The security concept of the R&S SMA100B 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:

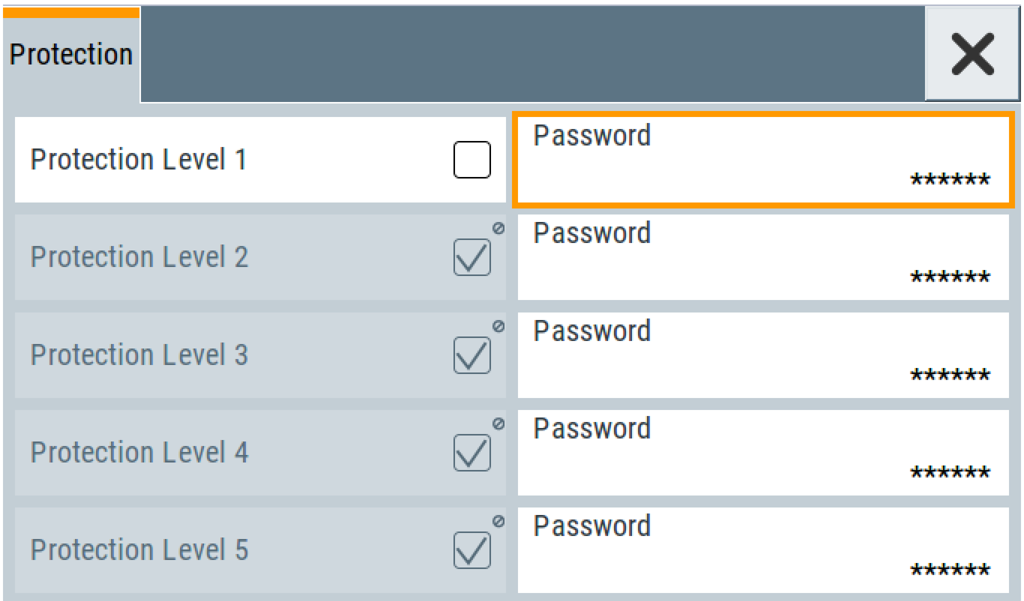
- **General** security parameters, such as:
  – **USB storage** that secures controlled access to the mass memory of the instrument
  – **Volatile mode** that prevents information to be written to the hard disk memory permanently.
  – **Sanitizing** that prevents the instrument from leaving a secure environment with stored user information.
  – **Annotation** frequency and amplitude prevent reading the display.
  To access the settings of these topics, see Chapter 10.4.2, "Setting Security Parameters", on page 232.
- **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, and a security password for accessing the mass storage of the instrument.
  See also Chapter 10.4.2, "Setting Security Parameters", on page 232.
- **LAN services** secure controlled network access
  You can individually lock and unlock the supported LAN interface services, see Chapter 10.4.3, "Configuring LAN Services", on page 236.
  Remote control via LAN interface requires that the interface is activated, but you can enable the required services specifically.
- **User interface** prevents front panel operation and/or reading the display.

For more information, see the document R&S SMA100B Instrument Security Procedures.

10.4.1 Protection Level Settings

Access:

► Select "System Config > Setup > Security > Protection".



The "Protection" dialog provides access to the unlocking of different protection levels.
Several functions in the instrument are password-protected to prevent for example accidental changes, "Protection" on page 230.

The remote commands required to unlock a protected stage are described in Chapter 12.16, "SYSTem Subsystem", on page 452.

Protection Level/Password
Unlocks the selected level of protection, if you enter the correct password.

The default protection level 1 password is 123456.

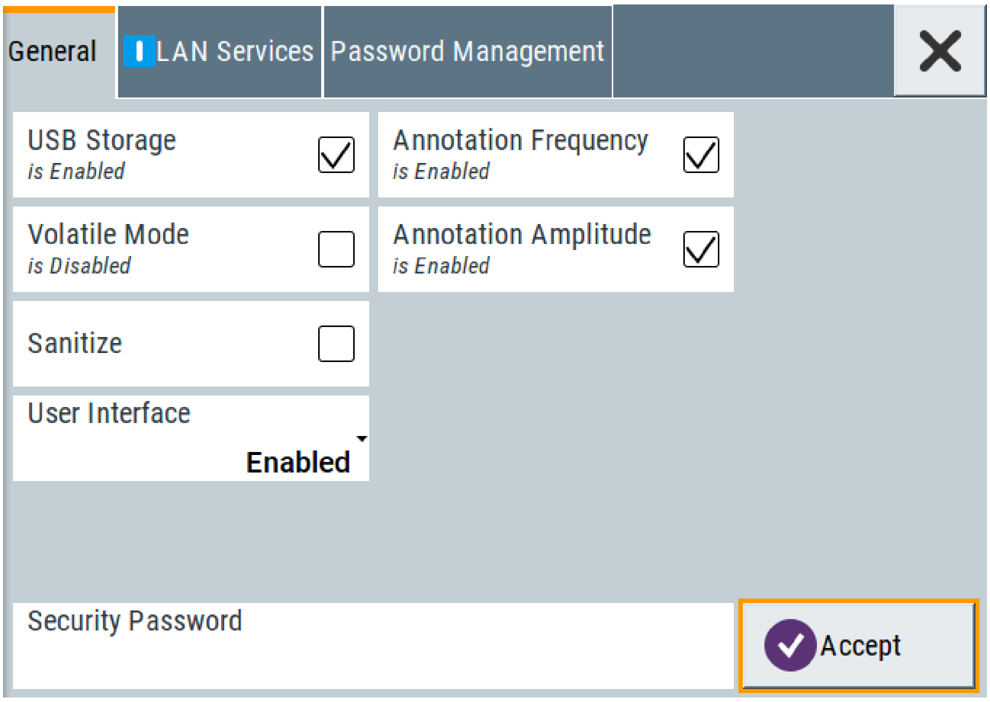
To lock the protection level again, clear the checkbox.

Remote command:
`:SYSTem:PROTect<ch>[:STATe]` on page 459

10.4.2 Setting Security Parameters

Access:

► Select "System Config > Setup > Security > General".



In the "Security" dialog, you can configure the mass storage security settings.

The settings in this dialog are not applied until you enter the Security Password and confirm with Accept.

The remote commands available to control security settings are described in Chapter 12.9, "DISPlay Subsystem", on page 334.

USB Storage

Activates the access to external USB storage media.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also Chapter 9.9.4, "Using a USB Storage Device for File Transfer", on page 210.

Volatile Mode

Activates volatile mode, so that no user data can be written on the internal memory permanently.

In volatile mode:

- Data that the instrument normally stores on the internal memory is redirected to volatile memory.
- The user directory is mapped to the volatile memory. You access the temporary data just as data stored in the `/var/user/`.
- Data on the internal memory cannot be changed. It is protected against modification or erasure.
- You can only save data:
  – Temporary in the volatile memory
  – On a connected external storage device, such as a memory stick

To activate volatile mode: enter the security password, confirm with "Accept" and reboot the instrument. Otherwise the change has no effect.

Activated volatile mode is indicated by an icon.

Remote command:
`:SYSTem:SECurity:VOLMode[:STATe]` on page 460

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

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

Remote command:
`:DISPlay:ANNotation:FREQuency` on page 337

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

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

Remote command:
`:DISPlay:ANNotation:AMPLitude` on page 336

Sanitize
Executes the erase procedure that sanitizes the internal memory.

If the instrument is subject to high security, and you have not enabled the volatile mode, the internal flash memory holds user-data, i.e. id poses a security risk. The sanitizing function makes sure that no user information is stored on the instrument when it leaves the secure environment.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also Chapter 10.4, "Managing the Security Settings", on page 230 for more information on the security concept.

Remote command:
`:SYSTem:SECurity:SANitize[:STATe]` on page 467

User Interface
Allows you to lock the controls for manual operation and the display individually.

To apply the change: enter the security password and confirm with "Accept". Otherwise the change has no effect.

See also Chapter 10.4, "Managing the Security Settings", on page 230 for more information on the security concept.

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

"Touchscreen Off"
Locks the touch sensitivity of the screen.
This security feature protects the instrument against unintentional change of settings by accidentally touching of the screen.

Still available controls for manual operation are:
- The keys at the front panel, including the rotary knob
- The external mouse and keyboard
- Remote operation over VNC

The instrument indicates the locked touchscreen by an icon .
Unlocking is possible via VNC, external controls or remote control.

"VNC Only"
Locks the keys at the front panel, the touchscreen and externally connected keyboard and mouse.
The display on the screen remains and shows the current settings and changes.
The instrument indicates the activated "VNC only" feature by the icon .
Unlocking is possible via VNC or turning off and on again.

"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 touchscreen functionality of the display
- The keys at the front panel of the instrument
- The external mouse and keyboard

The instrument indicates the locked controls by a padlock softkey.
Unlocking is possible by entering the security password, see Enabling a locked user interface for manual operation.

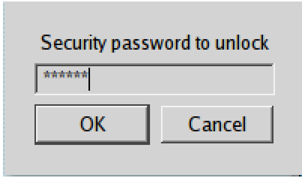
"Disabled"
Locks the display and all controls for the manual operation of the instrument.
This security feature protects the instrument against unauthorized reading and access, for example when you operate the instrument via remote control.

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

The screen shuts off and displays a padlock symbol instead.
Unlocking is possible by entering the security password, see also Enabling a locked user interface for manual operation.

Remote command:
`:SYSTem:ULOCk` on page 458
`:SYSTem:DLOCk` on page 459
`:SYSTem:KLOCk` on page 459

Enabling a locked user interface for manual operation
To unlock the user interface for manual operation, use one of the following:
- On the instrument's keypad or external keyboard, 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. Delete the entry before inserting the password.
  Enter the security password *123456*.
- In remote control mode, send the command `SYST:ULOC ENABled` to release all locks at once.
  Alternatively:
  – Send the command `SYST:KLOC OFF` to unlock the keyboard and touchscreen
  – Send the command `SYST:DLOC OFF` to release all locks.

  Via remote control, there is no password required.

Remote command:
`:SYSTem:ULOCk` on page 458
`:SYSTem:DLOCk` on page 459
`:SYSTem:KLOCk` on page 459

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

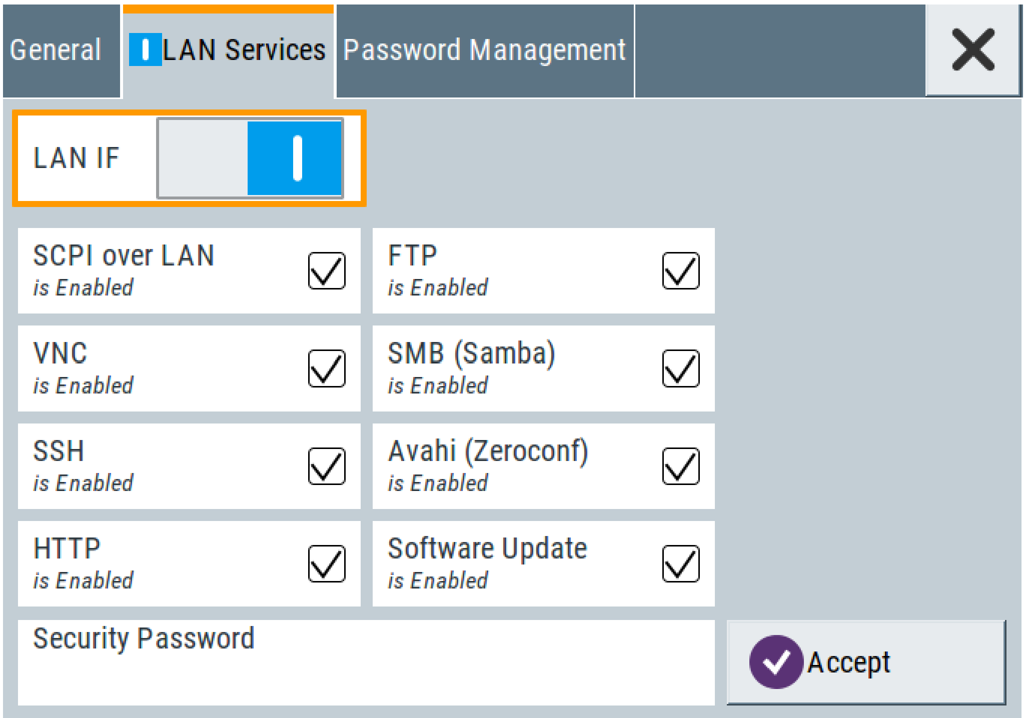
Note:
- We recommend that you change the default security password before connecting the instrument to the network.
- The security settings are not assigned until you select the "Accept" button.

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

10.4.3 Configuring LAN Services

Access:

► Select "System Config > Setup > Security > Security > LAN Services".



In the "LAN Services" dialog, you can individually enable or disable the supported LAN interface services.

The activated LAN services are not activated until you enter the "Security Password" on page 236 and confirm with Accept.

LAN Interface

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

Enable LAN Services individually

Enables or disables the following interface services individually.

"SCPI over LAN"
Activates access over LAN to control the instrument remotely, by using SCPI (Standard Commands for Programmable Instruments) commands.
See also "Starting a remote control session over LAN with R&S VISA" on page 277.

"VNC"
Activates access via VNC (Virtual Network Computing) interface, a graphical desktop sharing system that uses RFB protocol to control the instrument remotely.
See also Chapter 11.16, "How to Set Up Remote Operation via VNC", on page 294.

"SSH"
Activates access via SSH (Secure Shell), a network protocol for secure data communication.

"HTTP" Activates access via HTTP (Hyper Text Transfer Protocol), 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.
See also Chapter 9.9.2, "Accessing the File System of the R&S SMA100B via ftp", on page 207.

"SMB (Samba)"
Activates access to SMB (Server Message Block), used for providing shared access to files, printers and serial ports of a network.
See also Chapter 9.9.3, "Accessing the R&S SMA100B File System via SMB (Samba)", on page 209.

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

"Software Update"
Allows updating the software.

Security Password

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

Note:

- We recommend that you change the default security password before connecting the instrument to the network.
- The security settings are not assigned until you select the "Accept" button.

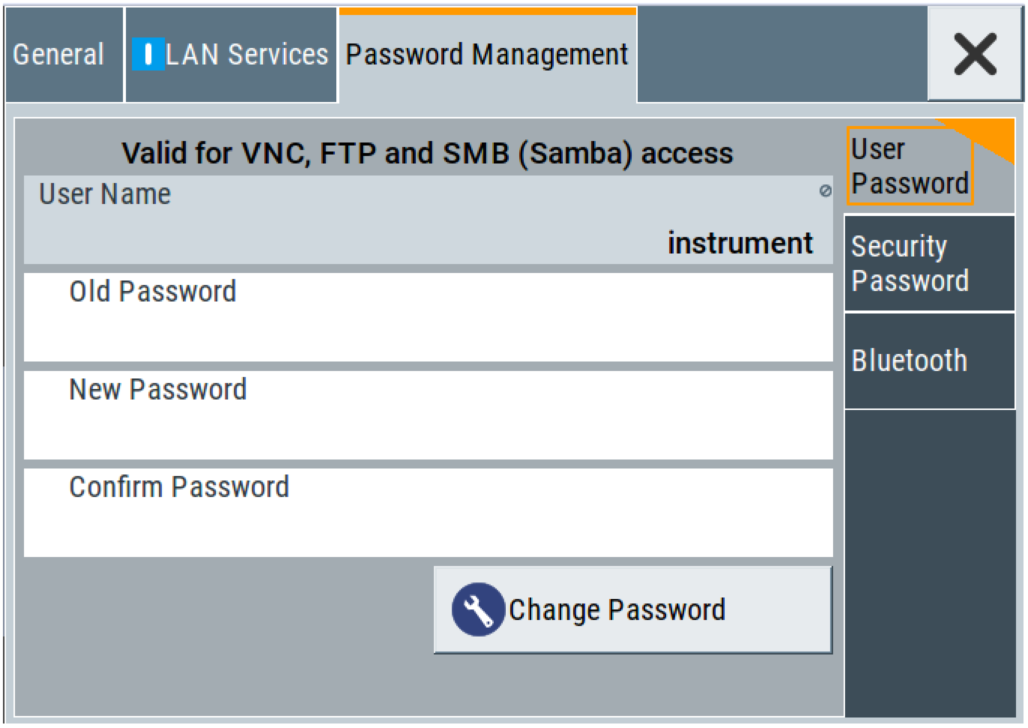
Accept

Applies the modified settings, provided the security password is entered and correct.

10.4.4 Password Management

Access:

► Select "System Config > Setup > Security > Security > Password Management".



In this tab, you can assign the security and a user-defined password and the blue-tooth pin.

A new password does not take effect until you confirm it with the corresponding "Change Password" button.

To confirm the new password, always press:

- "User Password" > Change Password
  Or
- "Security Password" > Change Password

User Name
Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SMB (Samba) access.

User Password
Access: "System Config > Setup > Security > Security > Password Management > User Password"

Allows you to change and confirm the user password.

Old Password ← User Password
Enters the current user password. The default password is "instrument".

Note: We recommend that you change the default password before connecting the instrument to a network.

New Password ← User Password
Enters the new user password.

The security password can contain decimal characters only.

Confirm Password ← User Password
Confirms the new user password by repeating.

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

Change Password ← User Password
Changes the user password accordingly.

Security Password
Access: "System Config > Setup > Security > Security > Password Management > Security Password"

Enables you to change and confirm the security password.

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

Note: We recommend that you change the default password before connecting the instrument to a network.

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

New Password ← Security Password
Enters the new security password.

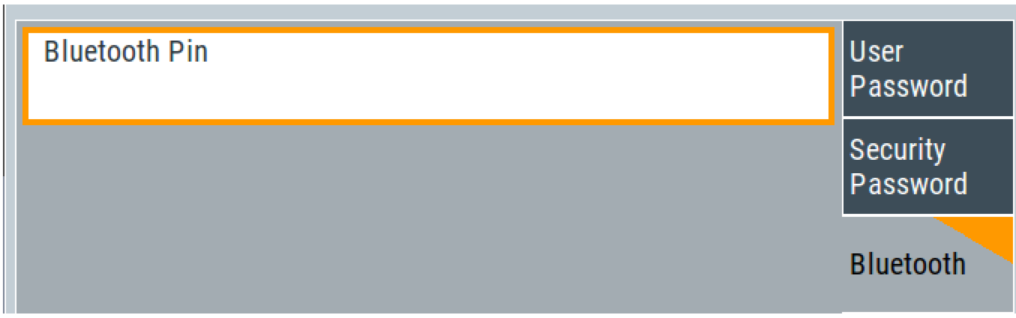
The security password can contain decimal characters only.

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

Note: The new password is not assigned until you select Change Password button.

Change Password ← Security Password
Changes the password accordingly.

Bluetooth Pin
Access: "System Config > Setup > Security > Security > Password Management > Bluetooth"



Defines the pin of an external bluetooth device. This pin is required to enable remote control via bluetooth.

10.5 Undoing or Restoring Actions

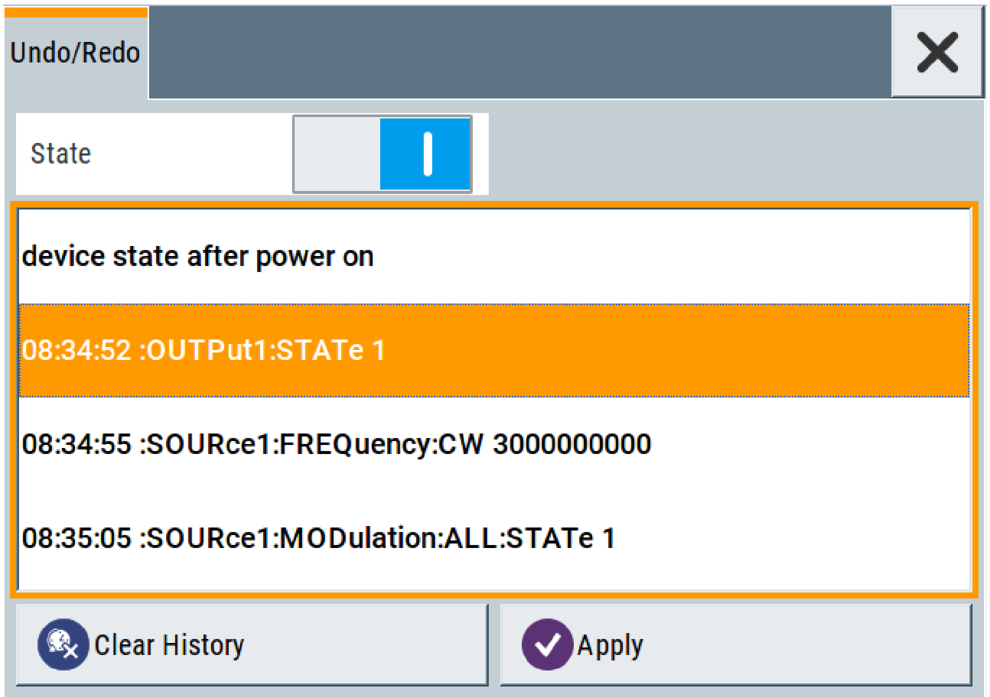
"Undo" is a function that removes the effect of the last action on the instrument and reverts it to an older state. Conversely, "Redo" restores a previously undone action.

You can "Undo/Redo" actions according to two criteria:

- Step by step
  Gradually undo/redo the actions in reverse order as previously performed. Depending on the available memory the "Undo/Redo" steps may restore all actions.
- Multiple steps at once
  Select any specific action in the history list to "Undo/Redo" multiple actions in a single step.
  Note: This mode requires a system restoration file on the instrument.

Access:

► Select "Setup > Settings > Undo/Redo".



The dialog contains all functions for enabling the "Undo/Redo" functionality.

Settings:

State

Enables the recording of the performed actions.

History List

Lists the performed actions, provided "Undo/Redo" state is "On".

Clear History

Deletes the recorded list of the performed steps.

Apply

Performs the "Undo/Redo".

If you select a previously performed action of the list, all subsequent actions are undone. The list entries remain.

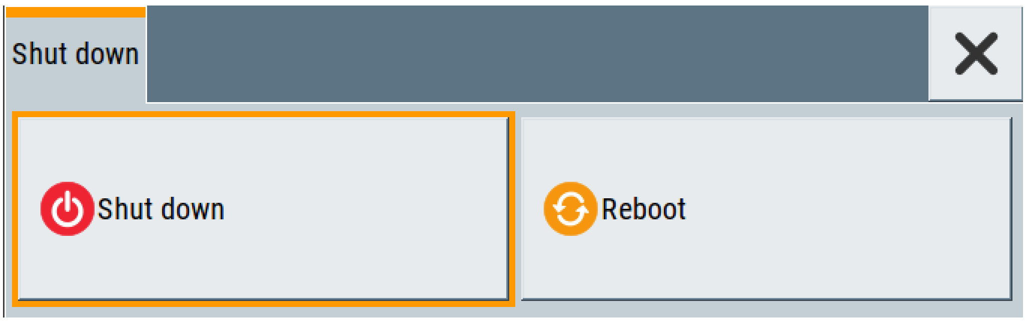
If you select a subsequently executed action, you can restore all the actions undone up to this state.

10.6 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, there is another possibility to shut down the instrument or to reboot the system.

Access:

► Select "System Config > Setup > Maintenance > Shut Down".



Remote command:

- `:SYSTem:REBoot` on page 474
- `:SYSTem:SHUTdown` on page 474

11 Network Operation and Remote Control

The description in this section requires basic knowledge of the remote control operation. Definitions specified in the SCPI standard are not provided.

You find some basic information to the SCPI syntax, command lists, and general programming recommendations in Chapter A.1, "Additional Basics on Remote Control", on page 505. See also Chapter A.1.5, "Status Reporting System", on page 517 for information on the status reporting system of the instrument.

As an alternative to the interactive operation directly at the instrument, you can operate the R&S SMA100B also from a remote location.

The Figure 11-1 shows the possibilities of the physical connection (interfaces) for the remote access.

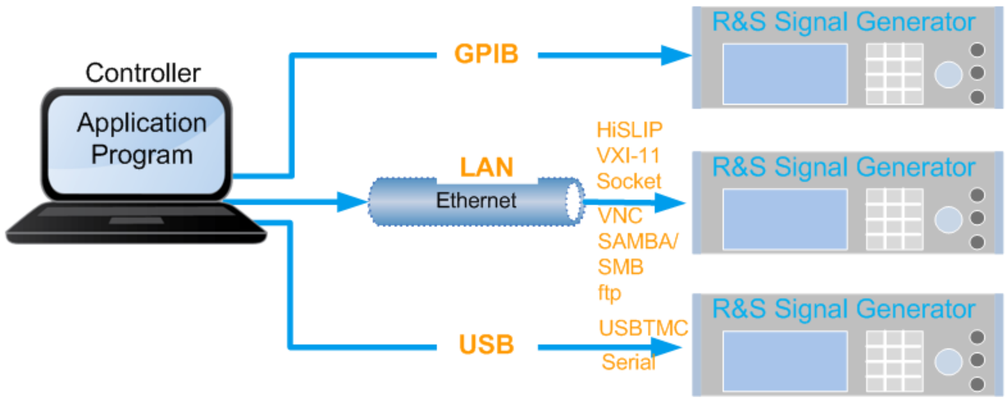


Figure 11-1: Supported remote connections

For information on how to configure a network, see the Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 26.

The various interfaces provide flexible access to the instrument, such as *remote control*, *remote operation* or *remote file access*. These remote access modes are fundamentally different, although they are often considered interchangeable. Refer to Overview of Remote Access Modes for details on these modes.

For comprehensive information on these topics, refer to the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

11.1 Overview of Remote Access Modes

This section outlines the possible access modes and their major characteristics.

Remote control (SCPI)

- A remote PC controls the instrument, usually via VISA (Virtual Instrument Software Architecture) interfaces.
- Remote control disables the manual operation of the instrument; you can set different lock states.
- The GUI is not visible.
- Remote control commands (SCPI) perform the settings, either individually or in sequences (SCPI programs).
- Using SCPI programs is faster than the manual operation, since they automate repeating applications.

Remote operation (VNC)

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.

- A remote device accesses the instrument via the common platform technology VNC (Virtual Network Computing).
- The protocol allows simultaneous operation from several remote devices and the instrument nevertheless remains locally operable.
- The GUI is visible.
- To perform the settings, you can operate the instrument as with the manual control.
- Clients supporting remote operation depend on the used remote device, see Table 11-1.

Table 11-1: Supported VNC operation modes

Remote device	VNC client	Requirements	Characteristics
Desktop (Windows, Linux, Mac™OS)	• Ultr@VNC • Other dedicated client software	*Ultr@VNC or Client Software* must be installed.	Fast, supports several options like full screen mode or auto-login.
	• Any web browser	*Java Runtime* must be installed and activated in the browser settings.	Fast and convenient - only the instrument address required. Java runtime is sometimes considered as security concern.
	• Web browser with HTML5	*Web sockets* must be supported.	Slower than the other modes. No additional installation or activation required. No security concern.

Remote device	VNC client	Requirements	Characteristics
Smart device (Tablet/ smartphone)	• Dedicated client App	*App* must be installed.	Fast, supports several options like full screen mode or auto-login.
	• Web browser with HTML5	*Web sockets* must be supported.	Support of QR code scanning Slower than a dedicated App.

Remote file access (FTP, SAMBA/SMB)

- A remote client accesses the instrument's file system, using the protocols FTP (file transfer protocol) and SAMBA/SMB (server message block).
- The protocols enable you to transfer files from or to the instrument and to get direct access to its file sharing directory /var/user/share.

For more information, refer to Chapter 9.9, "How to Transfer Files from and to the Instrument", on page 206.

11.2 Remote Control Interfaces and Protocols

The instrument supports various interfaces for remote control. The table gives an overview on the connectivity:

Table 11-2: Remote control interfaces and protocols

Interface	Protocols, VISA*) address string and library	Remarks
Local area network (LAN)	• **HiSLIP** High-Speed LAN Instrument Protocol (IVI-6.1) TCPIP::host address::hislip0[::INSTR] VISA • **VXI-11** TCPIP::host address[::LAN device name][::INSTR] VISA • **Socket communication** (Raw Ethernet, simple Telnet) TCPIP::host address[::LAN device name]::<port>::SOCKET VISA or socket controller	The LAN connector is on the rear panel of the instrument. The interface is based on TCP/IP and supports various protocols. For a description of the protocols, refer to: • Chapter 11.2.1.2, "HiSLIP Protocol", on page 248 • Chapter 11.2.1.3, "VXI-11 Protocol", on page 248 • Chapter 11.2.1.4, "Socket Communication", on page 248
USB	• **USBTMC** USB::<vendor ID>::<product ID>::<serial number>[::INSTR] VISA	USB connectors are located on the front or the rear panel of the instrument, or both. For a description of the interface, refer to Chapter 11.2.2, "USB Interface", on page 249
GPIB (IEC/IEEE Bus Interface)	• – GPIB::<address>[::INSTR] (no secondary address) VISA	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 11.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 249.
*) VISA (Virtual Instrument Software Architecture) 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 11.3.1, "VISA Library", on page 251.		

Rohde & Schwarz provides the standardized I/O software library R&S VISA for communication with the instruments 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 is described in Chapter 11.8, "How to Set Up a Remote Control Connection", on page 272.

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 (Rohde & Schwarz 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.

For more information, see also Chapter A.1, "Additional Basics on Remote Control", on page 505.

11.2.1 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. 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.

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.

11.2.1.1 VISA Resource Strings

The VISA resource string is required to establish a communication session between the controller and the instrument in a LAN. The resource string is a unique identifier, composed of the specific IP address of the instrument and some network and VISA-specific keywords.

TCPIP::host address[::LAN device name][::INSTR]

TCPIP = designates the network protocol
host address = designates the IP address or hostname of the instrument
[::LAN device name] = defines the protocol and the instance number of a subinstrument
[::INSTR] = indicates the instrument resource class (optional)

The **IP address** (host address/computer name) is used by the programs to identify and control the instrument. It is automatically assigned by the DHCP server the first time the device is registered on the network. Alternatively, you can also assign its **LAN device name**.

If assigned, the IP address is displayed on home screen. You can adjust it manually with the parameter the "System Config > Remote Access > Network" > IP AddressEnabling a locked user interface for manual operation.

The following section lists the characteristics of the VISA resource strings for the corresponding interface protocols. The highlighted characters are crucial.

HiSLIP

TCPIP::host address::**hislip0**[::INSTR]

hislip0 = HiSLIP device name, designates that the interface protocol HiSLIP is used (mandatory)

hislip0 is composed of `[::HiSLIP device name[,HiSLIP port]]` and must be assigned.

For details of the HiSLIP protocol, refer to Chapter 11.2.1.2, "HiSLIP Protocol", on page 248.

VXI-11

TCPIP::host address**[::inst0]**[::INSTR]

[::inst0] = LAN device name, indicates that the VXI-11 protocol is used (optional)

inst0 currently selects the VXI-11 protocol by default and can be omitted.

For details of the VXI-11 protocol, refer to Chapter 11.2.1.2, "HiSLIP Protocol", on page 248.

Socket communication

TCPIP::host address::**port::SOCKET**

port = determines the used port number
SOCKET = indicates the raw network socket resource class

Socket communication requires the specification of the port (commonly referred to as port number) and of "SOCKET" to complete the VISA resource string with the associated protocol used.

The registered port for socket communication is port 5025.

See also Chapter 11.2.1.4, "Socket Communication", on page 248.

11.2.1.2 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

11.2.1.3 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.

11.2.1.4 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 SMA100B 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.

11.2.2 USB Interface

Option: R&S SMAB-B86

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 install a separate driver.

USBTMC (USB Test & Measurement Cass Specification) is a protocol that is built on top of USB for communication with USB devices, like GPIB. It defines class code information of the instrument, that identifies its functionality to load the respective device driver. Using VISA library, it supports service request, triggers, and other specific operations, similar to GPIB.

11.2.2.1 USB Resource String

The resource string represents an addressing scheme that is used to establish a communication session with the instrument. It is based on the instrument address and some instrument- and vendor-specific information.

The USB resource string syntax is as follows:

USB::**<vendor ID>::<product ID>::<serial number>**[::INSTR]

USB	= denotes the used interface
<vendor ID>	= is the manufacturer ID for Rohde&Schwarz
<product ID>	= is the product identification of the R&S instrument
<serial number>	= is the individual serial number on the rear of the instrument
[::INSTR]	= indicates the instrument resource class (optional)

To set the USB resource string, see Remote Access Settings.

Example:

`USB::0x0AAD::0x0092::100001`

0x0AAD is the vendor ID for Rohde&Schwarz

0x0092 is the product ID for the R&S SMA100B

100001 is the serial number of the particular instrument

11.2.3 GPIB Interface (IEC/IEEE Bus Interface)

Option: R&S SMAB-B86

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.

GPIB address

The controller must address the instrument with the GPIB bus channel (see Chapter 11.4.3, "GPIB Address Settings", on page 259). GPIB provides channel addresses from 0 to 30.

The GPIB resource string syntax is as follows:

GPIB::**<address>**[::INSTR]

GPIB = denotes the used interface
<channel address> = the used channel
[::INSTR] = indicates the instrument resource class (optional)

Note: If the VISA implementation supports the GPIB interface, you can optionally define the VISA Instrument Control Resource (INSTR). It is used to define the basic operations and attributes for a device, such as reading, writing, or triggering.

Notes and characteristics

In connection with the GPIB interface, note the following:

- Up to 15 instruments can be connected.
- The total cable length is restricted to a maximum of 15 m, or 2 m times the number of devices, whichever is less. The cable length between two instruments should not exceed 2 m.
- 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.

11.2.4 LXI Browser Interface

The LXI browser interface allows easy configuration of the LAN and remote control of the R&S SMA100B without additional installation requirements. The instrument's LXI browser interface works correctly with all W3C compliant browsers.

See Chapter 11.17.1, "LXI Functionality", on page 300 for more about LXI.

The LAN settings are configured using the instrument's LXI browser interface described in Chapter 11.5.2.1, "LAN Configuration", on page 266. The LXI status settings in the R&S SMA100B are described in Chapter 11.5.1, "LXI Status Settings", on page 264.

11.3 Remote Control Programs and Libraries

This section shows how the remote-control programs access the instrument, and the libraries they require for the appropriate interface protocols.

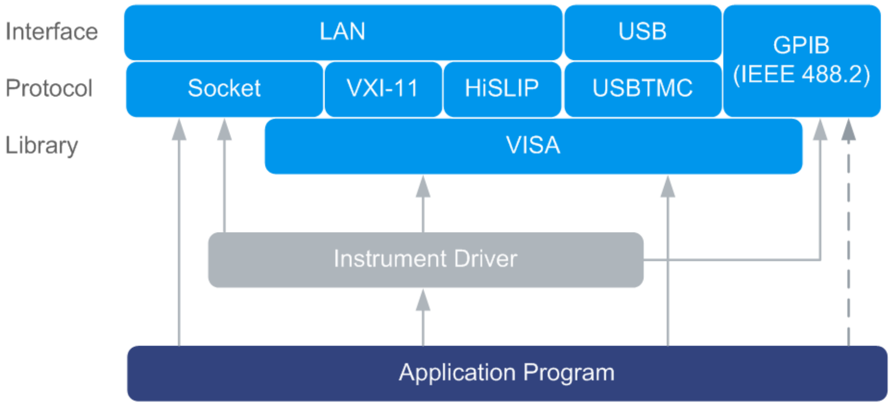


Figure 11-2: Overview of remote control interfaces, protocols and libraries

11.3.1 VISA Library

VISA is a standardized software interface library providing input and output functions to communicate with instruments. Thus, you can configure the interface without having to 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 an appropriately defined VISA alias (short name). See also Table 11-2 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 HiSLIP Protocol
- LAN interface using VXI-11 Protocol
- USB Interface

Instrument access via the LAN socket protocol or GPIB connections can be operated both, with or without the VISA library. See also Chapter 11.2.1.4, "Socket Communication", on page 248 and Chapter 11.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 249.

For more information about VISA library, refer to the user documentation.

11.3.2 Possible Setups and Access Functions

The following examples give an overview of dependencies between the available libraries, the possible interfaces and protocols, and whether an instrument driver is provided. The involved parts are **highlighted**. For more information, see the application note 1GP72: Connectivity of Rohde&Schwarz Signal Generators.

- Remote control (application) program using VISA

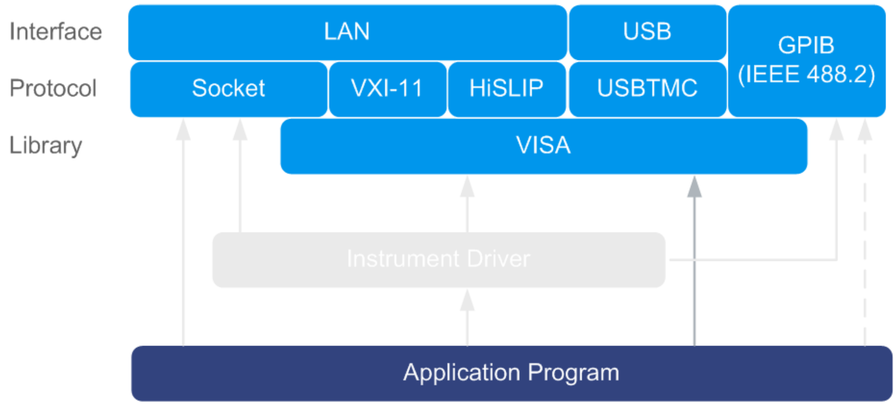


Figure 11-3: Application program using VISA

Protocol	Remote control program
Socket	`viOpen (..., "TCPIP:SMA100B-102030::5025::SOCKET", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
VXI-11	`viOpen (..., "TCPIP:SMA100B-102030::inst0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
HiSLIP	`viOpen (..., "TCPIP:SMA100B-102030::hislip0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
USBTMC	`viOpen (..., "USB::0x0092::0x0088::1000010::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
GPIB	`viOpen (..., "GPIB::28::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`

- Remote control program using instrument driver (VISA available)

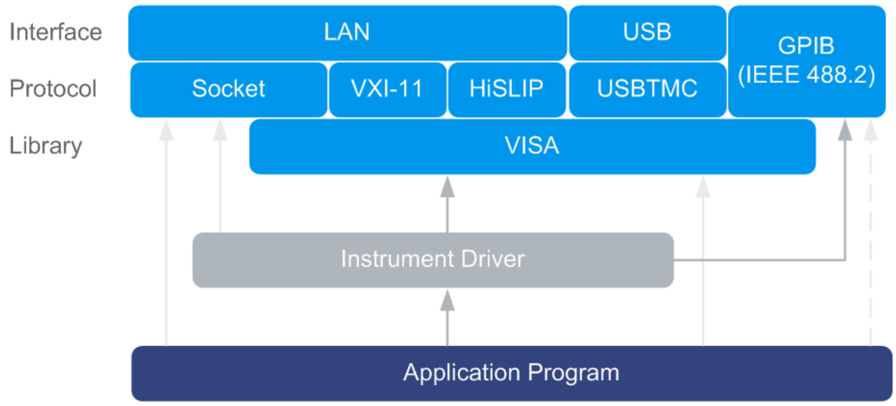


Figure 11-4: Application using instrument driver (VISA available)

Protocol	Remote control program
Socket	`rssmw_init ("TCPIP:SMA100B-102030::5025::SOCKET", ...)` `rssmw_SetFrequency (..., 2e9)`
VXI-11	`rssmw_init ("TCPIP:SMA100B-102030::inst0::INSTR", ...)` `rssmw_SetFrequency (..., 2e9)`
HiSLIP	`rssmw_init ("TCPIP:SMA100B-102030::hislip0::INSTR", ...)` `rssmw_SetFrequency (..., 2e9)`
USBTMC	`rssmw_init ("USB:::0x0092::0x0088::1000010::INSTR", ...)` `rssmw_SetFrequency (..., 2e9)`
GPIB	`rssmw_init ("GPIB::28::INSTR", ...)` `rssmw_SetFrequency (..., 2e9)`

- Remote control program using instrument driver (VISA not available)

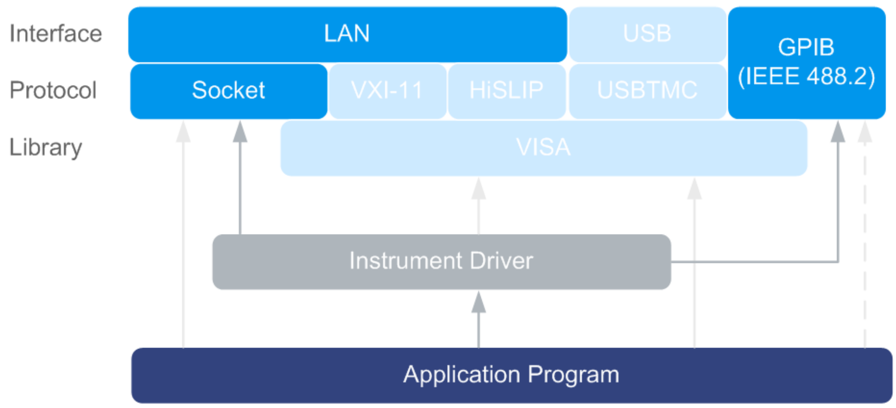


Figure 11-5: Remote control program using instrument driver (VISA not available)

Protocol	Remote control program
Socket	`rssmw_init ("TCPIP:SMA100B-102030::5025::SOCKET", ...)` `rssmw_SetFrequency (..., 2e9)`
GPIB	`rssmw_init ("GPIB::28::INSTR", ...)` `rssmw_SetFrequency (..., 2e9)`

11.4 Remote Access Settings

Network

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses
- Exchanging hardware

Errors can affect the entire network.

Default gateway

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

Instrument emulations

You can also remotely control the R&S SMA100B 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 SMA100B in an automated test setup, without adjusting the command scripts used.

The R&S SMA100B also covers command sets of Rohde & Schwarz signal generators, e.g. the R&S SMA100A, the R&S SMF100A, etc. To achieve optimal compatibility when replacing an instrument, we recommend that you select the emulation command set for the corresponding generator.

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

As any other parameter, the remote control command set can also be changed remotely by the command `:SYSTem:LANGuage`.

While working in an emulation mode, the R&S SMA100B specific command set is disabled and the SCPI command `:SYSTem:LANGuage` is discarded.

To return to the SCPI command set of the R&S SMA100B, use the appropriate command of the selected command set. If for example an HP generator is emulated, the HP command `EX` returns to the instrument-specific GPIB command set.

11.4.1 Network Settings

NOTICE

Risk of network failure

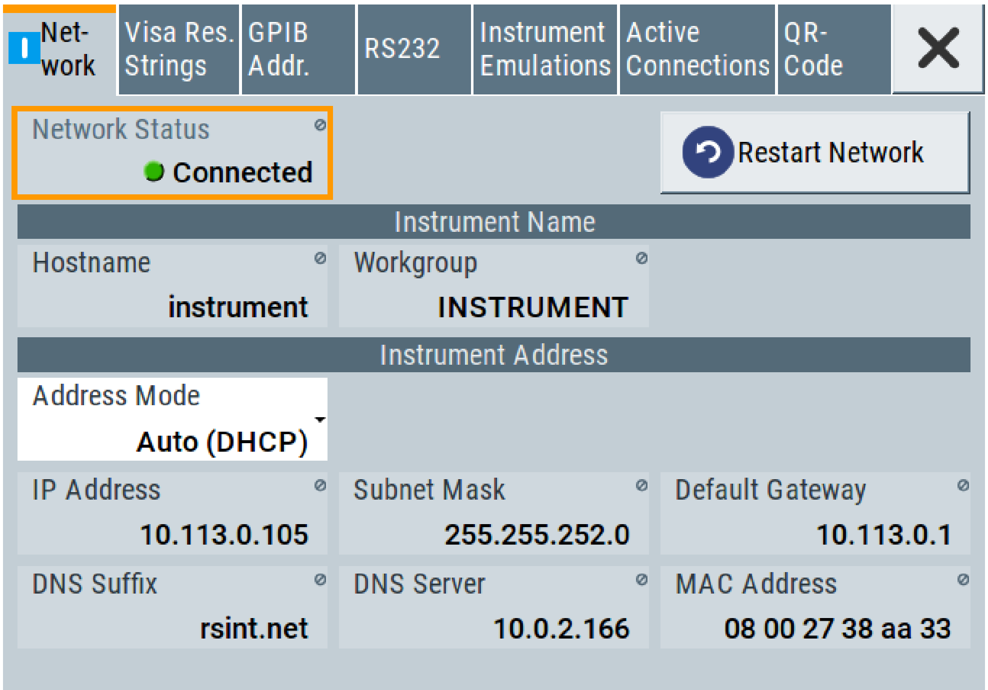
Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses
- Exchanging hardware

Errors can affect the entire network.

Access:

► Select "System Config > Remote Access > Network".



In the "Network" 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 configure the network remotely are described in Chapter 12.16, "SYSTem Subsystem", on page 452.

How to connect the signal generator to the network is described in the Chapter 2.1.3, "Setting Up a Network (LAN) Connection", on page 26.

Network Status

Indicates that the instrument is connected to the network.

Remote command:
`:SYSTem:COMMunicate:NETWork:STATus?` on page 463

Hostname

Displays the hostname.

Each instrument is delivered with an assigned hostname, 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 can change each time the instrument is reconnected. Unlike the IP address, the hostname name does not change.

Note:
This function is password-protected. Unlock the protection level 1 to access it, see "Protection Level/Password" on page 232.

- We recommend that you do not change the default network settings or the host-name to avoid problems with the network connection.
  If you change the hostname, be sure to use a unique name.

Remote command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 463

Workgroup

Sets the individual windows workgroup name of the R&S SMA100B. This parameter is required in case the instrument is integrated in a windows network.

This function is password-protected. Unlock the protection level 1 to access it, see "Protection Level/Password" on page 232.

Remote command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup` on page 464

MAC Address

Indicates the MAC (Media Access Control) address, a unique identifier of the network adapter in the R&S SMA100B.

Remote command:
`:SYSTem:COMMunicate:NETWork:MACaddress` on page 462

Address Mode

Selects the mode for assigning the IP address.

NOTICE! Risk of network failure.
Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses

- Exchanging hardware

Errors can affect the entire network.

"Auto (DCHP)"
: Assigns the IP address automatically, provided the network supports DHCP (Dynamic Host Configuration Protocol).

"Static"
: Enables you to assign the IP address manually.

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress:MODE` on page 462

IP Address

Displays the IP address of the instrument in the network.

By default, the R&S SMA100B 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 although the network requires an IP address assigned via the DHCP server can cause network connection failures.
See Chapter 14.5, "Resolving Network Connection Failures", on page 502.

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

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress` on page 462

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 464

Default Gateway

Displays the gateway address.

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

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

Remote command:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway` on page 464

DNS Suffix

Displays the primary DNS (Domain Name System) suffix, that means the DNS name without the hostname part.

The DNS system uses the suffix for registration and name resolution for unique identification of 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 463

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 hostname 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 464

Restart Network
Terminates the network connection of the instrument and subsequently sets it up again. You can use this function to fix network problems.

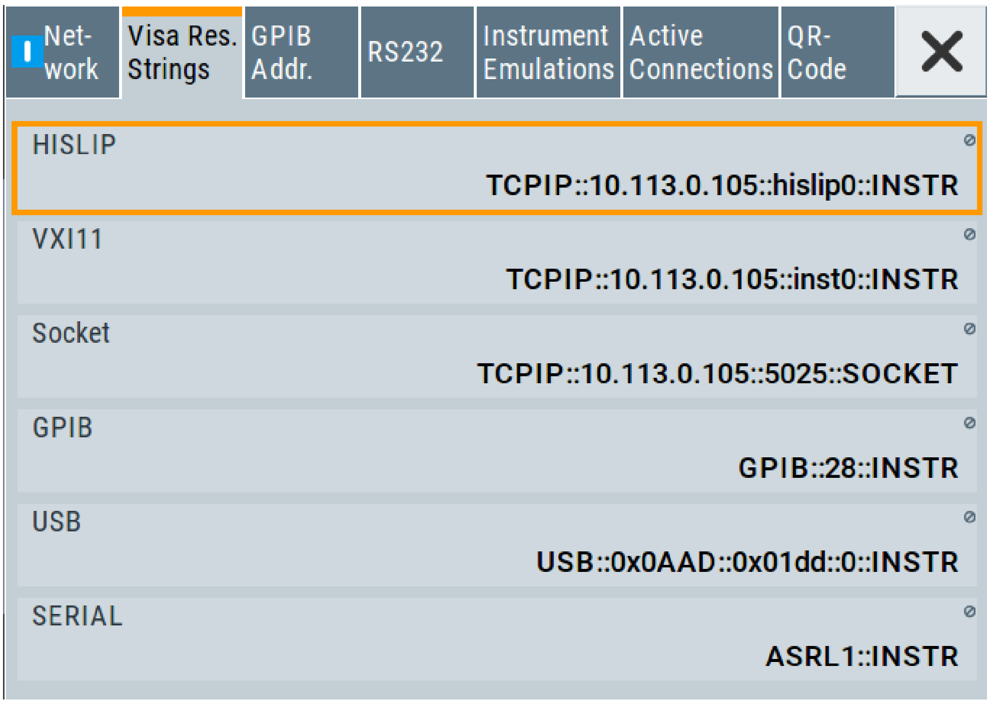
Note: This function restarts only the connection of the instrument to the network. It does not impact the network itself.

Remote command:
:SYSTem:COMMunicate:NETWork:RESTart on page 463

11.4.2 VISA Resource Strings

Access:

► Select "System Config > Remote Access > VISA Resource Strings".



The "VISA Resource String" dialog displays the VISA resource strings provided for remote control via the different interfaces.

Remote command:

`:SYSTem:COMMunicate:HISLip:RESource?` on page 461

`:SYSTem:COMMunicate:NETWork:RESource?` on page 462

`:SYSTem:COMMunicate:SOCKet:RESource?` on page 466

`:SYSTem:COMMunicate:GPIB:RESource?` on page 461

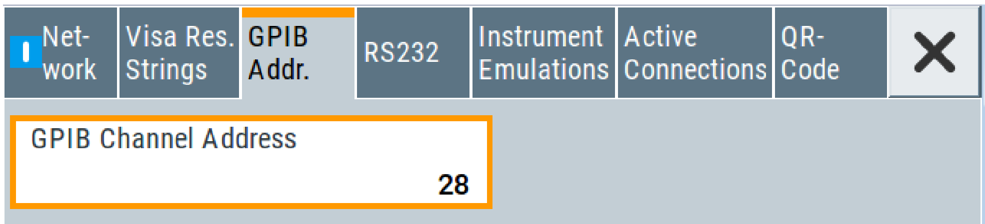
`:SYSTem:COMMunicate:USB:RESource?` on page 466

`:SYSTem:COMMunicate:SERial:RESource?` on page 465

11.4.3 GPIB Address Settings

Access:

1. Select "System Config > Remote Access > GPIB Address".



2. Set the GPIB channel address of the connected instrument.

Remote command:

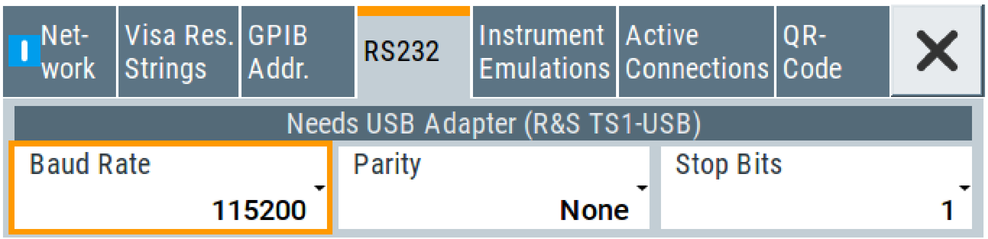
`:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` on page 461

11.4.4 RS232 Settings

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 detects and configures the R&S SMA100B automatically when the USB connection is established.

Access:

► Select "System Config > Remote Access > RS232".



In the "RS232" dialog, you can configure the settings of the serial interface.

The remote commands required to configure the settings remotely are described in Chapter 12.16, "SYSTem Subsystem", on page 452.

Baud Rate
Sets the baudrate for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:BAUD` on page 465

Parity
Sets the parity for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:PARity` on page 465

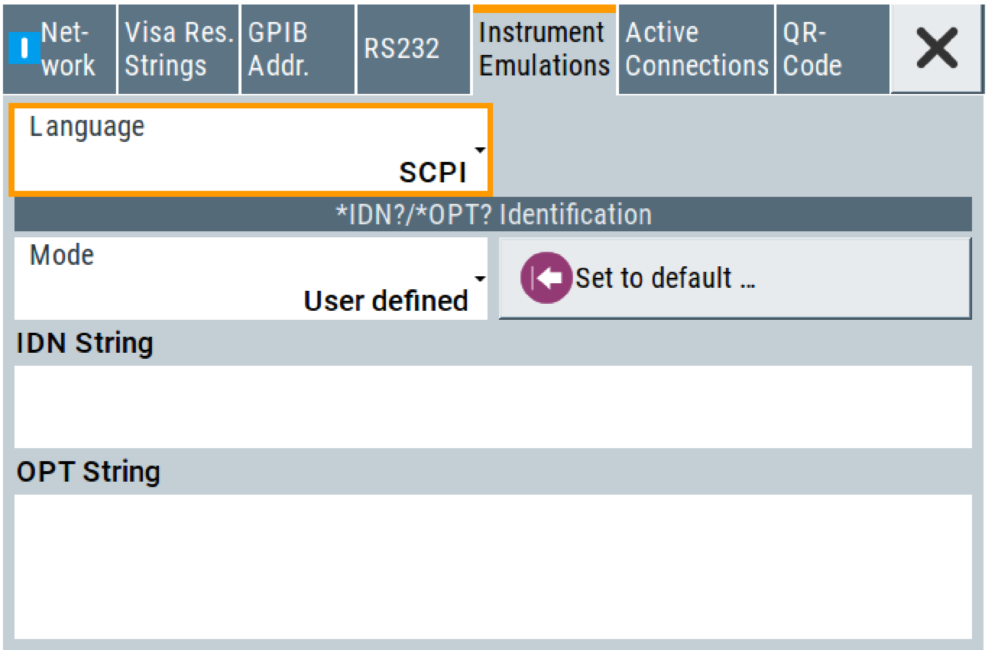
Stop Bits
Sets the number of stop bits for the serial remote control interface.

Remote command:
`:SYSTem:COMMunicate:SERial:SBITs` on page 465

11.4.5 Instrument Emulations Settings

Access:

► Select "System Config > Remote Access > Instrument Emulations".



The "Instrument Emulations" dialog enables you to emulate a remote control command set of another signal generator.

The remote commands required to configure the emulation settings remotely are described in Chapter 12.16, "SYSTem Subsystem", on page 452.

Language

Selects the instrument whose remote command set is emulated by the R&S SMA100B.

Remote command:

`:SYSTem:LANGuage` on page 467

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".

Remote command:

`:SYSTem:IDENtification` on page 466

Set to Default

In "Mode > User Defined", resets the `*IDN` and `*OPT` strings.

Remote command:

`:SYSTem:IDENtification:PRESet` on page 467

IDN String

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

In addition to the preset values, you can define your own identification string so that each generator uses an individual identification, like `My_SigGen` for instance.

Remote command:
`*IDN?` on page 306

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

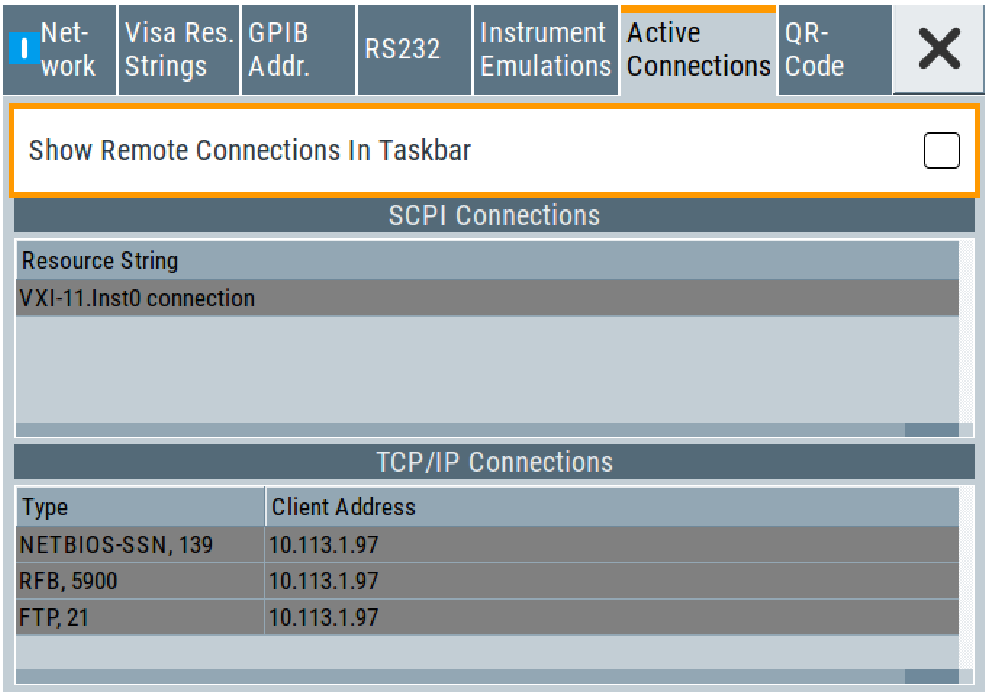
In "Mode > User Defined", you can define your own option string, additionally to the automatically created one.

Remote command:
`*OPT?` on page 307

11.4.6 Active Connections Settings

Access:

► Select "System Config > Remote Access > Active Connections".



The "Active Connections" dialog indicates all active SCPI and TCP/IP connections.

Show Remote Connections in Taskbar
Displays the currently active connections in the taskbar.

SCPI Connections
Shows the active VISA resource string of the interface via which the instrument is remotely controlled.

Remote command:
n.a.

TCP/IP Connections
Shows the type and client address of the LAN interface connection.

Remote command:
n.a.

11.4.7 QR Code

Access:

► Select "System Config > Remote Access > QR Code".

The "QR Code" dialog shows the current instrument address (IP address) in quick response (QR) format.

This functionality provides fast access to the instrument via VNC with, for example, a smart phone or a tablet.

See Chapter 11.16.2, "Setting Up a Remote Operation from a Smart Device", on page 297.

11.5 LXI Settings

On the R&S SMA100B the LXI functionality is already installed and enabled, see LXI Status Settings. Thus, the instrument can be accessed via any web browser (like the Microsoft Internet Explorer) to perform the following tasks:

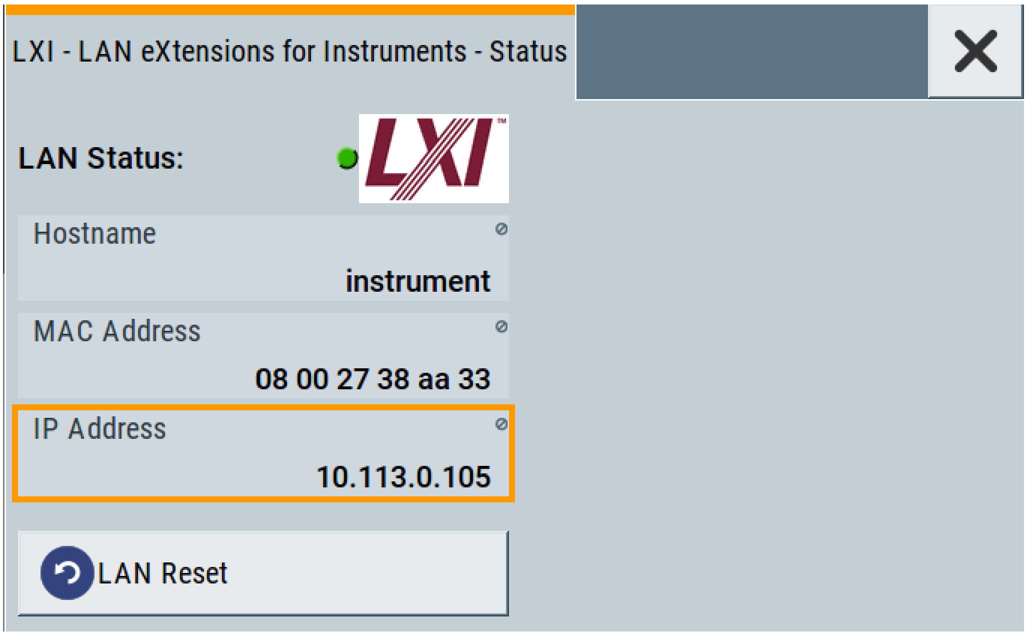
- Modifying network configurations
- Remote control the instrument
- Performing SCPI remote diagnostics

The LAN settings are configured using the instrument's LXI browser interface described in Chapter 11.5.2.1, "LAN Configuration", on page 266.

11.5.1 LXI Status Settings

Access:

► Select "System Config > Setup > Remote Access > LXI Status...".



The "LXI - Status" dialog shows the parameters of the LAN connection.

Alternatively, you can change the LAN settings using the LXI web browser interface, see Chapter 11.5.2.1, "LAN Configuration", on page 266.

LAN Status

The LED indicates the LXI status.

"green" Normal operation

"green (flashing)"
Device identification

"red" LAN fault

Hostname / MAC Address / IP Address
See "Hostname" on page 256.

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 also resets the following parameters for the Signal Generator:

Parameter	
Hostname	`Instrument-specific hostname`
Description	Vector signal generator
Negotiation	Auto detect
VXI-11 discovery	Enabled

11.5.2 LXI Browser Settings

To access the instrument via the web browser:

► In the address field of the browser on your PC, type the instrument's host name or IP address, for example *http://10.113.1.151*.
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, see LAN Status. 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 "Ping Client" on page 268.
  - "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 "Starting a remote control via the LXI web browser" on page 273.
- "Diagnostics"
  - "SCPI Remote Trace" records messages exchanged via the remote control interface, see "SCPI Remote Trace" on page 269.
- "Help"
  - "Glossary" explains terms related to the LXI standard.
  - www.rohde-schwarz.com opens the Rohde & Schwarz home page.
- "Data Sheet"
  Provides the data sheet with the specification data of the instrument at the time of delivery, see "Data Sheet" on page 270.

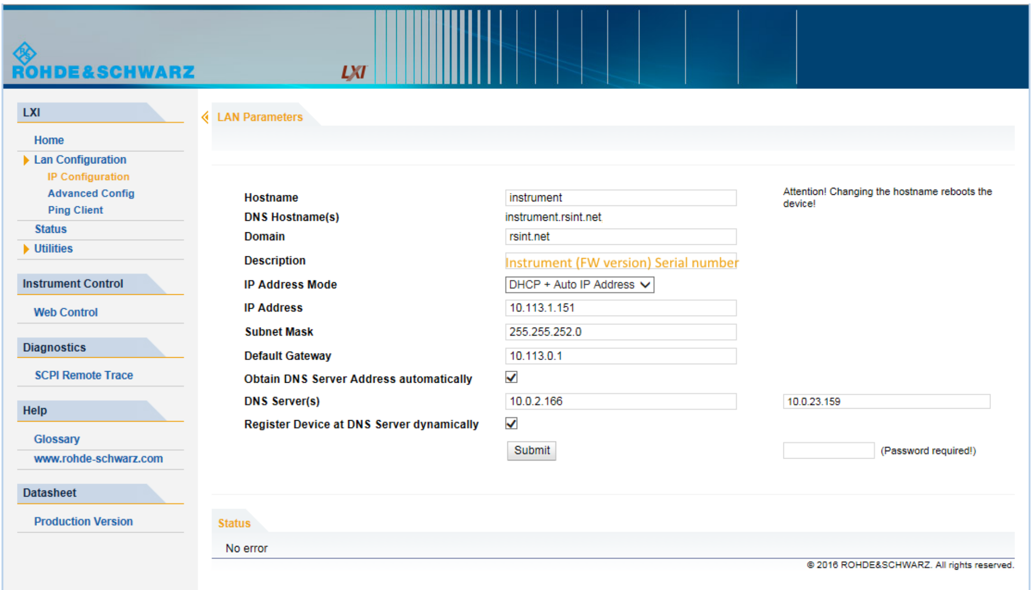
11.5.2.1 LAN Configuration

The "LAN Configuration" web page displays all mandatory LAN parameters and allows their modification.

It comprises the following navigation entries.

IP Configuration

The "IP configuration" web page displays all mandatory LAN parameters and allows their modification.



The "IP Address Mode" selects a configuration mode for the IP address of the instrument. 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.

Changing the LAN configuration

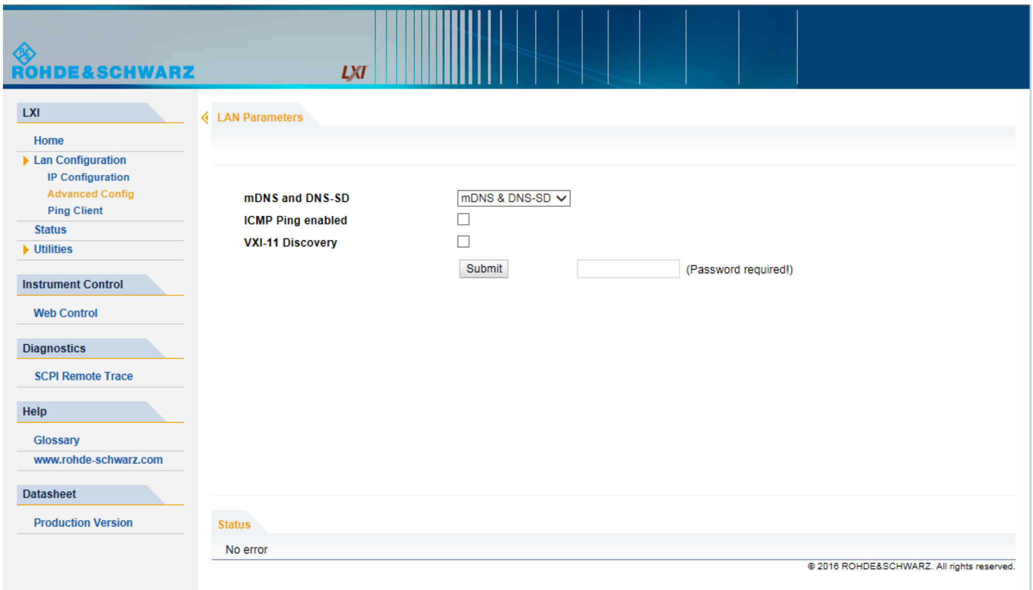
This function is password-protected. Unlock the protection level 1 to access it, see "Protection Level/Password" on page 232.

Note: We recommend that you change the default password before connecting the instrument to a network.

See Chapter 10.4.4, "Password Management", on page 238.

Advanced Config

The "Advanced Config" web 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": 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.

Changing the LAN configuration

This function is password-protected. Unlock the protection level 1 to access it, see "Protection Level/Password" on page 232.

Note: We recommend that you change the default password before connecting the instrument to a network.

See Chapter 10.4.4, "Password Management", on page 238.

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, this function checks whether the communication with a device via LAN is working. Ping is useful for the diagnosis of IP network or router failures.

To initiate a ping at the instrument:

1. On the "Ping Client" page, enter the IP address of the host in the "Destination Address" field (for example 10.113.1.151).
2. Select "Submit".

SCPI Remote Trace

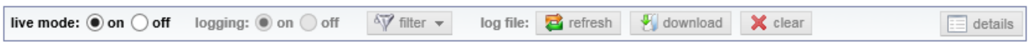
The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SMA100B, see Chapter 11.9, "Tracing SCPI Commands and Messages Exchanged via the LXI Web Browser Interface", on page 282.

A recorded trace (message log) can be evaluated directly in the dialog. Use the highlighting and navigation functions provided by 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, switch on "logging" and "live mode" in the toolbar.

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 at 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

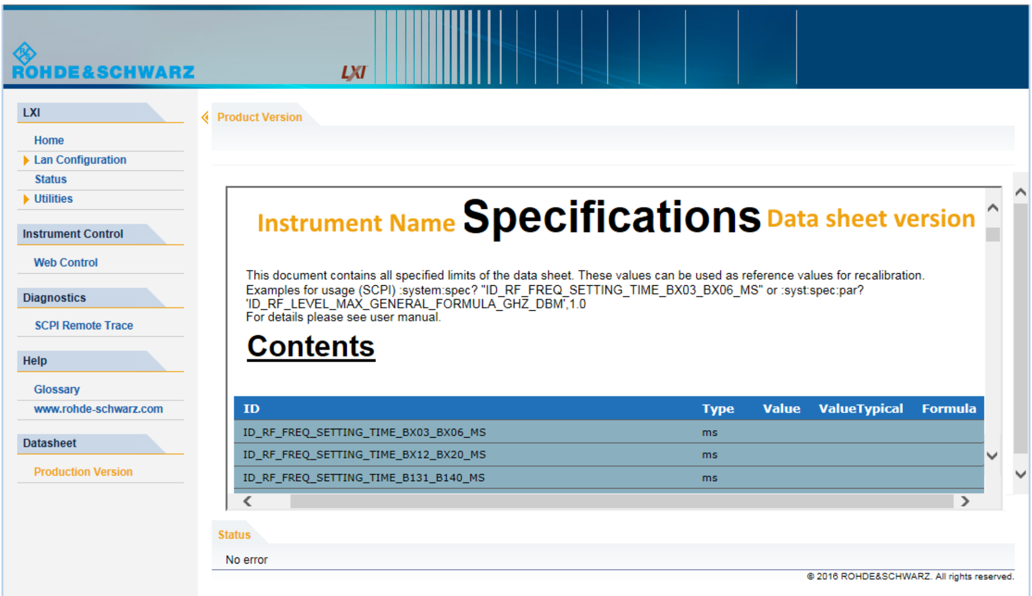
The following columns are available if no column filter is applied:

- "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

Data Sheet

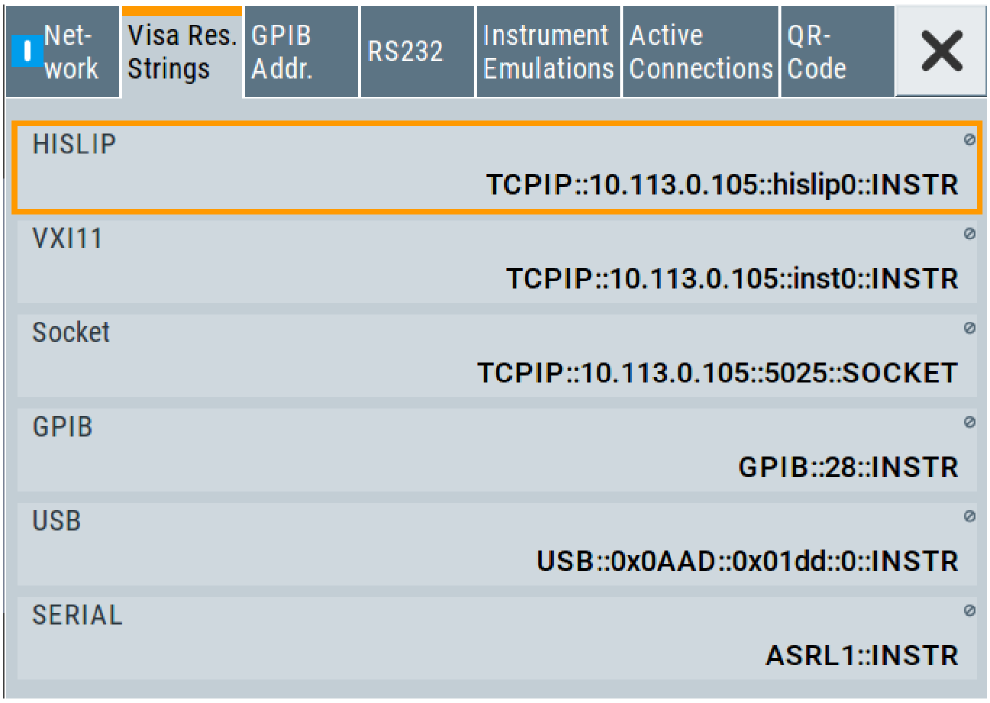
The data sheet functionality allows you to retrieve the specification data of the instrument at the time of delivery.

The document contains all specified value ranges and information of the data sheet, for example important as reference values for recalibration.



11.6 How to Find the VISA Resource String

► Select "System Config > Remote Access > VISA Resource Strings".



The dialog shows all specified resource strings of the supported remote control interfaces.

- For information on how to assign the IP address manually, see Chapter 2.1.3.3, "Assigning the IP Address", on page 28.
- Also note that using the RS232 serial interface via USB requires the USB serial adapter R&S TS-USB1.

11.7 How to Change the GPIB Instrument Address

Option: R&S SMAB-B86

To control the instrument remotely via the GPIB bus, it must be addressed using the GPIB address. The remote control address is factory-set to 28, 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.

To set the GPIB address:

1. Select "System Config > Remote Access > GPIB Address".
2. Select "GPIB Channel Address" and enter a value between 0 and 30.

Risk of losing remote connection

Since a Factory Preset resets the remote access 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!

11.8 How to Set Up a Remote Control Connection

This section guides you through the steps required to set up remote control connections of the available interfaces.

- Chapter 11.8.1, "Establishing a Remote Control Connection over the LXI Browser Interface", on page 273
- Establishing a Remote Control Connection over LAN Using VXI-11 Protocol
- Setting Up a Remote Control Connection over LAN Using Socket Communication
- Setting Up a Remote Control Connection over GPIB
- Setting Up a Remote Control Connection over USB

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, before it can send commands to and receive device responses from the instrument.

Instrument address

To operate the instrument via remote control, it must be addressed using the defined interface address.

See:

- Chapter 11.2.1, "LAN Interface", on page 246
- Chapter 11.2.2, "USB Interface", on page 249
- Chapter 11.2.3, "GPIB Interface (IEC/IEEE Bus Interface)", on page 249

You find the VISA resource strings in the "System Config > Remote Access > VISA Resource Strings" dialog.

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 more information, see:

- "Annotation Frequency" on page 234
- "Annotation Amplitude" on page 234

11.8.1 Establishing a Remote Control Connection over the LXI Browser Interface

Via the LXI browser interface to the R&S SMA100B one or more users can control the instrument remotely from another PC without additional installation. Most 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 SMA100B in the browser's address bar.

   The R&S SMA100B'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 and confirm with the ENTER key.

   After the connection is established, the current screen of the R&S SMA100B is displayed in the browser window.

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

11.8.2 Establishing a Remote Control Connection 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 SMA100B. 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 the R&S SMA100B's hostname or its IP address.

See also Chapter 11.2.1, "LAN Interface", on page 246.

In this following, we assume that:

- A LAN remote control link between the controller and the R&S SMA100B is set up.
- The R&S VISA program is installed on the remote PC
  See http://www.rohde-schwarz.com/rsvisa > "RS VISA Release Notes".

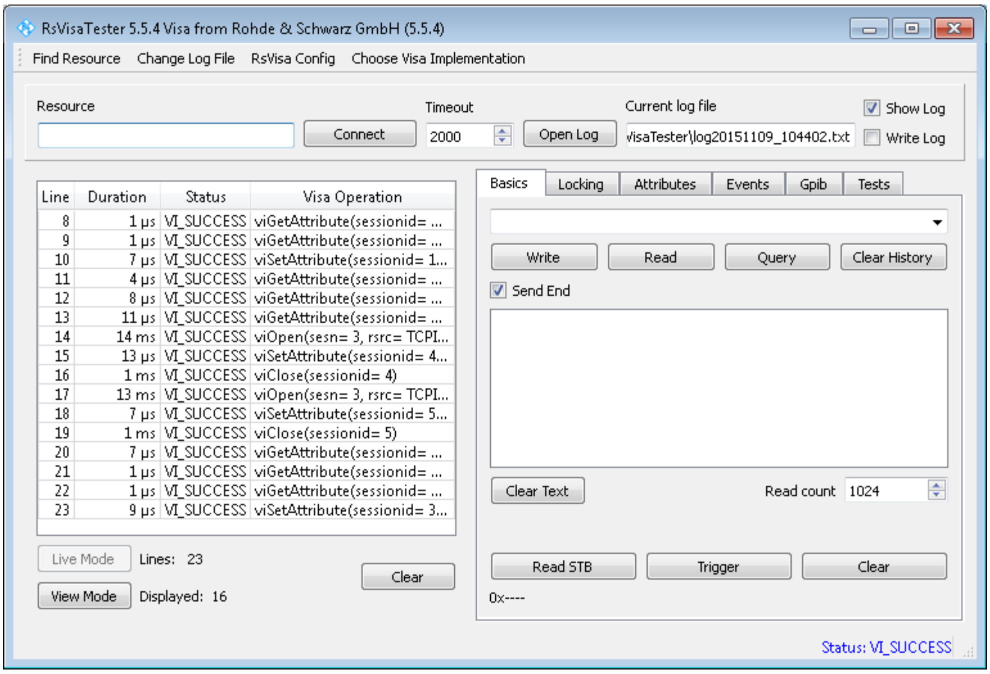
Setting up the controller with R&S VISA

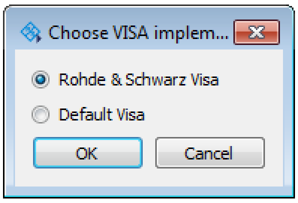
To remote control the R&S SMA100B, we use the R&S VISA Tester application. The application communicates via TCP/IP protocol.

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.

1. Connect the controller and the instrument in the same network (network cable) and switch them on.

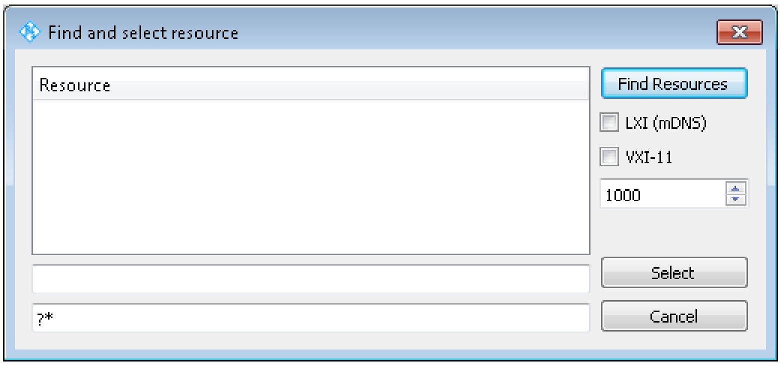
2. On the controller, start "R&S VISA > Tester 32bit" or "R&S VISA > Tester 64bit".





3. In the menu bar, select "Choose VISA Implementation > Rohde & Schwarz Visa" and confirm with "OK".

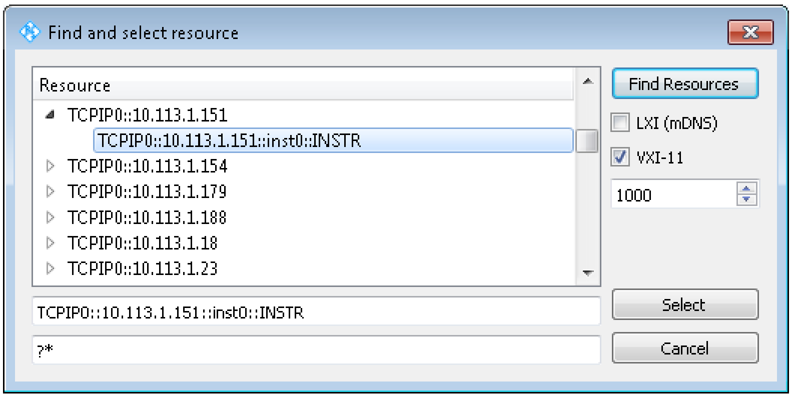
4. In the menu bar, select "Find Resource" to search for the instrument in the LAN.



5. 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.

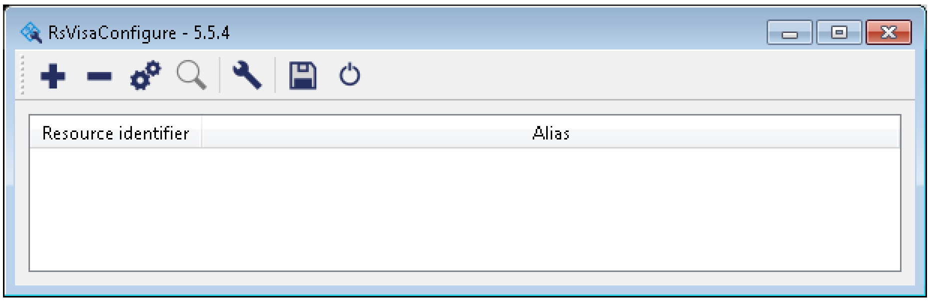
6. Select the required instrument and confirm with "Select".



The "Find and select resource" dialog closes and R&S VISA indicates the IP address in the "Resource" field of the main application window.

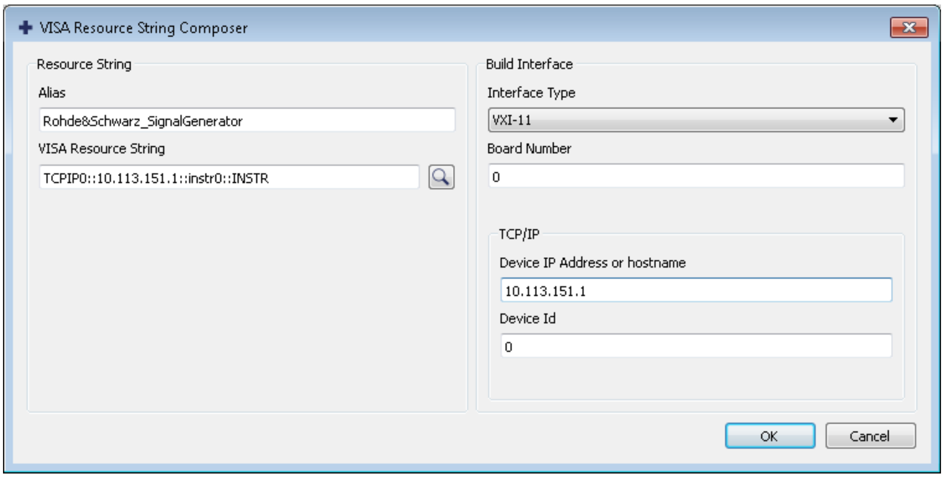
7. As an alternative to the IP address, you can assign an alias name to the R&S SMA100B:

   a) In the menu bar, select "RsVisaConfig".

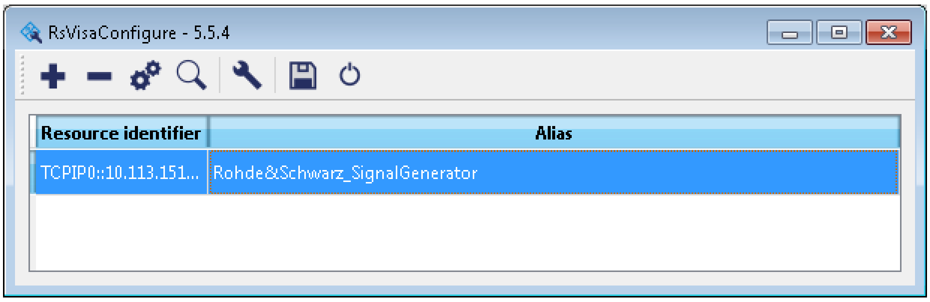


   b) In the toolbar, select "+" to access the "VISA Resource String Composer".

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.



d) Close the dialog.
The R&S SMA100B is registered in the program. It can be addressed via the resource string or alias name.

8. In the main window, select "Connect".

   R&S VISA establishes the connection to the R&S SMA100B.

   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 14.5, "Resolving Network Connection Failures", on page 502.

   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 session over LAN with R&S VISA

To set the instrument to remote control, you can use the addressed command `&GTR` or send any command from the controller.

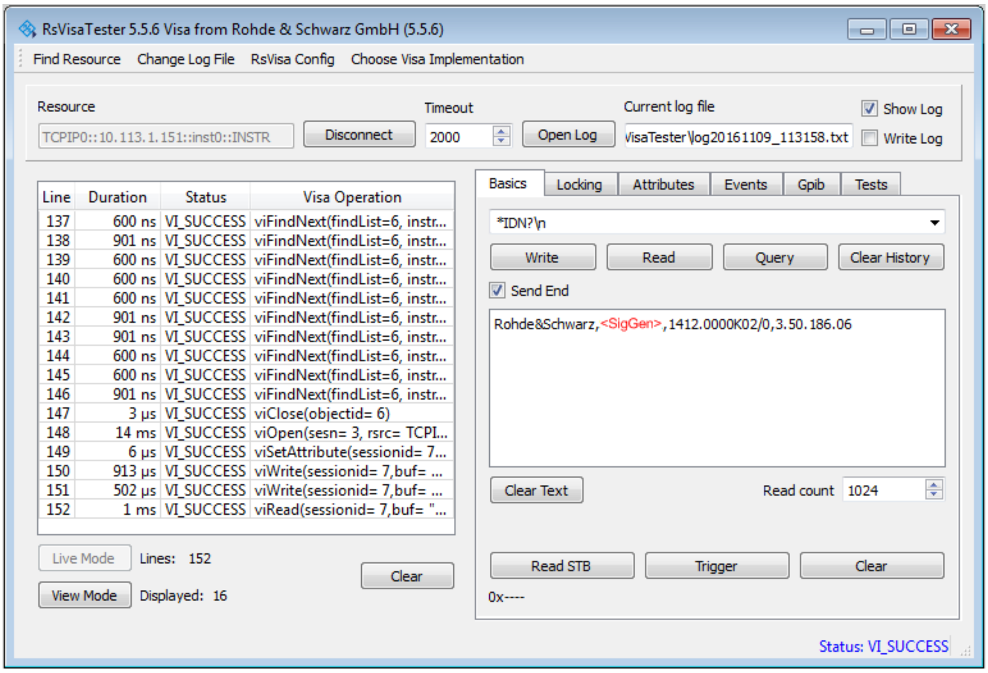
1. Start the R&S VISA Tester. Establish the connection to the R&S SMA100B.

See "Setting up the controller with R&S VISA" on page 274.

2. In the R&S VISA "Basics" tab, enter an SCPI command, e.g. "*IDN?". 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 "Query".
   The instrument response is `4000000000`. The value corresponds to the frequency in Hz.

   While remote control is active, the "Remote" icon in the status bar indicates that the instrument is in remote control mode. Currently ongoing communication (data transfer) is indicated by green colored arrows in the icon.
   Additionally, the "Connections" softkey in the taskbar shows the currently established remote connections. The operation via the front and touch 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 A.1.2, "LAN Interface Messages", on page 506.

   The instrument switches to "Remote LLO" state. The SETUP key is disabled.
7. To enable the SETUP key, use the command `&GTR`.
8. To return to manual operation, see Chapter 11.10, "How to Return to Manual Operation", on page 282.

   Tip: Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

11.8.3 Setting Up a Remote Control Connection over LAN Using Socket Communication

This section provides an example on how to establish a remote control connection over Telnet client and a simple sockets-based program example that can be further developed (see also Chapter A.2, "Telnet program examples", on page 526).

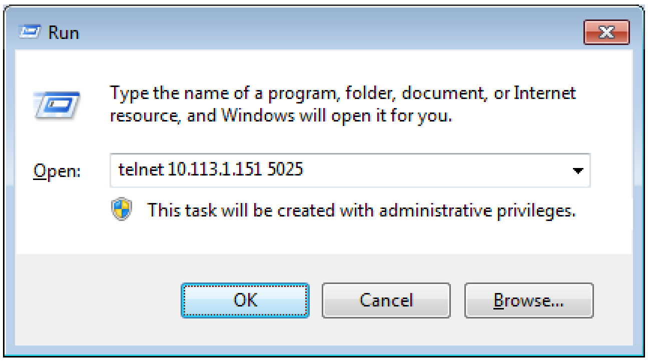
The telnet client transmits information unencrypted. Therefore, for sensitive information we recommend that you use a client which supports secure protocols, as e.g. SSH.

In the following example, we assume basic knowledge of programming and operation of the controller. You can find information on the interface commands in the corresponding manuals.

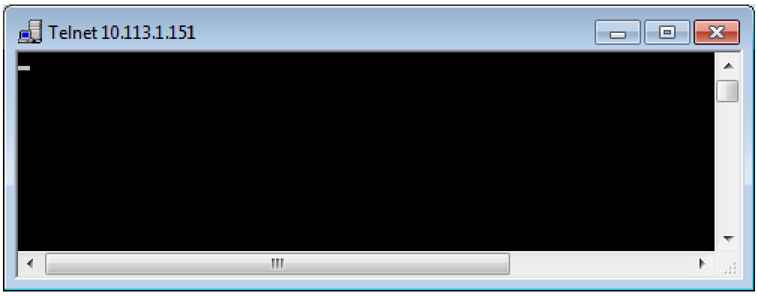
Setting up a Telnet connection

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 SMA100B, start the Telnet program and enter the socket address.
   The socket address is a combination of the IP address or the hostname of the R&S SMA100B and the number of the port configured for remote-control via Telnet.
   Tip: The R&S SMA100B uses the port number 5025 for remote connection via Telnet.

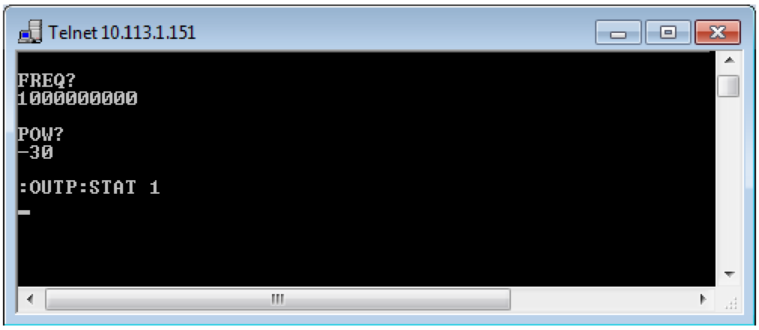


The connection to the instrument is set up and you can send remote-control commands.



2. Note that Telnet does not reflect your first entry. Insert a command, e.g. `*IDN` and confirm with "Enter".
3. Observe the screen.

   A response on the query confirms that the connection is working. The client displays all subsequent inputs and responses.
4. Even if the cursor is not visible on the screen, enter blind a remote-control command and confirm with Enter.



11.8.4 Setting Up a Remote Control Connection 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, for example IVI-COM and LabVIEW drivers, are available for download area on the product page at:
https://www.rohde-schwarz.com/driver/sma100b/

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 the following commands on the controller:
   a) Open the port to the instrument.
   `CALL IBFIND("DEV1", generator%)`
   b) Inform the controller about instrument address.
   `CALL IBPAD(generator%, 28)`
   c) Reset the instrument.
   `CALL IBWRT(generator%, "*RST;*CLS")`
   d) Set the instrument to new address.
   `CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 18")`
   e) Inform the controller about new address.
   `CALL IBPAD(generator%, 18)`

   The GPIB address of the instrument is changed.
3. To return to manual operation, press the LOCAL key at the front panel.

Risk of losing network connection

Since a factory preset resets the remote access 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!

11.8.5 Setting Up a Remote Control Connection over USB

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.

Starting a remote control session over USB

1. Connect instrument and controller using USB cable and switch them on.
2. Execute the following commands on the controller:
   a) Open the port to the instrument
   `viOpen (..., "USB:::0x0092::0x0088::1000010::INSTR", ...)`

b) Reset the instrument
`viRST (generator%, "*RST;*CLS")`
c) Set 2 GHz frequency
`viPrintf (..., "SOUR:FREQ 2GHz\n")`
d) Set 20 dBm output level
`viPrintf (..., "SOUR:POW -20dBm\n")`

The RF frequency and signal level of the instrument are changed.

3. To return to manual operation, press the LOCAL key.

11.9 Tracing SCPI Commands and Messages Exchanged via the LXI Web Browser Interface

The remote trace functionality allows you to trace commands and messages exchanged via a remote control interface of the R&S SMA100B.

To activate the SCPI remote trace:

1. Start a web browser that supports html5 (W3C compliant).
2. Enter the IP address of the R&S SMA100B in the browser's address bar.
   The R&S SMA100B's welcome page is displayed.
3. In the navigation pane, select "Diagnostics > SCPI Remote Trace".
4. 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.
   If you now control the R&S SMA100B with SCPI commands, using an appropriate tool, the LXI function records the information sent and received.
   The function records all sent commands, received responses and messages, and saves 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 save the log in a file.
   Note: The diagnostics functionality will be extended in later releases, e.g. to download or upload SCPI command files from / to the instrument.

11.10 How to Return to Manual Operation

Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

1. To return from "Remote" state to manual state, perform one of the following:
   - On the controller, use the command `&GTL`
     Note: If `&NREN` has been set before `&GTL` is locked. Use `&GTR` instead.
   - In the status bar, select the "Remote" icon.
   - On the front panel, press the LOCAL key.
   - In the block diagram, select "Context sensitive menu > Key Emulation > Local"
2. To return from "Remote LLO" state to manual or to "Remote" state, perform one of the following:
   Note: In the local lockout state, the command `&GTL` and the LOCAL key are locked. You can unlock this state only via remote control.
   - On the controller, use the command `&LOCS`.
     This command switches directly to manual operation.
   - Send the command `&REMS`.
     This command changes the remote control state from "Remote LLO" to "Remote".
   - Use the Visual Basic command `CALL IBLOC (generator%)`.
     The command switches directly to manual operation.
   - VISA function `viGpibControlREN()`
     This function switches directly to manual operation.

11.11 Automating Tasks with Remote Command Scripts

To achieve fast configuration, make complex test setups or repeating measurements reproducible, you can automate the required settings with scripts. A script contains a series of SCPI commands corresponding to the settings. When completed, it is converted to an executable format, saved in a file and can be run whenever needed.

If you frequently need to load and run a script, assign the script to the USER, and you can quickly and easily perform the task.

See Chapter 10.2.3, "Assigning Actions to the User Key", on page 225.

Note: In contrast to "Recall Setup" via the USER key, an assigned script execution does not close active dialogs and windows. On the contrary, even active window control (open / close) is possible.

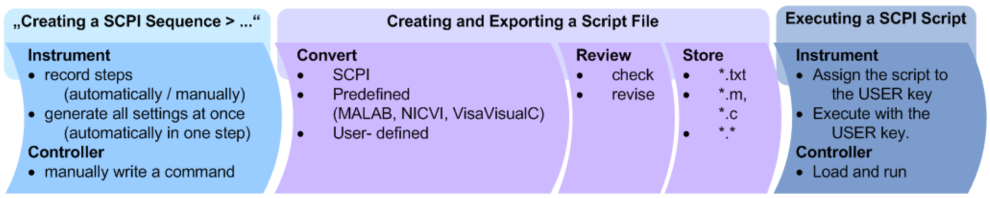


Figure 11-6: Steps for performing SCPI Scripts

In the graph, you can see the main steps required to work with an SCPI script.

Creating an SCPI list

With the SCPI record functions, you can create an SCPI command list directly in the instrument and then export the list to the controller. If you want to edit or write a script manually, use a suitable editor on the controller. Even for manually creating, the instrument supports you by showing the corresponding command syntax and the current settings value.

Directly in the instrument, you can create an SCPI list at any time of operation, in the following ways:

- Recording steps

  Both, automatic and manual SCPI recording of settings is possible. You can start, stop and resume automatic recording, and also record individual commands manually.
  - Manually record the steps selectively
    In manual recording mode, you can deliberately record a SCPI command with the "Add to Script" function, see How to record SCPI lists manually.
  - Automatically record all performed steps
    The instrument records the SCPI command and settings value of each step you perform, as if you run a series of commands, and then writes the commands to the file system, see How to record SCPI lists automatically.
    You can also add a SCPI command manually to the recording list during automatic SCPI recording, or after it has been stopped.
- Generating all settings at once
  Generates the SCPI commands of the current instrument settings in one step, and writes the command list in a temporary list, see How to create a SCPI list with the current instrument settings in one step.
  Note: This function lists all commands in alphabetical order, in contrast to the recording or manual creation, which consider the order the settings are configured. This can slow down the run time or cause errors during execution. Therefore, always check and revise a script if necessary, see "How to check an SCPI list" on page 292.
- Manually create a command script with "Copy" and paste
  Enables you to copy the SCPI command and the current setting, see Chapter 11.11.1, "Show SCPI Command", on page 286.

Some parameters cannot be set by a SCPI command.

If so, *no SCPI command found* is entered instead of a command when you record or generate all settings at once.

The difference between "Show SCPI Command" and the provided cross-reference

If you want to enter your settings in a script, or use a remote control program, you must know the corresponding SCPI command and the exact syntax.

If you need to look up the SCPI command, the instrument offers two ways to figure it out quickly.

- "Show SCPI command" (context-sensitive menu)
  Displays the SCPI command syntax of a selected parameter including the current setting value, see Chapter 11.12, "How to Find Out the SCPI Command Corresponding to the Manual Operation via "Show SCPI Command"", on page 289. The "Copy" function enables you to write a SCPI script conveniently by hand.
- Instrument help (F1 key)
  Opens a help topic that describes the selected parameter or instrument function, including a cross-reference to the corresponding SCPI command. The reference leads you to the description of the SCPI command comprising the complete SCPI syntax, all available setting values, value ranges, etc., see Chapter 11.13, "How to Find Out the SCPI Command Corresponding to the Manual Operation Using the Online Help", on page 289.

Creating and exporting a script file

When the script list is completed, a code generator translates the SCPI commands into the source code of a proprietary programming language, using a code template. Therefore, each language requires an appropriate code template. When converted, you can save the script in a file with an extension corresponding to the programming language.

The R&S SMA100B provides the following predefined code templates by default:

- Plain SCPI
  Represents SCPI base format, that is ASCII format, saved as text file (`*.txt`).
- MATLAB
  A programming environment, frequently used in signal processing and test and measurement applications (`*.m`).
  You can directly use this format with MATLAB(c) Toolkit. For comprehensive information on this topic, refer to the application note 1GP60: MATLAB Toolkit for R&S Signal Generators.
- NICVI
  An ANSI C programming environment designed for measurements and tests (`*.c`).
  You can directly use this format with National Instruments LabWindows CVI.

You can also convert a script to a user-specific format. In this case, you need a code template with the extension `*.expcodetmpl`.

For information on how to select the code template and save the script in a file, see Chapter 11.11.3, "SCPI Recording Export Settings", on page 287.

Executing an SCPI script

An SCPI script primarily runs on the controller PC. In addition, you can execute a script directly on the instrument, by assigning the script to the USER key.

See Chapter 10.2.3, "Assigning Actions to the User Key", on page 225.

11.11.1 Show SCPI Command

Access:

1. Select the parameter.
2. Open the context-sensitive menu (tap and hold).
3. Select "Show SCPI Command".

This function provides the syntax of the remote command with the current setting.

Copy
Copies the command and the current setting.

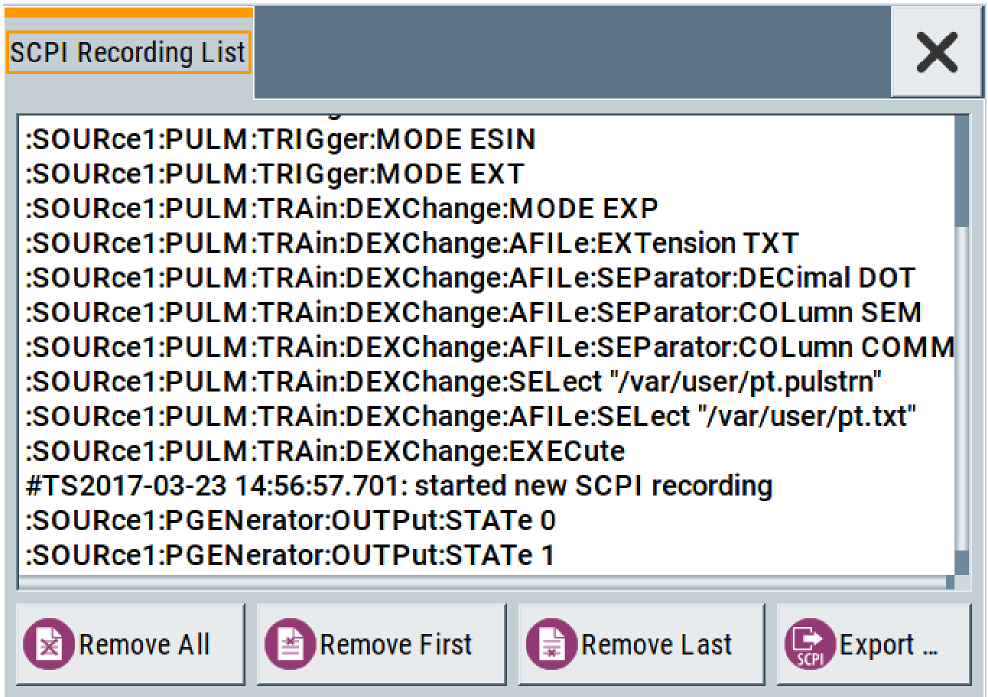
Close
Exits the "SCPI Command" dialog.

11.11.2 Displaying an SCPI List

The instrument displays a recorded SCPI list and thus provides viewing the recorded results before exporting.

► Depending on the starting point, you can access the "SCPI Recording List" dialog as follows:
- During recording
  Select "Show SCPI Recording List" in the context-sensitive menu.
- At any time outside recording
  Select "Show SCPI Recording List" in the context-sensitive menu.
  This function assumes that at least one recording has been executed after power-on.
- At the end of the recording
  Select "Stop automatic SCPI recording". The dialog opens automatically.
- After you have exported the script to a file
  Select "SCPI Recording Export > Show file content"

See Chapter 11.11.3, "SCPI Recording Export Settings", on page 287.



The "SCPI Recording List" shows the last recorded and exported commands.

Export

Opens the SCPI Recording Export dialog for configuring the file parameters for export.

Remove All, Remove First, Remove Last

Deletes the either first, the last or all recorded SCPI commands.

To remove several recorded commands, repeat the removing.

For post processing, export the SCPI command list in a file, see Chapter 11.15, "How to Convert and Save SCPI Lists", on page 293.

11.11.3 SCPI Recording Export Settings

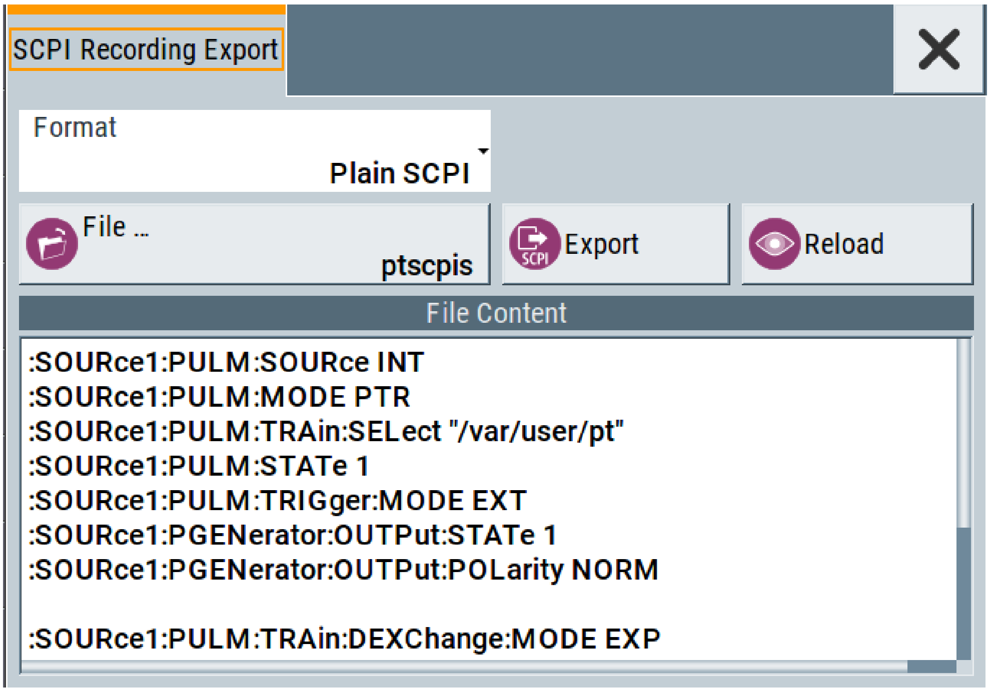
Scripts are configured and saved in the "SCPI Recording Export" dialog.

This dialog opens automatically, when you stop recording.

1. To access this dialog, select "Show SCPI Recording List" in the context-sensitive menu.

   The "SCPI Recording List" dialog opens.

2. Select "Export".



The "SCPI Recording Export" dialog contains all functions required for export of command lists to a file. It enables you to select the source code format, assign an individual filename and display the file content.

Format
Selects the source code format for the command list.

"Plain SCPI" Uses SCPI syntax.

"Predefined Code Generator"
Accesses the predefined templates for common source code generators that convert the recorded settings in the programming languages MATLAB or NICVI.

"User Code Generator"
Provides the ability to convert a script by a user-specific code generator.

Select Code Template
Opens the standard "File Select" dialog and lists the predefined or user-defined code templates.

See Chapter 9.5.1, "File Select Settings", on page 200.

File
Opens the standard file select dialog "Select Output File", see Chapter 9.5.1, "File Select Settings", on page 200.

Export
Executes data export.

Reload
Loads the SCPI list.

File content
Displays the content of the script in the selected format and code template.

11.12 How to Find Out the SCPI Command Corresponding to the Manual Operation via "Show SCPI Command"

1. To find out the SCPI command of a parameter in manual operation, select the respective parameter.
2. Open the context-sensitive menu and select "Show SCPI command"

You get the detailed command syntax, including the currently set value.
With the "Copy" function, you can conveniently paste the command including the current setting e.g. in a command script.

11.13 How to Find Out the SCPI Command Corresponding to the Manual Operation Using the Online Help

If you are looking for the remote command to a function in manual operation, you find it in the description of the online help.

1. To find out the SCPI command of a parameter in manual operation, select the respective parameter.
2. To open the corresponding help topic, select one of the following:
   - In the display, select "context-sensitive menu > Help".

   - On the front panel, press the HELP key.

   The help topic opens. Apart from the function description, it contains the SCPI command in detailed syntax.

How to find the corresponding GUI function to a command
Conversely, if you are looking for a function in the GUI, which belongs to a SCPI, you find it via a cross-reference in the online help and in the user manual.

11.14 How to Record / Create SCPI Lists

How to record SCPI lists automatically

The following example briefly explains how to proceed when you want to record SCPI lists.

For comprehensive information on this topic, refer to the application note 1GP98: SCPI Recorder Test Automation on a Fingertip.

1. On the screen, open the context-sensitive menu (touch and hold, or right mouse click) and select "Start SCPI recording".

   Starting from now, all steps you perform are recorded.
2. To stop SCPI recording, select "context-sensitive menu > Stop SCPI recording".

   The "SCPI Recording List" dialog opens automatically.
3. Proceed with How to check an SCPI list.

How to record SCPI lists manually

We recommend that you activate the "Mark All Parameters Changed from Preset". This function facilitates to track the changes.

1. To retrace your settings, open the context-sensitive menu and select "Mark all Parameters Changed from Preset".

   This function identifies all settings you have changed, both in the block diagram, and in the dialogs.
   Changed value are highlighted.
2. Open the context-sensitive menu and select "Start SCPI recording".

   Now you can selectively record your steps:

   a) Set the parameter.
   b) Open the context-sensitive menu.

c) Select "Add SCPI Command to Recording List"

Tip: You cannot see "Add SCPI ..." in the menu?
This may happen if you open it outside of a dialog or input field, for example in block diagram. Open the context-sensitive menu within the corresponding dialog or input field, and the feature is available.

d) Continue with the next setting, and repeat steps *a to b* whenever needed.

Each time you select "Add SCPI ...", the SCPI command is appended to a temporary list.

3. To check the progress of the recording, select "Context-Sensitive > Show SCPI Recording List".

The "SCPI Recording List" dialog opens, displaying all recorded settings so far.

4. To stop SCPI recording, open the context-sensitive menu again and select "Stop SCPI Recording".

The "SCPI Recording List" dialog opens automatically.

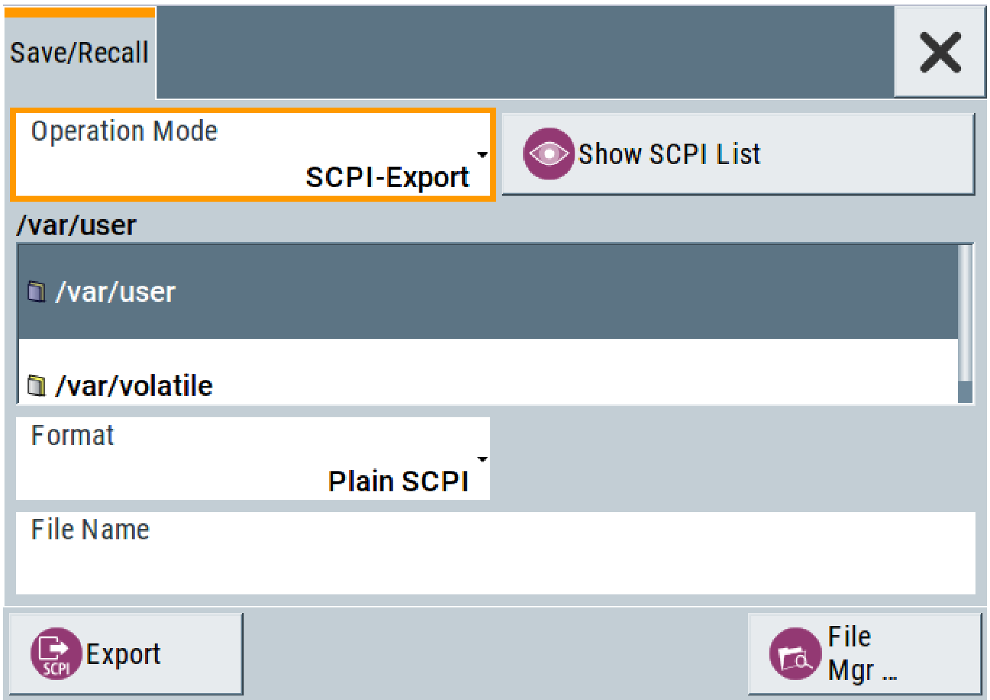
5. Proceed with How to check an SCPI list.

How to create a SCPI list with the current instrument settings in one step

You can also generate the appropriate SCPI list to a manually created instrument state at any time, in only one step.

To generate a SCPI list with commands for all settings performed:

1. Select "Save/Recall > SCPI Export".



The instrument opens the standard file select dialog, see Chapter 9.4.1, "Save/Recall Settings", on page 196.

2. In the "Format" entry field, select the source code.
3. Depending on the selected format, convert the script as described in Chapter 11.15, "How to Convert and Save SCPI Lists", on page 293
4. Enter a filename.
5. Select "Export".
   The instrument writes all SCPI commands of the key parameters and the modified settings in the file. The file extension is automatically assigned according to the source code format.
6. To preview the content of the SCPI list, select "System Config > Save/Recall":
   a) "Operation Mode > SCPI-Export"
   b) In the `/var/user/` directory, select a previously saved file.
   c) Select "Show SCPI List".

   The list of all SCPI commands is displayed for example for a final check.

Exporting the SCPI list of the instrument state in one step is a fast and convenient method. Nevertheless, it usually requires postprocessing on an external PC.

How to check an SCPI list

The easiest way to check a list is to execute it. The generator returns a warning if a setting could not be performed.

However, we recommend that you check the list and possibly rework. It can be that ...

- A parameter has not assigned an SCPI command or an element of the user interface has not an assigned parameter. In these cases, `:SYST:INF:SCPI 'SCPI command not available'` is entered in the list instead.
  Such entries are also detected during execution. The instrument recognizes these incomplete commands and displays an error message.
- A preset has been executed, but several standards subsequently perform some internal settings that are also assigned to the list with "SCPI Export".
- After a preset still some settings are defined, which are then written to the list generated with "SCPI Export."

Some suggestions on how you can check and revise a list:

1. Search and remove missing command entries.
2. Remove unnecessary content that has been written after a preset.
3. Rearrange the commands to a reasonable order. If you for example set a `STATe` command to the last position of a list, you can avoid intermediate calculations of the signal.
4. Preview the list for completeness by comparing it with the modified settings in the manual mode.
   a) To retrace your settings in manual operation, open the context-sensitive menu and select "Mark all parameters changed from preset".
   The function identifies all settings you have changed, both in the block diagram, and in the dialogs. They appear orange.
   b) Check whether there is a command in the list for all modified settings.
5. To perform modifications, export the list to a PC, using for example a USB stick.

11.15 How to Convert and Save SCPI Lists

After completing the recording, the "SCPI Recording Export" dialog opens.

1. Select the "Format" for the command syntax in which you want to save the list.
2. "Select Code Template"
   Depending on the selected format, proceed accordingly:
   Note: The code template must be selected before exporting.
   a) Plain SCPI
   Continue with the next step.
   b) Predefined code generator
   The "SCPI Recording Export - Select Predefined Code Template" dialog opens.
   Select one of the predefined code templates.

c) User code generator
A file system ("SCPI Recording Export - Select User Code Template") dialog opens.
Select your user-defined code template. The code template must have file extension `*.expcodetmpl`.

3. Select "File..."
The "SCPI Recording Export - Select Output File" dialog opens.
4. Select "New" and assign a filename for saving the recorded list.
5. In the "SCPI Recording Export" dialog, select "Export".
Saves the recorded data either in ASCII format (plain SCPI), or in the corresponding format of the used code template, and shows the SCPI list in the "File Content" section.

11.16 How to Set Up Remote Operation via VNC

This section shows you some examples of the various possibilities to set up remote operation.

- Using a desktop system
  – Chapter 11.16.1.1, "Using a Web Browser", on page 294
  – Chapter 11.16.1.2, "Using a VNC Client Software", on page 295
- Using a smart device
  – Chapter 11.16.2.1, "Using a VNC App", on page 298
  – Chapter 11.16.2.2, "Using a Web Browser with HTML5", on page 298
  – Chapter 11.16.2.3, "Special Mode QR Code ", on page 299

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.

11.16.1 Setting Up a Remote Operation from a Desktop System

11.16.1.1 Using a Web Browser

The R&S SMA100B supports remote operation via VNC with any web browser, like Windows Internet Explorer or Mozilla Firefox for instance, or alternatively, an HTML5 web browser.

To operate the instrument via a web browser remotely:

1. Install the *JRE (Java Runtime Environment)* on the remote computer.

Note: Skip this step if you are working with an HTML5 web browser.

2. Type the instruments' IP address in the address field of the web browser on your PC, e.g. *http://10.113.1.151*

   The VNC authentication screen appears.

3. Enter the password and confirm with "OK".
   The default password is *Instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

11.16.1.2 Using 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 through a LAN connection.

The VNC client software for setting up the connection is included in the operating system Linux/Unix per default. For Windows operating systems, a VNC client software must be installed manually.

Various free-of charge programs such as Ultr@VNC or similar VNC client programs are available for download on the Internet.

Setting up the VNC connection on a Linux/Unix desktop client

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>`, for example *vnc://10.113.1.151*.

   A dialog opens requesting the password for the remote VNC connection.

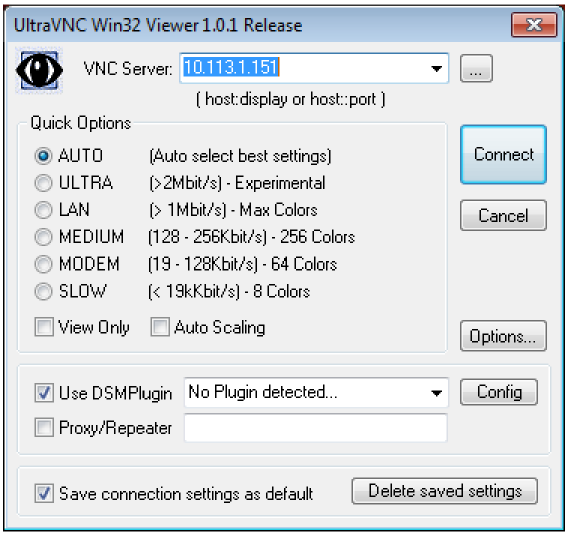
3. Enter the password and confirm with "OK".
   The default password is *Instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

Setting up the VNC connection on a Windows desktop client

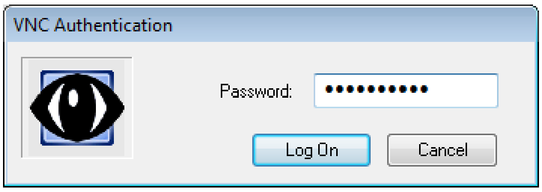
1. Install the VNC viewer program component on the remote computer.
   a) On the Internet, select a VNC client program and download it onto your PC.
   For example the free of charge software Ultr@VNC (`vncviewer.exe` is available, see http://www.uvnc.com/download/index.html.
   b) Execute the VNC client installation.
   c) Select the VNC viewer program component and follow the installation instructions.

2. Start VNC viewer program component on the PC.



3. Select "VNC Server" and enter the IP address of the instrument.
4. To initialize the connection, select "Connect".

   A dialog opens requesting the password.



5. Enter the password and confirm with "OK".
   The default password is *Instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated from the remote computer.

Terminating VNC connection

► Perform one of the following:

a) On an external Unix/Linux PC, close the Internet browser or close the signal generator window.
b) On an external Windows PC, close the VNC viewer program.

The connection is terminated but not disabled. It can be established again any time.
In the "Active Connections" tab, the displayed TCP/IP connection disappears.
Consider, however, the note concerning unauthorized access due to VNC connection ("Risk of unauthorized access" on page 244).

11.16.2 Setting Up a Remote Operation from a Smart Device

The R&S SMA100B supports remote operation via VNC from a smart device (remote client), like a tablet (tablet computer) or a smartphone. The smart device accesses the instrument via WLAN, either by a suitable App, or an HTML5 web browser, that means with embedded *javascript*.

There are several possibilities to establish a WLAN connection between the smart device and the R&S SMA100B, which are, however, not all described here. This section gives an example of how a network environment can be built up, and some essential configuration steps.

For comprehensive information on this topic refer to the application notes:

- 1MA216: Remote Operation of Windows Based Instruments with Apple iPad
- 7BM82: Apple iPad Remote Control of Broadcasting T&M Instruments

Example:

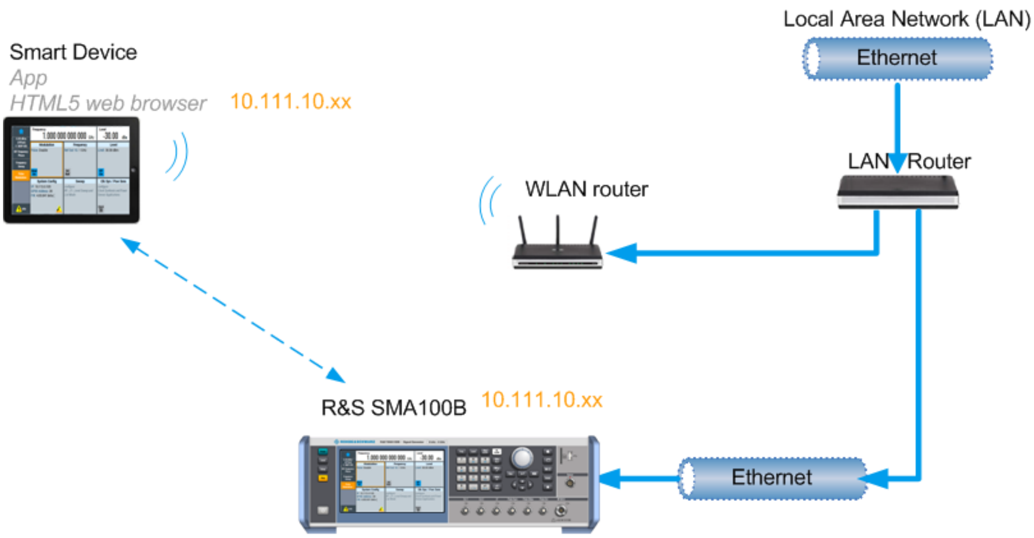


Figure 11-7: Example of a network configuration for remote operation with a smart device

As shown in the figure, the R&S SMA100B and the WLAN router are connected to the LAN router. The smart device accesses the Rohde & Schwarz instrument via the WLAN router.

Prerequisites

For this network configuration, the following prerequisites must be met:

- The required equipment is:
  - A LAN router
  - A WLAN router (hot spot)
    Required for accessing the R&S SMA100B
- The smart device must be known and accepted in the network of the R&S SMA100B.

- The *App* or web browser implements the VNC functionality on the smart device for remote operation.

It is recommended that all components in the network use DHCP, which automatically assigns the relevant address information.

With the configuration in the example, you can reach the instrument from a great distance, since the WLAN router acts as an additional access point.

11.16.2.1 Using a VNC App

Using a *VNC App* enables the smart device to access the R&S SMA100B via WLAN.

The VNC Apps are available from various manufacturers of the smart devices. The list of supported devices is different according to the smart device. Refer to the manufacturer's website to find out whether a VNC App is available for your device, and how it is installed.

1. In the network, establish the connection of the WLAN router to the LAN router.
   We assume that the LAN router and the R&S SMA100B are connected and configured in the LAN.
2. Configure the WLAN router according to the manufacturer's instructions.
3. Install the required *VNC App* on your smart device.
4. On the smart device, start the *VNC App*.
5. In the address field, enter the IP address of the instrument.
   Tip: The R&S SMA100B indicates IP address on the screen.

   A log-on dialog opens and requests the password for the VNC connection.

   The default user name and password is *instrument*.

   Tip: Default password. Remote access via VNC uses the user name "instrument" with default user password "instrument".
   Note: We recommend that you change the default password before connecting the instrument to a network.

   See Chapter 10.4.4, "Password Management", on page 238.
6. Enter the password to establish the remote access.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

11.16.2.2 Using a Web Browser with HTML5

The R&S SMA100B supports remote operation from a smart device via VNC with any HTML5 compliant web browser, like Internet Explorer, Firefox, Google Chrome, or Safari for instance.

To operate the instrument remotely via a web browser, proceed as follows:

1. In the web browser enter the IP address of the instrument, e.g. *http://10.113.1.151*.
2. Type the instrument IP address in the address field of the web browser on your PC, e.g. *http://10.113.1.151*
   Tip: The R&S SMA100B indicates IP address on the screen.

   The VNC authentication screen appears.
3. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

11.16.2.3 Special Mode QR Code

If your smart device is equipped with a camera and a QR code reader, you can scan the instrument's IP address or access the instrument with the Safari web browser.

QR code readers are available from various manufacturers of the smart devices. The list of supported devices is different according to the smart device. Refer to the manufacturer's website to find out whether a reader is available for your device, and how it is installed.

1. Install the required QR code reader software on your device.
2. Start the reader.
3. On the R&S SMA100B, select "System Config > Remote Access".
4. In the "Remote Access" dialog, select the "QR-Code" tab.
5. Scan the QR code of the instrument with your smart device.
6. On the device, decode the scanned QR code and pass it to the web browser.

   A dialog opens requesting the password for the VNC connection.
7. Enter the password and confirm with "OK".
   The default password is *instrument*.

   After the connection is established, the current screen of the signal generator is displayed and the instrument can be remotely operated.

11.17 References

11.17.1 LXI Functionality

LAN Extensions for Instrumentation (LXI) 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 in the R&S SMA100B allows you to change certain LAN settings, to reset the LAN connection, and to identify the instrument.

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 LXI functionality in the R&S SMA100B is characterized by a common LAN implementation, including an ICMP ping responder for diagnostics. The instrument can be configured via a web browser. A LAN Configuration Initialize (LCI) mechanism resets the LAN configuration. The instrument also supports automatic detection in a LAN via the VXI-11 discovery protocol and programming by means of IVI drivers.

In addition the R&S SMA100B provides the following LXI-related functionality:

- Integrated "LXI Status" dialog for LXI status indication and reset of the LAN configuration, seeChapter 11.5.1, "LXI Status Settings", on page 264.
- "LXI Browser Interface", as described in Chapter 11.5.2.1, "LAN Configuration", on page 266.
- "SCPI Remote Trace" utility, see "SCPI Remote Trace" on page 269.

Firmware update

To enable the full LXI functionality after a firmware update, shut down and restart the instrument.

11.17.2 Code Generator Templates

This section describes the main structure of the code generator templates, and shows the method by means of the NICVI template.

The code generation is controlled by templates with the following blocks:

Command	Function
#EXTENSION_START #EXTENSION_END	Defines the output file extension.
#INIT_CODE_START #INIT_CODE_END	Contains initial entries, such as included files and libraries, buffer size, commands for synchronization, or creating a VISA session. All entries between start and end are written once at the beginning of the output file.
#COMMAND_CODE_START #COMMAND_CODE_END	Frame for an SCPI command. A command is accessed with %COMMAND.
#NO_COMMAND_CODE_START #NO_COMMAND_CODE_END	Frame for a parameter with no SCPI command available. A parameter is accessed with %PARAMETER.
#EXIT_CODE_START #EXIT_CODE_END	Closes the visa session. All entries between start and end are written once at the end of the output file.

Templates are created in ASCII format with file extension *.expcodetempl.

Example:

Example to the code generator template NICVI.expcodetmpl:

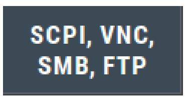
```
#EXTENSION_START
.c
#EXTENSION_END

#INIT_CODE_START
#include <ansi_c.h>
#include <visa.h>
#include <cvirte.h>

#define MAX_BUFFER_SIZE 200
static ViStatus status;
static ViSession defaultRM, handle;

static void write_command(char *command)
{
  char writeBuffer[MAX_BUFFER_SIZE];
        char readBuffer[MAX_BUFFER_SIZE];
        int length;
        int readCount;

        strcpy(writeBuffer, command);
        //append "*OPC?" to sync
        strcat(writeBuffer, ";*OPC?");
        length = strlen (writeBuffer);
        writeBuffer[length]='\n';
```

```
        length = length+1;
        viWrite (handle, writeBuffer, length, VI_NULL);
        //read result
        viRead(handle, readBuffer, 100, &readCount);
}
int main (int argc, char *argv[])
{
  if (InitCVIRTE (0, argv, 0) == 0)
     return -1;    /* out of memory */
        //create a VISA session and return a handle to it
     viOpenDefaultRM (&defaultRM);
        //create a VISA session to the serial port and return a handle to it
        viOpen (defaultRM, (ViRsrc)"TCPIP::localhost::INSTR", VI_NULL, VI_NULL,
&handle);
#INIT_CODE_END

#COMMAND_CODE_START
  write_command("%COMMAND");
#COMMAND_CODE_END

#NO_COMMAND_CODE_START
  //no SCPI command available for parameter %PARAMETER !
#NO_COMMAND_CODE_END

#EXIT_CODE_START
  viClose (handle);
        viClose (defaultRM);
        return 0;
}
#EXIT_CODE_END
```

11.17.3 Remote Control States

How to I recognize if there is an active remote connection to the instrument?

► Observe the indication on the taskbar.



A softkey in the taskbar indicates if and what kind of remote connections are currently set up.
See also Chapter 11.4.6, "Active Connections Settings", on page 262.

The following table shows the different remote control states and the associated commands or actions to return to manual control.

Table 11-3: Remote control status icons

GUI symbol	Transition to remote control state...	Transition to manual operation...(local state)
 	`&GTR` (controller) Remote control, but usable front panel keys. The parameters are in read-only mode.	• `&GTL` (controller) • Tap the "Remote" icon (display) • LOCAL (front panel or key emulation) A currently performed setting is indicated by the green arrows. The setting must be completed (white arrows), otherwise the instrument remains in remote state.
	`&LLO` (controller) Remote control with locked front panel keys to prevent user interaction. The parameters are in read-only mode. You can unlock LLO, and thus return to manual operation only via remote control.	• `&LOCS` (controller) • `CALL IBLOC (generator%)` (controller) **Note:** The command `&REMS` returns to "Remote" state.

12 Remote Control Commands

In the following, all remote-control commands are 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 11, "Network Operation and Remote Control", on page 243
- Chapter A.1, "Additional Basics on Remote Control", on page 505

12.1 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 SMA100B 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.
- **Factory preset values**
  Default parameter values that are reset only by factory preset.
- **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.

12.2 Programming Examples

The corresponding sections of the same title provide simple programming examples for the R&S SMA100B. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the examples as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (for example comments) start with two // characters.

At the beginning of the most remote control program, an instrument (p)reset is recommended to set the R&S SMA100B to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

In all the examples we assume that:

- A remote PC is connected to the instrument
- The remote PC and the instrument are switched on
- A connection between them is established
- The security setting "System Config > Setup > Security > SCPI over LAN" is enabled.

12.3 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>,<part number>/<serial number>,<firmware version>"

Example: `Rohde&Schwarz,SMA100B,1419.8888K02/0,4.00.033`

Usage: Query only

Manual operation: See "IDN String" on page 261

***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 "OPT String" on page 262

***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 Immediate x" on page 199

***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 192

***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 Immediate x" on page 198

***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

12.4 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 308). 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 310)
- Activating the preset state of all parameters that are not related to the signal path (`:DEVice:PRESet` on page 310)
- Activating the original state of delivery (factory reset, `:SYSTem:FPReset` on page 311). 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: `DEV:PRES`
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.

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 Table 9-1

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.

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 "Execute Factory Preset" on page 192

12.5 MMEMory Subsystem

The `MMEMory` subsystem (Mass MEMory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

Mass storage location

Without any additional measures, the R&S SMA100B stores user files on the internal memory, or if selected, on a memory stick.

Both, the user directory `/var/user` on the internal memory or the `/var/usb` directory, can be used to **preserve** user-defined data. Any directory structure can be created.

The `/var/volatile` directory serves as a RAM drive and can be used to protect sensitive information. The data is available **temporarily**.

If option R&S SMAB-B85 is installed, the R&S SMA100B maps the user directory to the removable memory. If a memory is mounted, user data is saved there. Otherwise user data is redirected to the volatile memory.

Default storage location

The R&S SMA100B stores user data in the user directory.

Depending on the installed options, the user directory is physically located on the internal memory or on the Removable memory.

In the file system, user directory is always indicated as **/var/user**.

In manual control, you access this directory via the "File Manager", see Chapter 9.8, "Using the File Manager", on page 203. In remote control, you can query it with the command :SYSTem:MMEMory:PATH:USER?.

To query and change the default directory used for mass storage, use the command :MMEMory:CDIRectory.

12.5.1 File Naming Conventions

To enable files to be used in different file systems, consider the following file naming conventions:

- The *filename* can be of any length and *is case-sensitive*, i.e it is distinguished between uppercase and lowercase letters.
- All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the filename).
- Avoid using special characters.
- Do not use slashes "\" and "/". These symbols are used in file paths.
- Avoid using the following filenames: CLOCK$, CON, COM1 to COM4, LPT1 to LPT3, NUL or PRN
  They are reserved by the operating system.

File extension

The file and the optional file *extension* are separated by a period sign. The R&S SMA100B distinguishes the files according to their extensions; each type of file is assigned a specific file content and hence a specific file extension. Refer to Chapter C, "Extensions for User Files", on page 534 for an overview of the supported file extensions.

Wildcards

The two characters "*" and "?" function as "wildcards", i.e. they are used for selecting several files. The "?" character represents exactly one character, while the "*" character represents all characters up to the end of the filename. "*.*" therefore represents all files in a directory.

Filename and file path

When used in remote control commands, the parameter <filename> is specified as a string parameter with quotation marks. It can contain either the complete path including the root user directory /var/user and filename, or only the filename. The filename must include the file extension. The same applies for the directory /var/volatile and for the parameters <directory_name> and <path>.

Depending on how much information is provided, the values specified in the parameter or with the command MMEM:CDIR are used for the path and drive setting in the commands.

12.5.2 Accessing Files in the Default or in a Specified Directory

For better overview and easy file handling, you may not save all user files in the user directory `/var/user` but rater organize them into subdirectories.

The command syntax defines two general ways to access files with user data in a *specific* directory:

- **Change the current default directory** for mass memory storage and then directly access the files in this default directory, like stored list files, files with user data or save/recall files.
  The subsequent commands for file handling (select, delete, read out files in the directory, etc.) require only specification of the filename. File extension can be omitted; after syntax evaluation of the used command, the R&S SMA100B filters out the relevant files.
- Define the **absolute file path**, including the user directory `/var/user`, created subdirectories and filename (see Example "Load file with user data from a specific directory" on page 313).
  As a rule, whenever an absolute file path is determined, it overwrites a previously specified default directory.

The following example explains this rule as a principle. Exceptions of this general rule are stated in the description of the corresponding command. The Chapter 12.5.3, "Programming Examples", on page 314 explains the general working principle with the commands for mass memory storage.

The same rule applies to the `/var/volatile` directory, see Example "Working with files in the volatile memory" on page 315.

Example: Load file with user data from a specific directory

This example shows the principle of file handling in remote environment by using list commands. Working with the files of other subsystems is analogical. We assume that the directory `/var/user/my_files` is existing and contains the files `list_test.lsw` and `list_2.lsw`.

```
//Query files in the user diectory
SOURce1:LIST:CATalog?
// -
// no files

// Set the default directory
MMEMory:CDIRectory "/var/user/my_files"
SOURce1:LIST:CATalog?
// "list_test","list_2"

// Specify the complete path to select a list file (*.lsw)
// in the specific directory
SOURce1:LIST:SELect "/var/user/my_files/list_test"
SOURce1:LIST:DELete "/var/user/my_files/list_2"
```

12.5.3 Programming Examples

Example: Storing and loading current settings

This example shows two ways of how to store the current instrument setting in the file `settings.savrcltxt` in the directory `/var/user/savrcl`.

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 then used in the `:MMEMory:STORe:STATe` command.

Also, after loading a file with instrument settings with command `:MMEMory:LOAD:STATe`, these settings have to be activated with the common command `*RCL <number>`.

```
// Store the current settings in an intermediate memory with number 4
*SAV 4

// store the settings in a file in a specific directory;
// the complete path has to be specyfied
MMEMory:STORe:STATe 4,"/var/user/savrcl/settings.savrcltxt"

// store the settings in a file in the default directory;
// set the default directory; specify only the file name
MMEMory:CDIRectory  "/var/user/savrcl"
*SAV 4
MMEMory:STORe:STATe 4,"settings.savrcltxt"

// Load the stored settings in the intermediate memory 4 and activate them
MMEMory:LOAD:STATe 4,"/var/user/settings.savrcltxt"
*RCL 4
```

Example: Working with files and directories

This example shows how to list files in a directory, list the subdirectories, query the number of files in a directory, create directory, rename and delete files.

```
// Query the current default directory for mass storage,
// change the directory to the default user directory "/var/user"
// and read out the files in it
MMEMory:CDIRectory?
// "/var/user/temp"
MMEMory:CDIRectory
MMEMory:CDIRectory?
// "/var/user/"
MMEMory:CATalog?
// 1282630,8102817792,".,DIR,4096","..,DIR,4096","Log,DIR,4096",
// "settings.savrcltxt,BIN,16949","temp,DIR,4096","test,DIR,4096",
// "list.lsw,BIN,1245201"
// the directory "/var/user" contains the predefined directory "Log",
```

```
// the subdirectories "test" and "temp"
// as well as the files "settings.savrcltxt" and "list.lsw"

// query only the subdirectories of the current or specified directory
MMEMory:DCATalog? "/var/user"
// ".","..","Log","temp","test"

// query only number of subdirectories in the current or specified directory
MMEMory:DCATalog:LENGth? "/var/user"
// 5

// query number of files in the current or specified directory
MMEMory:CATalog:LENGth? "/var/user"
// 7

// Create a new directory for mass memory storage in the specified directory
MMEMory:MDIRectory "/var/user/new"

// Copy the file "settings.savrcltxt" into the new directory
MMEMory:COPY "/var/user/settings.savrcltxt","/var/user/new/settings.savrcltxt"

// Rename the file "settings.savrcltxt" into the new directory
// and read out the files in this specific directory
MMEMory:CDIRectory  "/var/user/new"
MMEMory:MOVE "settings.savrcltxt","settings_new.savrcltxt"
MMEMory:CATalog? "/var/user/new"
// 25141,8102789120,".,DIR,4096","..,DIR,4096","settings_new.savrcltxt,BIN,16949"

// Delete the "test" directory
MMEMory:RDIRectory "/var/user/test"
```

Example: Working with files in the volatile memory

This example shows how to work with files in the `/var/volatile` directory.

```
// Change the default directory for mass storage,
// read out the files, load and play a file with the ARB
MMEMory:CDIRectory "/var/volatile"
MMEMory:CDIRectory?
// "/var/volatile"
MMEMory:CATalog?
//13928,525352960,".,DIR,60","..,DIR,4096","list.lst,BIN,9772"

:SOURce1:LIST:SELect "/var/volatile/list"
:SOURce1:FREQuency:MODE LIST
:OUTPut1:STATe 1
```

12.5.4 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.

Usage: Query only

Manual operation: See "Directory, File List and Filename" on page 197

: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.

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 '..' .

Usage: SCPI confirmed

Manual operation: See "Directory, File List and Filename" on page 197

: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.

Usage: Setting only
SCPI confirmed

Manual operation: See "Cut, Copy&Paste and Delete" on page 205

:MMEMory:DATA <Filename>, <BinaryBlock>
:MMEMory:DATA? <Filename>

The setting command writes the block data `<BinaryBlock>` to the file identified by `<Filename>`.

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.

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.

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.

Usage: Event

SCPI confirmed

Manual operation: See "Cut, Copy&Paste and Delete" on page 205

: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`.

Usage: Setting only

Manual operation: See "Recall" on page 198

: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.

Usage: Event

Manual operation: See "Create New Directory" on page 205

: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.

Usage: Event
SCPI confirmed

Manual operation: See "Rename " on page 205

: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.

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`.

Usage: Event

Manual operation: See "Save" on page 198

: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

12.6 CALibration Subsystem

The `CALibration` subsystem contains the commands needed for performing internal adjustments. This procedure is triggered by the query commands.

Suffix <hw>

Suffix	Value range	Description
`CALibration<hw>`	[1]	Optional suffix

Understanding the query response

- `0`: error-free execution of the adjustments
- `1`: indicates that an error occurred; the process has been canceled

:CALibration:ALL[:MEASure]? [<Force>]

Starts all internal adjustments that do not need external measuring equipment.

NOTICE: Risk of DUT damage

During level adjustments, the instrument temporarily applies high power at the RF output. This high power can destroy a connected DUT.

Do not start level adjustments if DUT is connected. Disconnect the DUT and replace it by a terminating resistor with adequate power rating. We recommend that you use a 50 Ohm, 10 W or larger terminating resistor.

Query parameters:

<Force> string

Return values:

<Measure> 0 | 1 | OFF | ON

Example:

```
CAL:ALL:MEAS?
//"0"
// Executes the adjustments of all instrument functions.
// When completed, it indicates that the adjustment
// has been performed successfully.
```

Usage: Query only

Manual operation: See "Adjust All" on page 492

:CALibration:DATA:FACTory:DATE?

Queries the date of the last factory calibration.

Return values:

<Date> string

Example:

```
CAL:DATA:FACT:DATE?
// "2016-01-01"
```

Usage: Query only

Manual operation: See "Last Factory Calibration" on page 495

:CALibration:ROSCillator[:DATA] <Data>

Sets a user-defined calibration value for the internal reference frequency.

Parameters:

<Data> integer

Range: 0 to INT_MAX
*RST: 0

Example: See [:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] on page 444.

:CALibration<hw>:CONTinueonerror <State>

Continues the calibration even though an error was detected. By default adjustments are aborted on error.

Suffix:

<hw> [1]
Optional suffix

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example:

```
CAL:CONT ON
// Continues calibration after an error
```

Manual operation: See "Continue Adjustment on Error" on page 493

:CALibration:CSYNthesis[:MEASure]?

Starts all adjustments which affect the clock synthesis.

Return values:

<Measure> 0 | 1 | OFF | ON

Example:

```
CALibration:CSYNthesis:MEASure?
// starts adjustment
// 0
// Adjustment successful
```

Usage: Query only

Options: R&S SMAB-B29

:CALibration:LEVel:BWIDth <Bandwidth>

Parameters:

<Bandwidth> LOW | HIGH | AUTO

*RST: AUTO

:CALibration:LFOutput[:MEASure]?

Performs all adjustments which affect the internal modulation generator.

Return values:

<Measure>	0 | 1 | OFF | ON

Example:	`CAL:LFO?`
	`// 0`
	`// the adjustments have been performed successfully`

Usage:	Query only

:CALibration<hw>:ALL:DATE?

Queries the date of the most recently executed full adjustment.

Suffix:

<hw>	[1] Optional suffix

Return values:

<Date>	string
Example:	`CAL:ALL:DATE?` `// "2016-01-01"`
Usage:	Query only
Manual operation:	See "Last Full Adjustment" on page 492

:CALibration<hw>:ALL:TEMP?

Queries the temperature deviation compared to the calibration temperature.

Suffix:

<hw>	[1] Optional suffix

Return values:

<Temperature>	string
Example:	`CALibration:ALL:TEMP?` `// "+39.00 K"`
Usage:	Query only
Manual operation:	See "Temperature Offset To Last Full Adjustment" on page 492

:CALibration<hw>:DEBug <State>

Activates logging of the internal adjustments.

Suffix:
<hw> [1]
Optional suffix

Setting parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `CALibration:DEBug 1`

Usage: Setting only

:CALibration<hw>:FMOFfset[:MEASure]?

Starts adjustment of the FM/PhiM modulator.

Suffix:
<hw> [1]
Optional suffix

Return values:
<Measure> 0 | 1 | OFF | ON

Example:
```
CALibration:FMOFfset:MEASure?
// starts adjustment
// 0
// Adjustment successful
```

Usage: Query only

Options: R&S SMAB-K720

:CALibration<hw>:FREQuency[:MEASure]?

Performs all adjustments which affect the frequency.

Suffix:
<hw> [1]
Optional suffix

Return values:
<Measure> 0 | 1 | OFF | ON

Example:
```
// Start adjustments for maximum frequency accuracy
CALibration:FREQuency:MEASure?
// 0
// Adjustments are performed successfully
```

Usage: Query only

: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 but customer data can also be used.

You can obtain data for external level correction by using a R&S NRP power sensor. External level correction is a protected function.

For more information, see R&S SMA100B Service Manual.

Suffix:
<hw> [1]
Optional suffix

Parameters:
<Data> FACTory | CUSTomer
*RST: FACTory

Example:
```
CALibration:LEVel:EXTern:DATA FACT
// level calibration with data aquired at the factory
CALibration:LEVel:EXTern:EXEC
```

:CALibration<hw>:LEVel:EXTern:EXEC

Starts level calibaration from the data selected with the command `:CALibration<hw>:LEVel:EXTern:DATA`.

Suffix:
<hw> [1]
Optional suffix

Example: See `:CALibration<hw>:LEVel:EXTern:DATA` on page 325.

Usage: Event

:CALibration<hw>:LEVel:STATe <State>

Activates internal level correction.

Suffix:
<hw> [1]
Optional suffix

Parameters:
<State> OFF | ON | 0 | 1
*RST: ON

Example:
```
CALibration:LEVel:STATe 1
```

: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.

Suffix:

<hw> [1]
Optional suffix

Query parameters:

<Force> "force"
*RST: force

Return values:

<Measure> 0 | 1

Example:

```
// Start adjustments for maximum level accuracy
CALibration:LEVel:MEASure?"force"
// 0
// Adjustments are performed successfully
```

Usage: Query only

12.7 CSYNthesis Subsystem

This subsystem contains the commands used to define the frequency settings for the separate clock source (clock synthesis).

Option: see "Required options" on page 183.

Example:

```
CSYNthesis:OTYPe DSIN
CSYNthesis:FREQuency 10000000
CSYNthesis:POWer -15
CSYNthesis:OFFSet:STATe 1
CSYNthesis:OFFSet 0.1
CSYNthesis:PHASe 180
CSYNthesis:PHASe:REFerence
CSYNthesis:PHASe?
// 0
CSYNthesis:FREQuency:STEP:MODE DEC
CSYNthesis:POWer:STEP:MODE DEC
// CSYNthesis:FREQuency:STEP:MODE USER
// CSYNthesis:FREQuency:STEP 1000
// CSYNthesis:FREQuency UP
// 10001000
// CSYNthesis:POWer:STEP:MODE USER
// CSYNthesis:POWer:STEP:INCRement 0.5
CSYNthesis:STATe 1
```

:CSYNthesis:STATe <State>

Activates the clock synthesis.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See " State " on page 184

:CSYNthesis:OTYPe <Mode>

Defines the shape of the generated clock signal.

Parameters:

<Mode> SESine | DSQuare | CMOS | DSINe

`SESine` = single-ended sine
`DSINe` = differential sine
`DSQuare` = differential square
`CMOS` = CMOS

*RST: SESine

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See "Output Type" on page 184

:CSYNthesis:FREQuency <Frequency>

Sets the frequency of the generated clock signal.

Parameters:

<Frequency> float

Numerical value
Sets the frequency

UP|DOWN
Varies the frequency step by step.
The frequency is increased or decreased by the value set with the command `:CSYNthesis:FREQuency:STEP`.

Range: 100E3 to 1.5E9
Increment: 0.001
*RST: 10E6

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See " Frequency " on page 185

:CSYNthesis:POWer <Power>

Sets the power level of the generated clock signal.

Parameters:

<Power> float

Numerical value
Sets the level

UP|DOWN
Varies the level step by step.
The level is increased or decreased by the value set with the command `:CSYNthesis:POWer:STEP[:INCRement]`.

Range: -24 to 10
Increment: 0.01
*RST: -20

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See " Level " on page 185

:CSYNthesis:OFFSet:STATe <State>

Activates a DC offset.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See " DC Offset State " on page 185

:CSYNthesis:OFFSet <Offset>

Sets the value of the DC offset.

Parameters:

<Offset>	float Range: -5 to 5 Increment: 0.001 *RST: 0

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See " DC Offset " on page 186

:CSYNthesis:VOLTage <Voltage>

Sets the voltage for the CMOS signal.

Parameters:

<Voltage>	float Range: 0.8 to 2.7 Increment: 0.001 *RST: 1.8

Example:

```
CSYNthesis:OTYPe CMOS
CSYNthesis:VOLTage 1.8
CSYNthesis:FREQuency 100000000
CSYNthesis:STATe 1
```

Manual operation: See "Voltage" on page 186

:CSYNthesis:PHASe <Phase>

Shifts the phase of the generated clock signal.

Parameters:

<Phase>	float Range: -36000 to 36000 Increment: 0.1 *RST: 0

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See "Delta Phase" on page 186

:CSYNthesis:PHASe:REFerence

Resets the delta phase value.

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Usage: Event

:CSYNthesis:POWer:STEP:MODE <Mode>
:CSYNthesis:FREQuency:STEP:MODE <Mode>

Defines the type of step size to vary the frequency and level at discrete steps.

Parameters:

<Mode> DECimal | USER

DECimal
Increases or decreases the level in steps of 10.

USER
Increases or decreases the value in increments, set with the command:
`:CSYNthesis:FREQuency:STEP`
`:CSYNthesis:POWer:STEP[:INCRement]`

*RST: DECimal

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See "Variation Active" on page 186

:CSYNthesis:POWer:STEP[:INCRement] <Increment>

Sets the step width of the rotary knob and, in user-defined step mode, increases or decreases the level.

Parameters:

<Increment> float

Range: 0 to 35
Increment: 0.01
*RST: 1

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See "Variation Step" on page 186

:CSYNthesis:FREQuency:STEP <Step>

Sets the step width of the rotary knob and, in user-defined step mode, increases or decreases the frequency.

Parameters:

<Step> float

Range: 0 to 14999E5
Increment: 0.001
*RST: 1E6

Example: See Chapter 12.7, "CSYNthesis Subsystem", on page 327.

Manual operation: See "Variation Step" on page 186

12.8 DIAGnostic Subsystem

The `DIAGnostic` subsystem 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 affected by `*RST`.

The test functions are intended for services purposes.

They are thus password-protected functions. Unlock the corresponding protection level to access them, see `:SYSTem:PROTect<ch>[:STATe]`

For more information, see R&S SMA100B Service Manual.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
DIAGnostic<hw>	[1]	Optional suffix

Example: Programming example

The example lists the commands required to query assemblies and test points for diagnosis purposes.

```
// Query the modules available in the instrument
// and variant and revision state of a certain assembly
DIAGnostic1:BGINfo:CATalog?
// FRONT_AF,PSU300,IFB.BV,MB2_AF,...
DIAGnostic1:BGINfo? "PSU300"
// PSU300 2118.2067.02 01.00 100000

// Query the test points available in the instrument
// and trigger the measurement in a selected test point
DIAGnostic1:POINt:CATalog?
// ATT6HP_AF_DET_N,ATT6HP_AF_DET_P,ATT6HP_AF_DET_TEMP...
DIAGnostic1:MEASure:POINt? "ATT6HP_AF_DET_N"
//  0.000000V
```


:DIAGnostic<hw>:BGINfo:CATalog?

Queries the names of the assemblies available in the instrument.

Return values:

<Catalog> string

List of all assemblies; the values are separated by commas
The length of the list is variable and depends on the instrument equipment configuration.

Example: See Example "Programming example" on page 332.

Usage: Query only

:DIAGnostic<hw>:BGINfo? [<Board>]

Queries information on the modules available in the instrument, using the variant and revision state.

Query parameters:

<Board> string

Module name, as queried with the command `:DIAGnostic<hw>:BGINfo:CATalog?`.
To retrieve a complete list of all modules, omit the parameter.
The length of the list is variable and depends on the instrument equipment configuration.

Return values:

<BgInfo> <Module name> <Module stock number incl. variant> <Module revision> <Module serial number>

List of comma-separated entries, one entry per module.
Each entry for one module consists of four parts that are separated by space characters.

Example: See Example "Programming example" on page 332.

Usage: Query only

Manual operation: See "Assembly" on page 494

:DIAGnostic<hw>:POINt:CATalog?

Queries the test points available in the instrument.

For more information, see R&S SMA100B Service Manual.

Return values:

<Catalog> string

List of comma-separated values, each representing a test point

Example: See Example "Programming example" on page 332.

Usage: Query only

:DIAGnostic<hw>[:MEASure]:POINt? <Name>

Triggers the voltage measurement at the specified test point and returns the measured voltage.

For more information, see R&S SMA100B Service Manual.

Query parameters:

<Name> <test point identifier>

Test point name, as queried with the command `:DIAGnostic<hw>:POINt:CATalog?`

Return values:

<Value> <value><unit>

Example: See Example "Programming example" on page 332.

Usage: Query only

12.9 DISPlay Subsystem

The `DISPlay` system contains the commands to set the power-save mode of the instrument.

Programming Examples

Example: Activating screen saver mode and display update

Use the following commands to switch on the screen saver of your instrument or to automatic display. These settings are particularly useful when you control the instrument remotely.

```
// Set the wait time interval and activate the screen saver
:DISPlay:PSAVe:HOLDoff 10
:DISPlay:PSAVe:STATe ON

// Disable the display of the current frequency and level values in remote control
:DISPlay:ANNotation:ALL ON
// :DISPlay:ANNotation:FREQuency ON
// :DISPlay:ANNotation:AMPLitude ON

// Enable automatic update of the display at defined time intervals
:DISPlay:UPDate ON
```

Example: Querying the dialog IDs, opening and closing dialogs

Use the following commands to query the dialog IDs of all currently open dialogs. The dialog ID is a prerequisite for opening and closing dialogs via the remote control.

The dialog ID is also required to define user key actions.
See Chapter 10.2.3, "Assigning Actions to the User Key", on page 225.

```
// Query the dialog IDs of all open dialogs
:DISPlay:DIALog:ID?
// CEUtraDLGenSetDlg,_,$A DlgKeyRf_Rosc

// Open and close dialogs via remote control
:DISPlay:DIALog:OPEN "CEUtraDLGenSetDlg,_,$A"
:DISPlay:DIALog:OPEN "DlgKeyRf_Rosc"
:DISPlay:DIALog:CLOSe "DlgKeyRf_Rosc"
:DISPlay:DIALog:CLOSe:ALL
```


:DISPlay:PSAVe:HOLDoff <HoldoffTimeMin>

Sets the wait time for the screen saver mode of the display.

Parameters:

<HoldoffTimeMin> integer

Range: 1 to 60
*RST: n.a. (factory preset: 10)
Default unit: minute

Example: see Example "Activating screen saver mode and display update" on page 334

Manual operation: See "Wait Time" on page 218

:DISPlay:PSAVe[:STATe] <State>

Activates the screen saver mode of the display.

We recommend that you use this mode to protect the display, if you operate the instrument in remote control.

To define the wait time, use the command `:DISPlay:PSAVe:HOLDoff`.

Parameters:

<State>	0 | 1 | OFF | ON *RST: n.a. (factory preset: 0)
Example:	See Example "Activating screen saver mode and display update" on page 334
Manual operation:	See "Screen Saver" on page 218

:DISPlay:BRIGhtness <BRIGhtness>

Sets the brightness of the dispaly.

Parameters:

<BRIGhtness>	float Range: 1.0 to 20.0 Increment: 1.0 *RST: 14.0
Example:	`DISPlay:BRIGhtness 14`
Manual operation:	See "Display" on page 219

:DISPlay:BUTTon:BRIGhtness <ButtonBrightnes>

Sets the brightness of the RF ON/OFF key.

Parameters:

<ButtonBrightnes>	integer Range: 1 to 20 *RST: n.a. (no preset)
Example:	`DISPlay:BUTTon:BRIGhtness 15`
Manual operation:	See "RF Hardkey" on page 219

:DISPlay:UPDate <Update>

Activates the refresh mode of the display.

Parameters:

<Update>	0 | 1 | OFF | ON *RST: n.a. (factory preset: 1)
Example:	See Example "Activating screen saver mode and display update" on page 334
Manual operation:	See "Display Update is" on page 220

:DISPlay:ANNotation:AMPLitude <State>

Indicates asterisks instead of the level values in the status bar.

Parameters:

<State>	0 | 1 | OFF | ON
	*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 334

Manual operation: See "Annotation Amplitude" on page 234

:DISPlay:ANNotation:FREQuency <State>

Indicates asterisks instead of the frequency values in the status bar.

Parameters:

<State>	0 | 1 | OFF | ON
	*RST: n.a. (factory preset: 1)

Example: See Example "Activating screen saver mode and display update" on page 334

Manual operation: See "Annotation Frequency" on page 234

:DISPlay:ANNotation[:ALL] <State>

Displays asterisks instead of the level and frequency values in the status bar of the instrument.

We recommend that you use this mode if you operate the instrument in remote control.

Parameters:

<State>	0 | 1 | OFF | ON
	*RST: 1

Example: See Example "Activating screen saver mode and display update" on page 334

:DISPlay:DIALog:ID?

Returns the dialog identifiers of the open dialogs in a string separated by blanks.

Return values:

<DialogIdList> <DialogID#1>< ><DialogID#2>< > ... < ><DialogID#n>

Dialog identifiers are string without blanks. Blanks are represented as `$$`.

Dialog identifiers `<DialogID>` are composed of two main parts: `<DialogName>[<OptionalParts>]`

<DialogName>

Meaningful information, mandatory input parameter for the commands:

`:DISPlay:DIALog:OPEN` on page 338

`:DISPlay:DIALog:CLOSe` on page 338

<Optional parts>

String of `$<X>` values, where `<X>` is a character, interpreted as follows:

`$q<DialogQualifier>`: optional dialog qualifier, usually the letter `A` or `B`, as displayed in the dialog title.

`$i<Instances>`: comma-separated list of instance indexes, given in the order `h,c,s,d,g,u,0`. Default is zero; the terminating `",0"` can be omitted.

`$t<TabIds>`: comma-separated indexes or tab names; required, if a dialog is composed of several tabs.

`$x<Left>$y<Top>$h<Left>$w<Top>`: position and size; superfluous information.

Example: See Example "Querying the dialog IDs, opening and closing dialogs" on page 334

Usage: Query only

Manual operation: See "SCPI" on page 225

:DISPlay:DIALog:OPEN <DialogId>

Opens the specified dialog.

Setting parameters:

<DialogId> string

To find out the dialog identifier, use the query `:DISPlay:DIALog:ID?`.

The `<DialogName>` part of the query result is mandatory.

Example: See Example "Querying the dialog IDs, opening and closing dialogs" on page 334

Usage: Setting only

Manual operation: See "SCPI" on page 225

:DISPlay:DIALog:CLOSe <DialogId>

Closes the specified dialog.

Setting parameters:

<DialogId> string

To find out the dialog identifier, use the query :DISPlay:DIALog:ID?.
The <DialogName> part of the query result is sufficient.

Example: See Example "Querying the dialog IDs, opening and closing dialogs" on page 334

Usage: Setting only

:DISPlay:DIALog:CLOSe:ALL

Closes all open dialogs.

Example: See Example "Querying the dialog IDs, opening and closing dialogs" on page 334

Usage: Event

12.10 FORMat Subsystem

The commands in the FORMat subsystem determine the format of data returned by the R&S SMA100B to the controller. This affects all query commands that return a list of numerical data or block data, noted in the descriptions of the commands. The set data format applies to both paths.

: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
Expects/sends the *least* significant byte of each IEEE754 floating-point number first and the *most* significant byte last.

SWAPped
Expects/sends the *most* significant byte of each IEEE754 floating-point number first and the *least* significant byte last.

*RST: NORMal

Example: FORM:BORD SWAP
transfers the data with the most significant bit first.

:FORMat:SREGister <Format>

Determines the numeric format for responses of the status register.

Parameters:

<Format> ASCii | BINary | HEXadecimal | OCTal

ASCii
Returns the register content as a decimal number.

BINary|HEXadecimal|OCTal
Returns the register content either as a binary, hexadecimal or octal number. According to the selected format, the number starts with #B (binary), #H (hexadecimal) or #O (octal).

*RST: ASCii

Example: `FORM:SREG HEX`
returns the register content as a hexadecimal number.

:FORMat[:DATA] <Data>

Determines the data format the instrument uses to return data via the IEC/IEEE bus.

The instrument automatically detects the data format used by the controller, and assigns it accordingly. Data format determined by this SCPI command is in this case irrelevant.

Parameters:

<Data> ASCii | PACKed

ASCii
Transfers numerical data as plain text separated by commas.

PACKed
Transfers numerical data 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`
transfers the data as ASCII data.

12.11 HCOPy Subsystem

The `HCOPy` subsystem contains the commands to generate and save a hard copy of the display.

To access a stored hard copy file, use the commands of the `MEMM` subsystem.

12.11.1 Programming Examples

Example: Store a hard copy of the display

The following example lists commands to configure and execute a hard copy to an automatic named file.

```
// ******************************************************************
// Hard copy settings
// ******************************************************************
:HCOPy:DEVice:LANGuage PNG
:HCOPy:FILE:NAME:AUTO:STATe 1
// defines the output format
// sets the instrument to automatically create output file names

// ******************************************************************
// Configure hard copy options, set automatic naming rules
// An automatically generated file name consists of:
// <Prefix><YYYY><MM><DD><Number>.<Format>
// ******************************************************************
:HCOPy:DEVice:LANGuage BMP
// defines output format *.bmp
:HCOPy:REGion DIALog
// selects the region to be copied
:HCOPy:FILE:AUTO:DIR "usb/HCopy"
// sets destination directory of automatic named file to "/usb/HCopy"
:HCOPy:FILE:NAME:AUTO:FILE:PREFix:STATe 1
:HCOPy:FILE:NAME:AUTO:FILE:PREFix:"hardcopy"
:HCOPy:FILE:NAME:AUTO:FILE:YEAR:STATe 1
:HCOPy:FILE:NAME:AUTO:FILE:MONTh:STATe 1
// uses automatic naming prefix
// sets automatic naming prefix to "hardcopy"
// uses automatic naming date parameters year and month

// ******************************************************************
// Execute and transfer the hard copy
// ******************************************************************
:HCOPy:EXECute
:HCOPy:DATA
// generates a hard copy
// transfers the hard copy to the remote client
:HCOPy:FILE:AUTO:FILE?
// queries the automatic file name
// response: "hardcopy1607001.bmp"
:HCOPy:FILE:AUTO:NUMBer?
// queries the number in the automatic file name
// response: "001"
:HCOPy:FILE:AUTO?
```

```
// queries the path and file name of the automatically generated file
// response: "/usb/HCopy/hardcopy1607001.bmp"
```

12.11.2 Hard Copy Settings

With the following commands, you can configure the settings of a hard copy.

:HCOPy:DATA?

Transfers the hard copy data directly as a NByte stream to the remote client.

Return values:
<Data> block data

Example: See Example "Store a hard copy of the display" on page 341

Usage: Query only

:HCOPy:IMAGe:FORMat <Format>
:HCOPy:DEVice:LANGuage <Language>

Selects the graphic format for the hard copy. You can use both commands alternatively.

Parameters:
<Language> BMP | JPG | XPM | PNG
*RST: PNG

Example: See Example "Store a hard copy of the display" on page 341

Manual operation: See "Format" on page 212

:HCOPy:REGion <Region>

Selects the area to be copied.

You can create a snapshot of the screen or an active dialog.

Parameters:
<Region> ALL | DIALog
*RST: ALL

Example: See Example "Store a hard copy of the display" on page 341

Manual operation: See "Region" on page 213

:HCOPy:FILE[:NAME] <Name>

Determines the file name and path to save the hard copy, provided automatic naming is disabled.

Note: If you have enabled automatic naming, the instrument automatically generates the file name and directory, see Chapter 12.11.3, "Automatic Naming", on page 343.

Parameters:

<Name> string

Example: See Example "Store a hard copy of the display" on page 341

Manual operation: See "File..." on page 212

:HCOPy[:EXECute]

Generates a hard copy of the current display. The output destination is a file.

Example: See Example "Store a hard copy of the display" on page 341

Usage: Event

Manual operation: See "Save" on page 212

12.11.3 Automatic Naming

Use the following commands to automatically assign a file name.

:HCOPy:FILE[:NAME]:AUTO?

Queries path and file name of the hardcopy file, if you have enabled *Automatic Naming*.

Return values:

<Auto> string

Example: See Example "Store a hard copy of the display" on page 341

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

Determines the path to save the hard copy, if you have enabled *Automatic Naming*.

If the directory does not yet exist, the instrument automatically creates a new directory, using the instrument name and `/var/user/` by default.

Parameters:

<Directory>	string *RST: /var/user/
Example:	See Example "Store a hard copy of the display" on page 341
Manual operation:	See "Path..." on page 214

:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

Deletes all files with extensions `*.bmp`, `*.jpg`, `*.png` and `*.xpm` in the directory set for automatic naming.

Example:	See Example "Store a hard copy of the display" on page 341
Usage:	Event
Manual operation:	See "Clear Path" on page 214

:HCOPy:FILE[:NAME]:AUTO:FILE?

Queries the name of the automatically named hard copy file.

An automatically generated file name consists of:

<Prefix><YYYY><MM><DD><Number>.<Format>.

You can activate each component separately, to individually design the file name.

Return values:

<File>	string
Example:	See Example "Store a hard copy of the display" on page 341.
Usage:	Query only

:HCOPy:FILE[:NAME]:AUTO:STATe <State>

Activates automatic naming of the hard copy files.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 1
Example:	See Example "Store a hard copy of the display" on page 341
Manual operation:	See "Automatic Naming" on page 213

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

Uses the date parameters (year, month or day) for the automatic naming. You can activate each of the date parameters separately.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 1
Example:	See Example "Store a hard copy of the display" on page 341
Manual operation:	See "Prefix, Year, Month, Day" on page 214

:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

Queries the number that is used as part of the file name for the next hard copy in automatic mode.

At the beginning, the count starts at 0. The R&S SMA100B searches the specified output directory for the highest number in the stored files. It increases this number by one to achieve a unique name for the new file.

The resulting auto number is appended to the resulting file name with at least three digits.

Return values:

<Number>	integer Range: 0 to 999999 *RST: 0
Example:	See Example "Store a hard copy of the display" on page 341
Usage:	Query only
Manual operation:	See "Current Auto Number" on page 215

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>
:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

Uses the prefix for the automatic generation of the file name, provided `PREF:STAT` is activated.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 1
Example:	See Example "Store a hard copy of the display" on page 341
Manual operation:	See "Prefix, Year, Month, Day" on page 214

12.12 KBOard Subsystem

The `KBOard` subsystem contains the commands to set a connected keyboard.

:KBOard:LAYout <Layout>

Selects the language for an external keyboard and assigns the keys acccordingly.

Parameters:

<Layout> CHINese | DANish | DUTCh | DUTBe | ENGLish | ENGUK | FINNish | FRENch | FREBe | FRECa | GERMan | ITALian | JAPanese | KORean | NORWegian | PORTuguese | RUSSian | SPANish | SWEDish | ENGUS

*RST: n.a. (factory preset: ENGLish)

Example:
```
:KBOard:LAYout US
// activates American keyboard
```

Manual operation: See "USB Keyboard > Layout" on page 219

12.13 OUTPut Subsystem

In the `OUTPut` subsystem, you can configure the output signals.

The LF output signal is defined with the commands of the Chapter 12.15.5, "SOURce:LFOutput Subsystem", on page 400 system.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`OUTPut<hw>`	[1]	Optional suffix

:OUTPut:ALL[:STATe] <State>

Activates all RF output signals of the instrument.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: `OUTP:ALL OFF`

switches off all RF output signals.

:OUTPut<hw>[:STATe] <State>

Activates the RF output signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `OUTP ON`

Activates the RF output.

Manual operation: See "RF State/RF ON" on page 63

:OUTPut<hw>[:STATe]:PON <Pon>

Defines the state of the RF output signal when the instrument is switched on.

Parameters:

<Pon> OFF | UNCHanged

*RST: n.a. (factory preset: UNCHanged)

Example: `OUTP:PON OFF`

The RF output is deactivated when the instrument is switched on.

Manual operation: See " Power-On State " on page 221

:OUTPut<hw>:AMODe <AMode>

Sets the attenuator mode at the RF output.

Parameters:

<AMode> AUTO | FIXed

AUTO
The attenuator adjusts the level settings automatically, within the full variation range.

FIXed
The attenuator and amplifier stages are fixed at the current position, providing level settings settings with constant output VSWR. The resulting variation range is calculated according to the position.

*RST: AUTO

Example:
```
SOURce:POWer:ALC:STATe 1
OUTPut:AMODe FIXed
```

Manual operation: See " Mode " on page 144

:OUTPut<hw>:IMPedance?

Queries the impedance of the RF outputs.

Return values:

<Impedance> G1K | G50 | G10K

*RST: G50

Example: `OUTP:IMP?`
queries the impedance of RF output.
`Response: 50`
the impedance is 50 ohms

Usage: Query only

Manual operation: See "RF output impedance" on page 63

:OUTPut<hw>:AFIXed:RANGe:LOWer?
:OUTPut<hw>:AFIXed:RANGe:UPPer?

Queries the settable minimum/maximum value in mode `:OUTPut:AMODe FIXed`, i.e. when the attenuator is not being adjusted.

See `:OUTPut<hw>:AMODe` on page 347

Return values:

<Upper> float

Increment: 0.01
Default unit: dBm

Example:
```
OUTPut1:AMODe FIXed
OUTPut1:AFIXed:RANGe:UPPer?
// -27
OUTPut1:AFIXed:RANGe:LOW?
// -50
```

Usage: Query only

Manual operation: See " Attenuator Level Range " on page 145

:OUTPut<hw>:PROTection:CLEar

Resets the protective circuit after it has been tripped.

To define the output state, use the command `:OUTPut<hw>[:STATe]`.

Example: `OUTP:PROT:CLE`
Resets the protective circuit of the RF output.

Usage: Event

Manual operation: See "Overload" on page 145

: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 of the RF output.
`Response: 0`
the protective circuit has not tripped.

Usage: Query only

Manual operation: See "Overload" on page 145

:OUTPut<hw>:FILTer:MODE <Mode>

Activates low harmonic filter or enables its automatic switching.

Parameters:

<Mode> ON | AUTO | 1

ON|1
Ensures best low harmonics performance but decreases the level range

AUTO
Applies an automatically selected harmonic filter that fits to the current level setting.

*RST: AUTO

Example: `OUTPut:FILTer:MODE AUTO`

Manual operation: See " Harmonic Filter " on page 71

12.14 SENSe, READ, INITiate and SLISt Subsystems

These subsystems contain the commands for configuring the power measurements with R&S NRP power sensor connected to the R&S SMA100B.

The local state is set with the `INIT` command. Switching off the local state enhances the measurement performance. Measurements results can be retrieved in local state on or off.

Sensor parameters are set with the `SENSe` commands.

To start the measurement and retrieve the result, use the `:READ<ch>[:POWer]?` command.

Suffix	Value range	Description
`SENSe<ch>`	[1] to 4	Indicates the sensor Default sensor mapping: ● `SENSe[1]` - sensor connected to the SENSORconnector ● `SENSe2` - sensor connected to a USB connector ● `SENSe3|4` - further connected sensors to USB connectors, in the connection order Use the `:SLISt` commands to change the sensor mapping

Programming examples

Example: Detecting and assigning a power sensor

```
SLISt:LIST?
// Response: "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy"
// list of automatically detected sensors

SLISt:SCAN:STATe 1
// searches for sensors connected in the LAN or via the USBTMC protocol

SLISt:LIST?
// Response:
// "NRP33SN-V-900007-USB Legacy","NRP-Z211-900001-USB Legacy",
// "NRP33SN-V-900005-USBTMC","NRP33SN-V-900011-LAN"
// the list contains more entries

SLISt:ELEMent3:MAPPing SENS1
// maps the third sensor from the list to the first sensor channel
```

Example: Performing a simple power measurement

Prerequisite: The sensor is connected to the instrument and mapped to the first sensor channel.

```
:INITiate1:CONTinuous ON
//Switches the continous power measurement on

:READ1?
// Triggers the measurement and displays the results
```

Example: Performing a power measurement with a fixed filter

Prerequisite: The sensor is connected to the instrument and mapped to the first sensor channel.

```
SENSe1:SOURce RF
//Sensor measures the power of the RF signal

SENSe1:FILTer:TYPE NSRatio
//Selects fixed noise filter mode

SENSe1:FILTer:NSRatio 0.02 DB
//Sets the maximum noise component in the result to 0.02 DB

SENSe1:FILTer:NSRatio:MTIMe 10
//Limits the settling time to 10 seconds.

:SENSe1:APERture:DEFault:STATe 0
// Deactivates the default aperture time of the sensor

:SENSe1:APERture:TIMe 10e-6
// Sets the aperture time to 10 us

SENSe1:UNIT DBM
//Selects unit dBm for the measured value

:INITiate:CONTinuous ON
//Switches the continous power measurement on

:READ?
//Triggers the measurement and displays the results
```

:SLISt[:LIST]?

Returns a list of all detected sensors in a comma-separated string.

Return values:

<SensorList> String of comma-separated entries

Each entry contains information on the sensor type, serial number and interface.
The order of the entries does not correspond to the order the sensors are displayed in the "NRP Sensor Mapping" dialog.

Example: See Example "Detecting and assigning a power sensor" on page 350.

Usage: Query only

Manual operation: See " Sensor Mapping List " on page 160

:SLISt:SCAN[:STATe] <State>

Starts the search for R&S NRP power sensors, connected in the LAN or via the USBTMC protocol.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Detecting and assigning a power sensor" on page 350.

Manual operation: See " Scan " on page 161

:SLISt:ELEMent<ch>:MAPPing <Mapping>

Assigns an entry from the `:SLISt[:LIST]?` to one of the four sensor channels.

Parameters:

<Mapping> SENS1 | SENSor1 | SENS2 | SENSor2 | SENS3 | SENSor3 | SENS4 | SENSor4 | UNMapped

Sensor channel.

*RST: UNMapped

Example: See Example "Detecting and assigning a power sensor" on page 350.

Manual operation: See " Sensor Mapping List " on page 160

:INITiate<ch>[:POWer]:CONTinuous <Continuous>

Switches the local state of the continuous power measurement by R&S NRP power sensors on and off. Switching off local state enhances the measurement performance during remote control.

The remote measurement is triggered with `:READ<ch>[:POWer]?`). This command also returns the measurement results. The local state is not affected, measurement results can be retrieved with local state on or off.

Parameters:

<Continuous> 0 | 1 | OFF | ON

*RST: 0

Example: `INIT1:CONT ON`

Switches local state of continuous power measurement on.

Manual operation: See " State " on page 165

:READ<ch>[:POWer]?

Triggers power measurement and displays the results. The sensor returns the result in the unit set with command `:SENSe<ch>:UNIT[:POWer]`

Certain power sensors, such as the R&S NRP-Z81, return two values, first the value of the average level and - separated by a comma - the peak value.

Note: This command does not affect the local state, i.e. you can get results with local state on or off. For long measurement times, we recommend that you use an SRQ for command synchronization (MAV bit).

Suffix:

<ch> 1..3

Return values:

<Power> float or float,float

Example: `SENS1:UNIT DBM`
Selects unit dBm for presentation of measurement result.
`READ1?`
Queries the measurement result of the sensor.
`Response: -45.6246576745440230`
-45.6 dBm were measured at the given frequency.

Example: R&S NRP-Z81
`READ1?`
`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) / Level (Average) " on page 164

:SENSe<ch>:UNIT[:POWer] <Power>

Selects the unit (Watt, dBm or dBµV) of measurement result display, queried with `:READ<ch>[:POWer]?`.

Parameters:

<Power> DBM | DBUV | WATT

*RST: DBM

Example: `SENS2:UNIT DBM`
Selects dBm as unit for the measured value returned by command `READ`.
`READ2?`
`Response: 7.34`
7.34 dBm are measured by sensor 2.

Manual operation: See " Level (Peak) / Level (Average) " on page 164

: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 355.

Parameters:

<UseDefAp> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Performing a power measurement with a fixed filter" on page 351.

Manual operation: See "Default Aperture Time" on page 167

: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: See Example "Performing a power measurement with a fixed filter" on page 351.

Manual operation: See "Aperture Time" on page 167

:SENSe<ch>[:POWer]:CORRection:SPDevice:SELect <Select>

Several S-parameter tables can be stored in a sensor. The command selects a loaded data set for S-parameter correction for the corresponding sensor.

Parameters:

<Select> float

*RST: 0

Manual operation: See " S-Parameter " on page 167

:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe <State>

Activates the use of the S-parameter correction data.

Note: If you use power sensors with attenuator, the instrument automatically activates the use of S-parameter data.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example:

```
SENSe1:POWer:CORRection:SPDevice:STATe 1
// activates the use of the S-parameters correction data
```

Manual operation: See " S-Parameter " on page 167

:SENSe<ch>[:POWer]:CORRection:SPDevice:LIST?

Queries the list of the S-parameter data sets that have been loaded to the power sensor.

Return values:

<List> string list

*RST: 0

Usage: Query only

Manual operation: See " S-Parameter " on page 167

:SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority <Priority>

Selects average or peak power for permanent display.

Parameters:

<Priority> AVERage | PEAK

*RST: AVERage

Example: `SENS1:DISP:PERM:STAT ON`
The permanent viewer is switched on.
`SENS1:DISP:PERM:PRI AVER`
The measured average power is indicated.

Manual operation: See " Display " on page 165

:SENSe<ch>[:POWer]:DISPlay:PERManent:STATe <State>

Activates the permanent display of the measured power level results. The instrument also indicates the sensor type, the connection, the measurement source and the offset if set.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SENS1:POW:DISP:PERM:STAT ON`
The permanent viewer is switched on.

Manual operation: See " Permanent " on page 165

:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?

Queries the current filter length in filter mode `AUTO` (`:SENSe<ch>[:POWer]:FILTer:TYPE`)

Return values:

<Auto> float

Range: 1 to 65536

Example: `SENS1:FILT:TYPE AUTO`
Selects auto filter.
`SENS1:FILT:LENG:AUTO?`
Queries the automatically set filter length.
`Response: 1024`

Usage: Query only

Manual operation: See "Filter Length" on page 166

:SENSe<ch>[:POWer]:FILTer:LENGth[:USER] <User>

Selects the filter length for SENS:POW:FILT:TYPE USER. As the filter length works as a multiplier for the time window, a constant filter length results in a constant measurement time. You can set values 1 and 2^n.

The time window is fixed to 20 ms.

Parameters:

<User> float

Range: 1 to 65536
*RST: 1

Example: `SENS1:FILT:TYPE USER`
Selects user filter mode.
`SENS1: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 166

:SENSe<ch>[:POWer]:FILTer:NSRatio <NSRatio>

Sets an upper limit for the relative noise content in fixed noise filter mode (`:SENSe<ch>[:POWer]:FILTer:TYPE`). This value determines the proportion of intrinsic noise in the measurement results.

Parameters:

<NSRatio> float

Range: 0.001 to 1
Increment: 0.001
*RST: 0.01

Example: See Example "Performing a power measurement with a fixed filter" on page 351.

Manual operation: See "Noise/Signal Ratio" on page 166

:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe <MTime>

Sets an upper limit for the settling time of the auto-averaging filter in the `NSRatio` mode and thus limits the length of the filter. The filter type is set with command `:SENSe<ch>[:POWer]:FILTer:TYPE`.

Parameters:

<MTime> float

Range: 1 to 999.99
Increment: 0.01
*RST: 4

Example: See Example "Performing a power measurement with a fixed filter" on page 351.

Manual operation: See "Timeout" on page 167

:SENSe<ch>[:POWer]:FILTer:SONCe

Starts searching the optimum filter length for the current measurement conditions. You can check the result with command `:SENS1:POW:FILT:LENG:USER?` in filter mode `USER` (`:SENSe<ch>[:POWer]:FILTer:TYPE`).

Example:

`SENS1:FILT:TYPE USER`
Selects user filter mode.
`SENS1:FILT:SONC`
Activates the search for the optimum filter length.
`SENS1:FILT:LENG?`
Returns the found optimum filter length.
`Response: 128`

Usage: Event

Manual operation: See "Auto Once" on page 166

:SENSe<ch>[:POWer]:FILTer:TYPE <Type>

Selects the filter mode. The filter length is the multiplier for the time window and thus directly affects the measurement time.

Parameters:

<Type> AUTO | USER | NSRatio

AUTO
Automatically selects the filter length, depending on the measured value. The higher the power, the shorter the filter length, and vice versa.

USER
Allows you to set the filter length manually. As the filter-length takes effect as a multiplier of the measurement time, you can achieve constant measurement times.

NSRatio
Selects the filter length (averaging factor) according to the criterion that the intrinsic noise of the sensor (2 standard deviations) does not exceed the specified noise content. You can define the noise content with command `:SENSe<ch>[:POWer]:FILTer:NSRatio`.
Note: To avoid long settling times when the power is low, you can limit the averaging factor limited with the "timeout" parameter (`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe`).

*RST: AUTO

Example: See Example "Performing a power measurement with a fixed filter" on page 351.

Manual operation: See " Filter" on page 166

:SENSe<ch>[:POWer]:FREQuency <Frequency>

Sets the RF frequency of the signal, if signal source "USER" is selected (`:SENSe<ch>[:POWer]:SOURce`).

Parameters:

<Frequency> float

*RST: 1 GHz

Example:
`SENS1:SOUR USER`
Selects user-defined source.
`SENS1:FREQ 2.44GHz`
Sets the RF frequency of the source which is 2.44 GHz.

Manual operation: See " Frequency " on page 165

:SENSe<ch>[:POWer]:LOGGing:STATe <State>

Activates the recording of the power values, measured by a connected R&S NRP 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 167

:SENSe<ch>[:POWer]:OFFSet <Offset>

Sets a level offset which is added to the measured level value after activation with command `:SENSe<ch>[:POWer]:OFFSet:STATe`. The level offset allows, e.g. to consider an attenuator in the signal path.

Parameters:

<Offset> float

Range: -100.0 to 100.0
*RST: 0
Default unit: dB

Example:
`SENS1:POW:OFFS 10.0`
Sets a level offset of 10 dB

Manual operation: See " Level Offset State,Level Offset" on page 166

:SENSe<ch>[:POWer]:OFFSet:STATe <State>

Activates the addition of the level offset to the measured value. The level offset value is set with command `:SENSe<ch>[:POWer]:OFFSet`.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

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 State,Level Offset" on page 166

:SENSe<ch>[:POWer]:SNUMber?

Queries the serial number of the sensor.

Return values:
<SNumber> string

Example: `SENS1:SNUM?`
Queries the serial number.

Usage: Query only

Manual operation: See "Sensor type and serial number" on page 164

:SENSe<ch>[:POWer]:SOURce <Source>

Determines the signal to be measured.

Note: When measuring the RF signal, the sensor considers the corresponding correction factor at that frequency, and uses the level setting of the instrument as reference level.

Parameters:
<Source> A | USER | RF
*RST: A

Example: See Example "Performing a power measurement with a fixed filter" on page 351.

Manual operation: See " Use Frequency Of" on page 165

:SENSe<ch>[:POWer]:STATus[:DEVice]?

Queries if a sensor is connected to the instrument.

Return values:
<Status> 0 | 1 | OFF | ON
*RST: 0

Example: `SENS1:STAT?`
`Response: 1`
A sensor is connected.

Usage: Query only

Manual operation: See " State " on page 165

:SENSe<ch>[:POWer]:SVERsion?

Queries the software version of the connected R&S NRP power sensor.

Return values:

<SVersion> string

Example: `SENS1:POW:SVER?`
Queries the software version of the power sensor.

Usage: Query only

Manual operation: See "Current Sensors" on page 169

:SENSe<ch>[:POWer]:TYPE?

Queries the sensor type. The type is automatically detected.

Return values:

<Type> string

Example: `SENS1:TYPE?`
Queries the type of sensor.
`Response: NRP-Z21`
The R&S NRP-Z21 sensor is used.

Usage: Query only

Manual operation: See "Sensor type and serial number" on page 164

:SENSe<ch>[:POWer]:ZERO

Performs zeroing of the sensor.

Zeroing is required after warm-up, i.e. after connecting the sensor.

Note: Switch off or disconnect the RF power source from the sensor before zeroing.

We recommend that you zero in regular intervals (at least once a day), if:

- The temperature has varied more than about 5 °C.
- The sensor has been replaced.
- You want to measure very low power.

Example: `SENS1:ZERO`
Executes zeroing.

Usage: Event

Manual operation: See " Zero " on page 165

12.15 SOURce Subsystem

The `SOURce` subsystem contains the commands for configuring the digital and analog signals.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`SOURce<hw>`	[1]	• SOURce[1] = RF output (optional keyword) • LF output = `SOURce:LFOutput` (`SOURce` is optional keyword)

12.15.1 Analog Modulation Subsystems

Option: see Chapter 4.1, "Required Options", on page 74.

The subsystems in this section describe all commands for analog modulation of the RF signal. Divided in separate sections, you can configure amplitude modulation (AM), frequency modulation (FM) , phase modulation (PhiM) and pulse modulation (PULM).

You can perform each of the modulations either with an internally generated modulation signal or with an externally applied signal.

To configure the internal signal, use the commands listed in Chapter 12.15.5, "SOURce:LFOutput Subsystem", on page 400.

For more information:

See Chapter 4, "Analog Modulations", on page 74.

12.15.1.1 SOURce:MODulation Subsystem

The command in this subsytem allows you to disable all active modulations at once, and, vice versa, to restore the last active ones.

[:SOURce<hw>]:MODulation[:ALL][:STATe] <State>

Activates all modulations that were active before the last switching off.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example:

```
SOURce1:AM1:DEPTh 30
SOURce1:AM1:SOURce LF1
SOURce1:AM1:STATe 1
SOURce1:FM1:DEViation 1000
SOURce1:FM1:STATe 1
// disable both modulation
SOURce1:MODulation:ALL:STATe 0
SOURce1:AM1:STATe?
// 0
SOURce1:FM1:STATe?
// 0
// enable both modulation
SOURce1:MODulation:ALL:STATe 1
SOURce1:AM1:STATe?
// 1
SOURce1:FM1:STATe?
// 1
```

Manual operation: See "MOD ON/OFF" on page 76

12.15.1.2 SOURce:AM Subsystem

Option: R&S SMAB-K720

The AM subsystem contains the commands for setting the amplitude modulation and also the broadband amplitude modulation.

The following examples show some variants for generating AM signals.

Example: Creating an amplitude modulated RF signal

Using the internal LF generator, the following command sequence configures an amplitude modulated signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the modulation signal
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 20000
```

```
// Configure the amplitude modulation settings and switch AM on
SOURce1:AM1:SOURce LF1
SOURce1:AM1:DEPTh 30
SOURce1:AM:RATio 40
SOURce1:AM1:STATe 1

// Switch on LF and RF signal output
SOURce1:LFOutput1:STATe 1
OUTPut1:STATe 1
```

Example: Using an external signal source

Using an external signal source, you can additionally determine whether you want to use only the AC component of the external modulation signal.

```
// Reset the instrument to start from a defined state
*RST

// Set frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the amplitude modulation settings and switch AM on
SOURce1:AM1:SOURce EXT1
SOURce1:AM1:DEPTh 40

// Query the input sensitivity at the external modulation input
SOURCe1:AM1:SENSitivity?
// Response:  40
// Since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 50%/V.
// This value is assigned to the voltage value for full
// modulation of the input.

// select the coupling mode AC for external amplitude modulation
SOURce1:INPut:MODext:COUPling1 AC

// Switch on AM and RF signal output
SOURce1:AM1:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:AM:RATio <Ratio>

Sets the deviation ratio (path#2 to path#1) in percent.

Parameters:

<Ratio> float

Range: 0 to 100
Increment: 0.01
*RST: 100

Example: See Example "Creating an amplitude modulated RF signal" on page 363.

Manual operation: See "Ratio Path2/Path1" on page 82

[:SOURce<hw>]:AM:SENSitivity?

Queries the sensitivity of the externally applied signal for amplitude modulation. The sensitivity depends on the set modulation 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: See Example "Using an external signal source" on page 364.

Usage: Query only

[:SOURce<hw>]:AM<ch>:SOURce <Source>

Selects the modulation source for amplitude modulation.

Suffix:

<ch> 1 to 2
Modulation signal channel

Parameters:

<Source> LF1 | LF2 | NOISe | EXT1 | EXT2 | EXTernal | INTernal

LF1|LF2
Uses an internally generated LF signal.

EXT1|EXT2
Uses an externally supplied LF signal.

NOISe
Uses the internally generated noise signal.

INTernal
Uses the internally generated signal of LF1.

EXTernal
Uses an external LF signal (EXT1).

*RST: LF1 <AM1>; LF2 <AM2>

Example: See Example "Creating an amplitude modulated RF signal" on page 363.

Manual operation: See "Source" on page 80

[:SOURce<hw>]:AM<ch>:STATe <State>

Activates amplitude modulation.

Suffix:

<ch> 1 to 2
Modulation signal channel

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Creating an amplitude modulated RF signal" on page 363.

Manual operation: See "State" on page 79

[:SOURce<hw>]:AM<ch>[:DEPTh] <Depth>

Sets the depth of the amplitude modulation in percent.

Suffix:

<ch> 1 to 2
Modulation signal channel

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1

Example: See Example "Creating an amplitude modulated RF signal" on page 363.

Manual operation: See "AM Depth" on page 82

[:SOURce<hw>]:AM:EXTernal:COUPling <Coupling>

Selects the coupling mode for the external modulation input in case of amplitude modulation.

Parameters:

<Coupling> AC | DC

AC
Passes the AC signal component of the modulation signal.

DC
Passes the modulation signal with both components, AC and DC.

*RST: AC

Example: `:SOURce:AM:EXTernal:COUPling AC`

12.15.1.3 SOURce:FM Subsystem

Option: R&S SMAB-K720

The FM subsystem contains the commands for setting the frequency modulation.

Example: Creating a frequency modulated RF signal

Using the internal LF generator, the following command sequence configures a frequency modulated signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the modulation signal
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 20000

// Configure the frequency modulation settings and switch FM on
SOURce1:FM1:SOURce LF1
SOURce1:FM1:DEViation 1000
SOURce1:FM:RATio 40
SOURce1:FM:MODe LNOise
SOURce1:FM1:STATe 1

// Switch on LF and RF signal output
SOURce1:LFOutput1:STATe 1
OUTPut1:STATe 1
```

Example: Using an external signal source

Alternatively configure the frequency modulation settings with an external modulation signal.

```
// Reset the instrument to start from a defined state
*RST

// Set RF frequency and amplitude
SOURce1:FREQuency:CW 6000000000
SOURce1:POWer:LEVel:IMMediate:AMPLitude -25

// Configure the frequency modulation settings and switch FM on
SOURce1:FM1:SOURce EXT1
SOURce1:FM1:DEViation 5000

// Query the input sensitivity at the external modulation input
:SOURCe1:FM1:SENSitivity?
// Response:  1000
// since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 5000 Hz/V.

// Switch on FM and RF signal output
SOURce1:FM1:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:FM<ch>[:DEViation] <Deviation>

Sets the modulation deviation of the frequency modulation in Hz.

Suffix:

FM<ch> 1|2
Modulation signal channel

Parameters:

<Deviation> float

The maximum deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Range: 0 to max
Increment: 0.01
*RST: 1E3

Example: See Example "Creating a frequency modulated RF signal" on page 367.

Manual operation: See "Deviation" on page 80

[:SOURce<hw>]:FM:MODE <Mode>

Selects the mode for the frequency modulation.

Parameters:

<Mode> HBANdwidth | LNOise

HBANdwidth
Selects maximum range for modulation bandwidth.

LNOise
Selects optimized phase noise and spurious characteristics with reduced modulation bandwidth and FM deviation.

*RST: HBANdwidth

Example: See Example "Creating a frequency modulated RF signal" on page 367.

Manual operation: See "Mode" on page 81

[:SOURce<hw>]:FM:RATio <Ratio>

Sets the deviation ratio (path2 to path1) in percent.

Parameters:

<Ratio> float

Range: 0 to 100
Increment: 0.01
*RST: 100

Example: See Example "Creating a frequency modulated RF signal" on page 367.

Manual operation: See "Ratio Path2/Path1" on page 80

[:SOURce<hw>]:FM:SENSitivity?

Queries the sensitivity of the externally supplied signal for frequency modulation. The sensitivity depends on the set modulation deviation.

Return values:

<Sensitivity> float

Sensitivity in Hz/V.
It is assigned to the voltage value for full modulation of the input.

Range: 0 to max
Increment: 0.01

Example: See Example "Using an external signal source" on page 368.

Usage: Query only

[:SOURce<hw>]:FM<ch>:SOURce <Source>

Selects the modulation source for frequency modulation.

Suffix:

FM<ch> 1|2
Modulation signal channel.

Parameters:

<Source> LF1 | LF2 | NOISe | EXT1 | INTernal | EXTernal | EXT2

LF1|LF2
Uses an internally generated LF signal.

INTernal = LF2
Works like `LF1`

EXTernal
Works like `EXT1`

EXT1|EXT1
Uses an externally supplied LF signal.

NOISe
Uses the internally generated noise signal.

*RST: LF1 <FM1>; LF2 <FM2>

Example: See Example "Creating a frequency modulated RF signal" on page 367.

Manual operation: See "Source" on page 80

[:SOURce<hw>]:FM<ch>:STATe <State>

Activates frequency modulation.

Suffix:

FM<ch> 1..2
determines the modulation signal channel.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Creating a frequency modulated RF signal" on page 367.

Manual operation: See "State" on page 79

12.15.1.4 SOURce:PM Subsystem

Option: R&S SMAB-K720

The PM subsystem contains the commands for setting the phase modulation. You can configure the internal modulation source (LF generator) with the commands listed in Chapter 12.15.5, "SOURce:LFOutput Subsystem", on page 400 .

Example: Performing phase modulation

The following example shows a command sequence to perform phase 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 phase modulation settings
SOURce1:LFOutput1:SHAPe SINE
SOURce1:LFOutput1:FREQuency 1000

// Select the LF signal generated by the internal modulation generator
// or the internally generated noise signal
SOURce1:PM1:DEViation 1
SOURce1:PM1:SOURce LF1
// SOURce1:PM1:SOURce INTernal
// SOURce1:PM1:SOURce NOISe
SOURce1:PM1:RATio 40
SOURce1:PM1:MODE HBAN

// Alternatively configure the phase modulation settings for an
// external modulation source and query the input sensitivity.
SOURce1:PM1:SOURce EXT1
// SOURce1:PM1:SOURce EXTernal
SOURce1:PM1:DEViation 1
SOURce1:PM1:SENSitivity?
// Response: 1
// since the voltage value for full modulation is 1V,
// the resulting sensitivity is precisely 1RAD/V.

// Activate the signal output
SOURce1:PM1:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:PM:MODE <Mode>

Selects the mode for the phase modulation.

Parameters:

<Mode>	HBANdwidth | HDEViation | LNOise **HBANdwidth** Sets the maximum available bandwidth. **HDEViation** Sets the maximum range for ΦM deviation. **LNOise** Selects a phase modulation mode with phase noise and spurious characteristics close to CW mode. *RST: HBANdwidth

Example: See Example "Performing phase modulation" on page 371.

Manual operation: See "Mode" on page 81

[:SOURce<hw>]:PM:RATio <Ratio>

Sets the deviation ratio (path2 to path1) in percent.

Parameters:

<Ratio>	float Range: 0 to 100 Increment: 0.01 *RST: 100

Example: See Example "Performing phase modulation" on page 371.

Manual operation: See "Ratio Path2/Path1" on page 81

[:SOURce<hw>]:PM:SENSitivity?

Queries the 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: See Example "Performing phase modulation" on page 371.

Usage: Query only

[:SOURce<hw>]:PM<ch>:SOURce <Source>

Selects the modulation source for phase modulation signal.

Suffix:

PM<ch>	1|2 Sets the modulation signal channel.

Parameters:

<Source> LF1 | LF2 | NOISe | EXT1 | EXT2 | INTernal | EXTernal

LF1|LF2
Uses an internally generated LF signal.

EXT1|EXT2
Uses an externally supplied LF signal.

NOISe
Uses the internally generated noise signal.

INTernal
Uses the internally generated signal of LF1.

EXTernal
Uses an external LF signal (EXT1).

*RST: LF1 <PM1>; LF2 <PM2>

Example: See Example "Performing phase modulation" on page 371.

Manual operation: See "Source" on page 80

[:SOURce<hw>]:PM<ch>:STATe <State>

Activates phase modulation.

Activation of phase modulation deactivates frequency modulation.

Suffix:

PM<ch> 1|2
Sets the modulation signal channel.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Performing phase modulation" on page 371.

Manual operation: See "State" on page 79

[:SOURce]:PM<ch>[:DEViation] <Deviation>

Sets the modulation deviation of the phase modulation in RAD.

Parameters:

<Deviation> float

The maximal deviation depends on the RF frequency and the selected modulation mode (see data sheet).

Range: 0 to max
Increment: 1
*RST: 1
Default unit: RAD

Example: See Example "Performing phase modulation" on page 371.

Manual operation: See "Deviation" on page 81

12.15.1.5 SOURce:PULM Subsystem

Option: see Chapter 4.1, "Required Options", on page 74.

The PULM subsystem contains the commands for setting the pulse modulation.

Pulse Modulation Settings

With the commands described in this section, you can configure the settings for pulse modulation, select the trigger mode and determine delay times for the pulse modulation signal.

Example: Perform pulse modulation

The 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,
// set trigger mode, select pulse mode, transition type
// and select the polarity of the internally generated pulse video output
SOURce:PULM:SOURce INT
SOURce:PULM:TRIGger:MODE AUTO
SOURce:PULM:MODE DOUB
SOURce:PULM:TTYPe SMO
SOURce:PULM:OUTPut:VIDeo:POLarity INVerted

// Alternatively configure the pulse modulation settings for
// external modulation source
// Select the source, set the polarity of the external signal,
// select the impedance for the external pulse modulation input/
// for the external pulse modulation trigger input
SOURce:PULM:SOURce EXT
SOURce:PULM:POLarity NORMal
SOURce:PULM:IMPedance G1K

// Configure the pulse generator settings
// Set pulse period, width, and delay
SOURce:PULM:PERiod 10 us
SOURce:PULM:WIDth 8 us
SOURce:PULM:DOUBle:WIDTh 0.0000012
SOURce:PULM:DOUBle:DELay 0.0000045
```

```
// Activate the signal output
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1
```

The following commands are available:

[:SOURce<hw>]:PULM:SOURce <Source>

Selects between the internal (pulse generator) or an external pulse signal for the modulation.

Parameters:

<Source> INTernal | EXTernal

*RST: INTernal

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Source" on page 78

[:SOURce<hw>]:PULM:PERiod <Period>

Sets the period of the generated pulse, that means the repetition frequency of the internally generated modulation signal.

Parameters:

<Period> float

The minimum value depends on the installed options R&S SMAB-K22 or R&S SMAB-K23

Range: 20E-9 to 100
Increment: 5E-9
*RST: 10E-6

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Pulse Period" on page 86

[:SOURce<hw>]:PULM:DELay <Delay>

Sets the pulse delay.

Parameters:

<Delay> float

*RST: 1ms

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Pulse Delay" on page 87

[: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

*RST: 1E-6

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Double Pulse Delay" on page 87

[:SOURce<hw>]:PULM:DOUBle:WIDTh <Width>

Sets the width of the second pulse.

Parameters:

<Width> float

Increment: 5E-9

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Double Pulse Width" on page 87

[:SOURce<hw>]:PULM:POLarity <Polarity>

Sets the polarity of the externally applied modulation signal.

Parameters:

<Polarity> NORMal | INVerted

NORMal
Suppresses the RF signal during the pulse pause.

INVerted
Suppresses the RF signal during the pulse.

*RST: NORMal

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Polarity" on page 95

[:SOURce<hw>]:PULM:IMPedance <Impedance>

Sets the impedance for the external pulse trigger and pulse modulation input.

Parameters:

<Impedance> G50 | G10K

*RST: G50

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Impedance" on page 95

[:SOURce<hw>]:PULM:THReshold <Threshold>

Sets the threshold for the input signal at the PULSE EXT connector.

Parameters:

<Threshold> float

Range: 0 to 2
Increment: 0.1
*RST: 1
Default unit: V

Example: `SOURce:PULM:THReshold 1`

Manual operation: See "Threshold" on page 95

[:SOURce<hw>]:PULM:MODE <Mode>

Selects the mode for the pulse modulation.

Parameters:

<Mode> SINGle | DOUBle | PTRain

SINGle
Generates a single pulse.

DOUBle
Generates two pulses within one pulse period.

PTRain
Generates a user-defined pulse train.
Specify the pulse sequence with the commands:
`[:SOURce<hw>]:PULM:TRAin:ONTime`
`[:SOURce<hw>]:PULM:TRAin:OFFTime`
`[:SOURce<hw>]:PULM:TRAin:REPetition`

*RST: SINGle

Example: See Example "Perform pulse modulation" on page 374.

Options: PTRain requires R&S SMAB-K27

Manual operation: See "Pulse Mode" on page 83

[:SOURce<hw>]:PULM:OUTPut:VIDeo:POLarity <Polarity>

Sets the polarity of the pulse video (modulating) signal, related to the RF (modulated) signal.

Parameters:

<Polarity> NORMal | INVerted

NORMal
the video signal follows the RF signal, that means it is high wihen RF signal is high and vice versa.

INVerted
the video signal follows in inverted mode.

*RST: NORMal

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Video Polarity" on page 78

[:SOURce]:PULM[:INTernal][:TRAin]:TRIGger:IMMediate

[:SOURce<hw>]:PULM:STATe <State>

Activates pulse modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "State" on page 77

[:SOURce<hw>]:PULM:TRIGger:MODE <Mode>

Selects a trigger mode - auto, external, external single or external gated - for generating the modulation signal.

Parameters:

<Mode> AUTO | EXTernal | EGATe | ESINgle

*RST: AUTO

Example: See Example "Perform pulse modulation" on page 374.

Manual operation: See "Trigger Mode" on page 84

[:SOURce<hw>]:PULM:TTYPe <Source>

Sets the transition mode for the pulse signal.

Parameters:

<Source>	SMOothed | FAST **SMOothed** flattens the slew rate, resulting in longer rise/fall times. **FAST** enables fast transitions with shortest rise and fall times. *RST: FAST
Example:	See Example "Perform pulse modulation" on page 374.
Manual operation:	See "Transition Type" on page 78

[:SOURce<hw>]:PULM:WIDTh <Width>

Sets the width of the generated pulse, that means the pulse length. It must be at least 20ns less than the set pulse period.

Parameters:

<Width>	float Range: 20E-9 to 100 Increment: 10E-9 *RST: 2E-6
Example:	See Example "Perform pulse modulation" on page 374.
Manual operation:	See "Pulse Width" on page 86

[:SOURce<hw>]:PULM:DOUBle:STATe <State>

Provided for backward compatibility with former Rohde & Schwarz signal generators.

Works like the command `[:SOURce<hw>]:PULM:MODE DOUBle`.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0

Pulse Train Settings

Option: R&S SMAB-K27

This section describes the commands for the pulse train modulation and the associated file handling. For background information, see Chapter 4.4.3.2, "Pulse Generator > Pulse Train Settings", on page 87.

Example: Generating a pulse train signal

The following settings are required to perform pulse train modulation.

Always create and select pulse train data list first before you activate the pulse train mode.

Otherwise, an error is displayed

```
*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/'
SOURce1:PULM:TRAin:CATalog?
// my_pt
// Create and7or select the pulse train data file
SOURce1:PULM:TRAin:SELect "/var/user/pt"
// Enter the pulse train data
SOURCe:PULM:TRAin:ONTime 0.0001,0.00025,0.0001
SOURCe:PULM:TRAin:OFFTime 500us,500us,300us
SOURCe:PULM:TRAin:REPetition 2,0,3
// the second pulse is ignored

// Select pulse train mode
// Select the internal modulation generator and the pulse mode
SOURce1:PULM:SOURce INT
SOURce1:PULM:MODE PTR
SOURce1:PULM:TRIGger:MODE EXT
SOURce1:PGENerator:OUTPut:STATe 1
SOURce1:PGENerator:OUTPut:POLarity NORM
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1

// SOURce1:PULM:TRAin:CATalog?
// my_pt, pt
// SOURce1:PULM:TRAin:DEL "/var/user/my_pt"
```

The following commands are available:

[:SOURce<hw>]:PULM:TRAin:CATalog?

Queries the available pulse train files in the specified directory.

Return values:

<Catalog> string

List of list filenames, separated by commas

Example: See Example "Generating a pulse train signal" on page 379.

Usage: Query only

Manual operation: See "Pulse Train Data" on page 89

[:SOURce<hw>]:PULM:TRAin:DELete <Filename>

Deletes the specified pulse train file.

Setting parameters:

<Filename> string

Filename or complete file path; file extension is optional.

Example: See Example "Generating a pulse train signal" on page 379.

Usage: Setting only

Manual operation: See "Edit Pulse Train Data" on page 89

[:SOURce<hw>]:PULM:TRAin:ONTime <OnTime>
[:SOURce<hw>]:PULM:TRAin:OFFTime <OffTime>

Enters the pulse on/off times values in the selected list.

Parameters:

<OffTime> Offtime#1{, Offtime#2, ...} | binary block data

List of comma-separated numeric values or binary block data, where:
The list of numbers can be of any length.
In binary block format, 8 (4) bytes are always interpreted as a floating-point number with double accuracy.
See `:FORMat[:DATA]` on page 340 for details.
The maximum length is 2047 values.

Range: 0 ns to 5 ms

Example: See Example "Generating a pulse train signal" on page 379.

Manual operation: See "Edit Pulse Train Data" on page 89

[:SOURce<hw>]:PULM:TRAin:REPetition:POINts?
[:SOURce<hw>]:PULM:TRAin:ONTime:POINts?
[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts?

Queries the number of on and off time entries and repetitions in the selected list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Generating a pulse train signal" on page 379.

Usage: Query only

[:SOURce<hw>]:PULM:TRAin:REPetition <Repetition>

Sets the number of repetitions for each pulse on/off time value pair.

Parameters:

<Repetition> Repetition#1{, Repetition#2, ...}

0 = ignore value pair
Set "Repetition = 0" to skip a particular pulse without deleting the pulse on/off time value pair

Range: 0 to 65535

Example: See Example "Generating a pulse train signal" on page 379.

Manual operation: See "Edit Pulse Train Data" on page 89

[:SOURce<hw>]:PULM:TRAin:SELect <Filename>

Selects or creates a data list in pulse train mode.

If the list with the selected name does not exist, a new list is created.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "Generating a pulse train signal" on page 379.

Manual operation: See "Pulse Train Data" on page 89

Pulse Train Data Exchange

Option: R&S SMAB-K27

With the following commands, you can configure pulse trains in ASCII format and export or import them accordingly.

```
SOURce1:PULM:SOURce INT
SOURce1:PULM:MODE PTR
SOURce1:PULM:TRAin:SELect "/var/user/pt"
SOURce1:PULM:STATe 1

SOURce1:PULM:TRAin:DEXChange:MODE EXP
SOURce1:PULM:TRAin:DEXChange:AFILe:EXTension TXT
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal DOT
```

```
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn SEM
SOURce1:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn COMM
SOURce1:PULM:TRAin:DEXChange:SELect "/var/user/pt.pulstrn"
SOURce1:PULM:TRAin:DEXChange:AFILe:SELect "/var/user/pt_script.txt"
SOURce1:PULM:TRAin:DEXChange:EXECute
```

The following commands are available:

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE <Mode>

Determines the import or export of a list.

Specify the source or destination file with the command `[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect`.

Parameters:

<Mode> IMPort | EXPort

*RST: IMPort

Example: See "Pulse Train Data Exchange" on page 382.

Manual operation: See " Mode " on page 92

[:SOURce<hw>]:PULM:TRAin: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: See "Pulse Train Data Exchange" on page 382.

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal <Decimal>

Sets "." (decimal point) or "," (comma) as the decimal separator used in the ASCII data with floating-point numerals.

Parameters:

<Decimal> DOT | COMMa

*RST: DOT

Example: See "Pulse Train Data Exchange" on page 382.

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:PULM:TRAin: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: See "Pulse Train Data Exchange" on page 382.

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?

Queries the available ASCII files in the current or specified directory.

Return values:

<Catalog> string
List of ASCII files `*.txt` or `*.csv`, separated by commas.

Example: See "Pulse Train Data Exchange" on page 382.

Usage: Query only

Manual operation: See "Select Source/Select Destination" on page 93

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

Parameters:

<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See "Pulse Train Data Exchange" on page 382.

Manual operation: See "Select Source/Select Destination" on page 93

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a pulse train list.

Parameters:

<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See "Pulse Train Data Exchange" on page 382.

Manual operation: See "Select Source / Select ASCII Destination" on page 93

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute

Usage: Event

Manual operation: See "Import / Export" on page 94

Executes the import or export of the selected list file, according to the transfer direction set with command `[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE`.

12.15.2 SOURce:CORRection Subsystem

The `SOURce:CORRection` subsystem contains the commands for defining correction values for external test assemblies.

You can acquire the correction values any time, regardless of the modulation settings of the generator. The correction is performed by adding the correction values to the output level of the respective RF frequency.

Determine the correction values in one of the following ways:

- Measure the RF output level at several frequency points and enter the value pairs manually in a table
- Connect an R&S NRP to the generator output signal and send the command `[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` to fill the table automatically.

Correction values can be stored in files with the predefined file extension `*.uco`.

Refer to Chapter 12.5.2, "Accessing Files in the Default or in a Specified Directory", on page 313 for general information on file handling in the default and in a specific directory.

Programming example

The examples in this section assume that:

- The files are stored in the default directory.
- `*RST` does not affect data lists.

Example: Create a table with user-defined correction values for the RF level

The following example shows a command sequence to create and activate a list for assigning level correction values to arbitrary RF frequencies. Further hardware settings are not considered.

```
// Reset the instrument to start from an initial state
// Query the available user correction list files in the default directory
// Select a file or create a new one
// ******************************************************************
*RST; *CLS
SOURce1:CORRection:CSET:CATalog?
// Response: shows the name of available user correction files (if applicable)
// Select a file
SOURce1:CORRection:CSET:SELect "/var/user/ucor1"
```

```
// Create a new file (if not existing)
SOURce1:CORRection:CSET:SELect "/var/user/ucor2"

// Enter the frequency/level value pairs in the table;
// existing data is overwritten
// Query the number of frequency/power entries in the selected list
SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
SOURce1:CORRection:CSET:DATA:POWer -10,-7.5,-5.0,-2.5,0,2.5
SOURce1:CORRection:CSET:DATA:FREQuency:POINts?
// 6
SOURce1:CORRection:CSET:DATA:POWer:POINTs?
// 6

// Enable user correction mode and RF output
SOURce1:CORRection:STATe 1
OUTPut1:STATe ON

// Query the currently used correction value
SOURce1:CORRection:VALue?
// -2.5

// Delete a user correction file
SOURce1:CORRection:CSET:DELEte "/var/user/ucor1.uco"
```

Example: Fill user correction data with sensor

The following example shows a command sequence to fill a user correction list automatically supported by a connected R&S NRP.

```
// Fill a user correction list with the level values
// measured by an R&S NRP,
// store the data in a file and enable multi level user correction.

*RST; *CLS

SOURce1:CORRection:CSET:SELect "/var/user/Ucor1_AutoFill.uco"
SOURce1:CORRection:CSET:DATA:FREQuency 100MHz,110MHz,120MHz,130MHz,140MHz,150MHz
SOURce1:CORRection:ZERoing:STATe 1
SOURce1:CORRection:CSET:DATA:SENSor1:POWer:SONCe
// Query the number of automatically filled correction level values
SOURce1:CORRection:CSET:DATA:POWer:POINTs?
// 6
SOURce1:CORRection:STATe 1

// Query the correction value at a certain frequency
FREQ 120000000
SOURce1:CORRection:VALue?
// -52.13
```

Example: User correction data exchange

The following example shows a command sequence to export a user correction list (here the list created with the example before) into an ASCII file. Further hardware settings are not considered.

```
// Select a user correction file for exporting to file in ASCII format
// Set ASCII data parameters
// Set the ASCII file extension, the decimal separator
// and the column separator for the ASCII data
SOURce1:CORRection:DEXChange:AFILe:CATalog?
// my_ucor
SOURce1:CORRection:CSET:CATalog?
// ucor1,Ucor1_AutoFill
SOURce1:CORRection:CSET:SELect "/var/user/Ucor1_AutoFill.uco"
SOURce1:CORRection:DEXChange:AFILe:EXTension CSV
SOURce1:CORRection:DEXChange:AFILe:SEParator:DECimal DOT
SOURce1:CORRection:DEXChange:AFILe:SEParator:COLumn COMMa

// Select source and destination
SOURce1:CORRection:DEXChange:AFILe:SELect "/var/user/ucor2ASCII"

// Export the user correction data into the ASCII file
SOURce1:CORRection:DEXChange:MODE EXPort
SOURce1:CORRection:DEXChange:EXECute

// Query the available ASCII files with extension .csv
SOURce1:CORRection:DEXChange:AFILe:CATalog?
// ucor2ASCII,my_ucor

// Import a user correction ASCII file
SOURce1:CORRection:DEXChange:MODE IMPort
SOURce1:CORRection:DEXChange:AFILE:SELect "/var/user/my_ucor"
SOURce1:CORRection:DEXChange:EXECute
```


12.15.2.1 Correction Settings

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

Enters the frequency value in the table selected with `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:

<Frequency> Frequency#1[, Frequency#2, ...]

String of values with default unit Hz.

Example: See Example "Create a table with user-defined correction values for the RF level" on page 385 .

Manual operation: See "Edit List Mode Data" on page 139

[:SOURce<hw>]:CORRection:CSET:DATA:POWer <Power>

Enters the level values to the table selected with `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:

<Power> Power#1[, Power#2, ...]

String of values with default unit dB.

Example: See Example "Create a table with user-defined correction values for the RF level" on page 385 .

Manual operation: See "Edit List Mode Data" on page 139

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts?
[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

Queries the number of frequency/level values in the selected table.

Return values:

<Points> integer

Range: 0 to 10000
*RST: 0

Example: See Example "Create a table with user-defined correction values for the RF level" on page 385 .

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction table 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: See Example "Fill user correction data with sensor" on page 386.

Usage: Event

Manual operation: See " Fill User Correction Data with Sensor" on page 154

[:SOURce<hw>]:CORRection:CSET[:SELect] <Filename>

Selects or creates a file for the user correction data.

If the file with the selected name does not exist, a new file is created.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "Create a table with user-defined correction values for the RF level" on page 385 .

Manual operation: See "UCOR Data" on page 150

[: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: See Example "Create a table with user-defined correction values for the RF level" on page 385 .

Usage: Query only

Manual operation: See "User Correction" on page 150

[: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

*RST: 1

Example: See Example "Fill user correction data with sensor" on page 386.

Manual operation: See " Fill User Correction Data with Sensor" on page 154

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

Fills the selected user correction list with the level values measured by the power sensor for the given frequencies.

Suffix:

SENSor<ch> Defines the used power sensor, i.e. the sensor whose values are used.

Example: See Example "Fill user correction data with sensor" on page 386.

Usage: Event

[:SOURce<hw>]:CORRection[:STATe] <State>

Activates user correction with the currently selected table.

Parameters:

<State>	0 | 1 | OFF | ON *RST: 0
Example:	See Example "Create a table with user-defined correction values for the RF level" on page 385 .
Manual operation:	See "State" on page 150

[:SOURce]:CORRection:CSET:CATalog?

Queries a list of available user correction tables.

Return values:

<Catalog>	string List of list filenames, separated by commas
Example:	See Example "Create a table with user-defined correction values for the RF level" on page 385 .
Usage:	Query only
Manual operation:	See "UCOR Data" on page 150

[:SOURce]:CORRection:CSET:DELete <Filename>

Deletes the specified user correction list file.

Setting parameters:

<Filename>	string Filename or complete file path; file extension is optional.
Example:	See Example "Create a table with user-defined correction values for the RF level" on page 385 .
Usage:	Setting only
Manual operation:	See "UCOR Data" on page 150

12.15.2.2 Correction Data Exchange

With the following commands, you can configure user correction lists and export or import them accordingly.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?

Queries the available ASCII files for export or import of user correction data in the current or specified directory.

Return values:

<Catalog> string

List of ASCII files `*.txt` or `*.csv`, separated by commas.

Example: See Example "Create a table with user-defined correction values for the RF level" on page 385 .

Usage: Query only

Manual operation: See "Select Source/Select Destination" on page 93

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension <Extension>

Determines the extension of the ASCII files for file import or export, or to query existing files.

Parameters:

<Extension> TXT | CSV

*RST: TXT

Example: See Example "User correction data exchange" on page 387 .

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "User correction data exchange" on page 387 .

Manual operation: See "Select Source/Select Destination" on page 93

[: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: See Example "User correction data exchange" on page 387 .

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:CORRection: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 Example "User correction data exchange" on page 387 .

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:CORRection:DEXChange:EXECute

Executes the import or export of the selected correction list, according to the previously set transfer direction with command `[:SOURce<hw>]:CORRection:DEXChange:MODE`.

Example: See Example "User correction data exchange" on page 387 .

Usage: Event

Manual operation: See "Import / Export" on page 94

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

Determines import or export of a user correction list.

Specify the source or destination file with the command `[:SOURce<hw>]:CORRection:DEXChange:SELect`.

Parameters:

<Mode>	IMPort | EXPort *RST: IMPort

Example: See Example "User correction data exchange" on page 387 .

Manual operation: See " Mode " on page 92

[:SOURce<hw>]:CORRection:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a user correction list.

Parameters:

<Filename>	string Filename or complete file path; file extension can be omitted.

Example: See Example "User correction data exchange" on page 387 .

Manual operation: See "Select Source / Select ASCII Destination" on page 93

12.15.3 SOURce:FREQuency Subsystem

The `SOURce:FREQuency` subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

Example: Frequency configuration

```
SOURce1:FREQuency:MODE CW
SOURce1:FREQuency:CW 6000000000
SOURce1:FREQuency:OFFSet 2000000000
SOURce1:FREQuency:MULTiplier 1.5
SOURce1:FREQuency:CW?
// 11000000000

// SOURce1:FREQuency:STEP:MODE USER
// SOURce1:FREQuency:STEP:INCRement 1000000
// SOURce1:FREQuency:CW UP

SOURce1:PHASe 2
SOURce1:PHASe:REFerence
```

[:SOURce<hw>]:FREQuency:MODE <Mode>

Sets the frequency mode for 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 sweep mode.
The instrument processes frequency (and level) settings in defined sweep steps.
Set the range and current frequency with the commands:
`[:SOURce<hw>]:FREQuency:STARt` on page 397 and `[:SOURce<hw>]:FREQuency:STOP` on page 398,
`[:SOURce<hw>]:FREQuency:CENTer` on page 397,
`[:SOURce<hw>]:FREQuency:SPAN` on page 397,
`[:SOURce<hw>]:FREQuency:MANual` on page 395

LIST
Sets list mode.
The instrument processes frequency and level settings by means of values loaded from a list.
To configure list mode settings, use the commands of the Chapter 12.15.6, "SOURce:LIST Subsystem", on page 413.

*RST: CW

Example: See Example "Frequency configuration" on page 393

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See "State (RF frequency sweep)" on page 124

[:SOURce<hw>]:FREQuency[:CW|FIXed] <Fixed>

Sets the frequency of the RF output signal in the selected path.

The effect depends on the selected mode:

- In CW mode (FREQ:MODE CW | FIXed), the instrument operates at a fixed frequency.
- In sweep mode (FREQ:MODE SWE), the value applies to the sweep frequency. The instrument processes the frequency settings in defined sweep steps.
- In user mode (FREQ:STEP:MODE USER), you can vary the current frequency step by step.

Parameters:

<Fixed> float

The following settings influence the value range:
An offset set with the command `[:SOURce<hw>]:FREQuency:OFFSet`

Numerical value
Sets the frequency in CW and sweep mode

UP|DOWN
Varies the frequency step by step in user mode.
The frequency is increased or decreased by the value set with the command `[:SOURce<hw>]:FREQuency:STEP[:INCRement]`.

Range: (RFmin + OFFSet) to (RFmax + OFFSet)
*RST: 100 MHz

Example: See Example "Frequency configuration" on page 393

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See "Frequency" on page 66

[:SOURce<hw>]:FREQuency[:CW|FIXed]:RCL <Rcl>

Set whether the RF frequency value is retained or taken from a loaded instrument configuration, when you recall instrument settings with 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: `SOURce1:FREQuency:CW:RCL INCLude`

Manual operation: See "Exclude Frequency" on page 198

[:SOURce<hw>]:FREQuency:MANual <Manual>

Sets the frequency and triggers a sweep step manually if SWEep:MODE MAN.

Parameters:

<Manual>	float
	You can select any frequency within the setting range, where:
	`STARt` is set with `[:SOURce<hw>]:FREQuency:STARt`
	`STOP` is set with `[:SOURce<hw>]:FREQuency:STOP`
	`OFFSet` is set with `[:SOURce<hw>]:FREQuency:OFFSet`
	Range: (STARt + OFFSet) to (STOP + OFFSet)
	Increment: 0.01Hz
	*RST: 100 MHz
	Default unit: Hz

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See " Current Frequency" on page 125

[:SOURce<hw>]:FREQuency:MULTiplier <Multiplier>

Sets the multiplication factor $N_{FREQ:MULT}$ of a subsequent downstream instrument.

The parameters offset $f_{FREQ:OFFSer}$ and multiplier $N_{FREQ:MULT}$ affect the frequency value set with the command FREQ.

The query FREQ? returns the value corresponding to the formula:

$f_{FREQ} = f_{RFout} * N_{FREQ:MULT} + f_{FREQ:OFFSer}$

See "RF frequency and level display with a downstream instrument" on page 64.

Parameters:

<Multiplier>	float Range: 1 to dynamic Increment: 0.001 *RST: 1

Example: See Example "Frequency configuration" on page 393

Manual operation: See "Multiplier" on page 66

[:SOURce<hw>]:FREQuency:OFFSet <Offset>

Sets the frequency offset $f_{FREQ:OFFSet}$ of a downstream instrument.

The parameters offset $f_{FREQ:OFFSer}$ and multiplier $N_{FREQ:MULT}$ affect the frequency value set with the command FREQ.

The query FREQ? returns the value corresponding to the formula:

$f_{FREQ} = f_{RFout} * N_{FREQ:MULT} + f_{FREQ:OFFSer}$

See "RF frequency and level display with a downstream instrument" on page 64.

Note: The offset also affects RF frequency sweep.

Parameters:

<Offset> float

Increment: 0.01
*RST: 0

Example: See Example "Frequency configuration" on page 393

Manual operation: See "Offset" on page 66

[:SOURce<hw>]:FREQuency:CENTer <Center>

Sets the center frequency of the sweep.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Parameters:

<Center> float

Range: 300 kHz to RFmax
Increment: 0.01 Hz
*RST: 300E6
Default unit: Hz

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See " Center Frequency " on page 129

[:SOURce<hw>]:FREQuency:SPAN <Span>

Sets the sapn of the frequency sweep range.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Parameters:

<Span> float

Full freqeuncy range

Increment: 0.01
*RST: 400E6

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See "Span" on page 129

[:SOURce<hw>]:FREQuency:STARt <Start>

Sets the start frequency for the RF sweep.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Parameters:

<Start>	float	
	Range:	300kHz to RFmax
	Increment:	0.01Hz
	*RST:	100 MHz

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See " Start Frequency/Stop Frequency " on page 129

[:SOURce<hw>]:FREQuency:STOP <Stop>

Sets the stop frequency range for the RF sweep.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Parameters:

<Stop>	float	
	Range:	300kHz to RFmax
	Increment:	0.01Hz
	*RST:	500 MHz
	Default unit:	Hz

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See " Start Frequency/Stop Frequency " on page 129

[:SOURce<hw>]:FREQuency:STEP:MODE <Mode>

Defines the type of step size to vary the RF frequency at discrete steps with the commands FREQ UP or FREQ DOWN.

Parameters:

<Mode> DECimal | USER

DECimal
Increases or decreases the level in steps of ten.

USER
Increases or decreases the level in increments, set with the command FREQ:STEP[:INCR].

*RST: DECimal

Example:

```
// increasing the RF frequency with a step size of 50 KHz
SOURce1:FREQuency:STEP 50E3
SOURce1:FREQuency:STEP:MODE USER
SOURce1:FREQuency:CW UP
```

Manual operation: See "Variation Active" on page 67

[:SOURce<hw>]:FREQuency:STEP[:INCRement] <Increment>

Sets the step width.

You can use this value to vary the RF frequency with command FREQ UP or FREQ DOWN, if you have activated FREQ:STEP:MODE USER.

Note: This value also applies to the step width of the rotary knob on the instrument and, in user-defined step mode, increases or decreases the frequency.

Parameters:

<Increment> float

Range: 0 Hz to RFmax - 100 kHz
Increment: 0.01 Hz
*RST: 1E6

Example: See Example "Frequency configuration" on page 393

Manual operation: See "Variation Step" on page 67

[:SOURce<hw>]:FREQuency:PLL:MODE <Mode>

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

Parameters:

<Mode> NORMal | NARRow

NORMal
Maximum modulation bandwidth and FM/PhiM deviation.

NARRow
Narrow PLL bandwidth

*RST: NORMal

Example: `SOURce:FREQuency:PLL:MODE NORMal`

Manual operation: See "Main PLL Bandwidth" on page 66

12.15.4 SOURce:INPut Subsystem

The `SOURce:INPut` subsystem contains the commands for configuring the inputs for external modulation signals. The instrument trigger setting influences all sweeps and is effective in the List mode (Instrument Trigger).

[:SOURce<hw>]:INPut:MODext:COUPling <Coupling>

Selects the coupling mode for an externally applied modulation signal.

Parameters:

<Coupling> AC | DC

AC
Passes the AC signal component of the modulation signal.

DC
Passes the modulation signal with both components, AC and DC.

*RST: AC

Example:
```
SOURce1:INPut:MODext:COUPling AC
SOURce1:INPut:MODext:IMPedance G50
```

Manual operation: See "Coupling (AC/DC)" on page 100

[:SOURce<hw>]:INPut:MODext:IMPedance<ch> <Impedance>

Sets the impedance for the externally supplied modulation signal.

Parameters:

<Impedance> G50 | G600 | HIGH

G50 = 50 Ohm to ground
G600 = 600 Ohm to ground
HIGH = 100 kOhm to ground

*RST: HIGH

Example: See [:SOURce<hw>]:INPut:MODext:COUPling on page 399.

Manual operation: See "Impedance" on page 100

[:SOURce]:INPut:TRIGger:SLOPe <Slope>

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

Parameters:

<Slope> NEGative | POSitive

*RST: POSitive

Manual operation: See "Trigger Slope" on page 127

12.15.5 SOURce:LFOutput Subsystem

The `SOURce:LFOutput` subsystem contains the commands for setting the LF signal source in CW and Sweep mode as well as for analog modulation.

Example: Setup an LF sweep

The following example shows a command sequence to setup an LF sweep.

```
// Reset the instrument to start from an initial state
*RST; *CLS
```

```
// Set the trigger mode, the sweep mode and the sweep range
TRIGger1:LFFSweep:SOURce SINGle
SOURce1:LFOutput1:SWEep:FREQuency:MODE AUTO
SOURce1:LFOutput1:FREQuency:STARt 1 kHz
SOURce1:LFOutput1:FREQuency:STOP 7 kHz

// Select linear spacing
// Select the waveform shape for the frequency sweep cycle
// Set the step width and the dwell time.
SOURce1:LFOutput1:SWEep:FREQuency:SPACing LINear
SOURce1:LFOutput1:SWEep:FREQuency:SHAPe SAWtooth
SOURce1:LFOutput1:SWEep:FREQuency:STEP:LINear 100 Hz
SOURce1:LFOutput1:SWEep:FREQuency:DWELl 150 ms
// Alternatively to the step width set the number of steps
SOURce1:LFOutput1:SWEep:FREQuency:POINts 61

// Activate change to start frequency while waiting for next trigger
// Prerequisites: sweep mode single and sweep waveform sawtooth
SOURce1:LFOutput:SWEep:FREQuency:RETRace 1

// Activate the LF frequency sweep
SOURce1:LFOutput:FREQuency:MODE SWE

// Trigger the sweep(depending on the set mode) and query the status
// Perform a one-off LF sweep
SOURce1:LFOutput1:SWEep:FREQuency:EXECute
SOURce1:LFOutput1:SWEep:FREQuency:RUNNing?
// 1
// the sweep is running

// ***************************************************
// For manual step LF sweep use the following commands
*RST; *CLS
SOURce1:LFOutput:SWEep:FREQuency:MODE MANual
// Activate the LF frequency sweep
SOURce1:LFOutput:FREQuency:MODE SWEep
// Activate LF Output1.
SOURce1:LFOutput1:STATe 1
// Input the frequency manually for each step
SOURce1:LFOutput1:FREQuency:MANual 2 kHz
SOURce1:LFOutput1:FREQuency:MANual 2.1 kHz
// Alternatively use UP or DOWN parameter with set step width.
SOURce1:LFOutput1:SWEep:FREQuency:STEP:LINear 500 Hz
SOURce1:LFOutput1:FREQuency:MANual UP
```

Example: Configuring the LF generator

The following is a simple example on how to configure the LF generator and output the generated signal.

```
// configure the signal of the LF1 generator
SOURce1:LFOutput1:SHAPe SQU
SOURce1:LFOutput1:SHAPe:PULSe:PERiod 0.001
SOURce1:LFOutput1:SHAPe:PULSe:WIDTh 0.0005
SOURce1:LFOutput1:SHAPe:PULSe:DCYCle 0.5
// configure the signal of the LF1 generator
SOURce1:LFOutput2:SHAPe SINE
SOURce1:LFOutput2:FREQuency 1000000
SOURce1:LFOutput2:PERiod?
// 0.000001

// changing the LF signal shape
// SOURce1:LFOutput2:SHAPe TRAP
// SOURce1:LFOutput2:SHAPe:PULSe:PERiod 0.2
// SOURce1:LFOutput2:SHAPe:TRAPeze:RISE 0.0001
// SOURce1:LFOutput2:SHAPe:TRAPeze:FALL 0.001
// SOURce1:LFOutput2:SHAPe:TRAPeze:FALL 0.0001
// SOURce1:LFOutput2:SHAPe:TRAPeze:HIGH 0.0005
// SOURce1:LFOutput2:SHAPe TRI
// SOURce1:LFOutput2:SHAPe:PULSe:PERiod 0.1
// SOURce1:LFOutput2:SHAPe:TRIangle:RISE 0.0001

// activate the LF output and select the LF1 as signal source
// configure the LF output signal
SOURce1:LFOutput1:FREQuency:MODE CW
SOURce1:LFOutput1:STATe 1
SOURce1:LFOutput1:SOURce LF1
SOURce1:LFOutput1:INTernal:VOLTage 1
SOURce1:LFOutput1:OFFSet 0.001
```


12.15.5.1 LF Generator Settings

With the commands described in this section, you can configure the LF signal source.

[:SOURce]:LFOutput<ch>:BANDwidth?

Queries the bandwidth of the external LF signal.

Return values:

<Bandwidth> BW0M2 | BW10m

*RST: BW10m

Example:

```
LFO:BAND?
// BW10m
// the bandwidth of the externally supplied LF signal is 10 MHz
```

Usage: Query only

Manual operation: See "Bandwidth" on page 100

[:SOURce]:LFOutput<ch>:FREQuency <Frequency>

Sets the frequency of the LF signal in `[:SOURce<hw>]:LFOutput:FREQuency:MODE` `CW|FIXed` mode.

Note

- If signal source "Internal" is set, the instrument performs the analog modulations (AM/FM/PhiM/PM) with this frequency.
- In sweep mode (`[:SOURce<hw>]:LFOutput:FREQuency:MODE` `SWE`), the frequency is coupled with the sweep frequency.

Parameters:

<Frequency> float

Range: depends on the installed options
*RST: 1000
Default unit: Hz

Example:

```
SOURce1:LFOutput1:FREQuency 5 kHz
// sets the LF frequency
```

Manual operation: See "Frequency" on page 98

[:SOURce<hw>]:LFOutput<ch>:PERiod?

Queries the repetition frequency of the sine signal.

Return values:

<LfSinePeriod> float

Range: 1E-6 to 100
Increment: 10E-9
*RST: 0.001
Default unit: s

Example: See Example "Configuring the LF generator" on page 401.

Usage: Query only

[:SOURce<hw>]:LFOutput:FREQuency:MANual <Manual>

Sets the frequency of the subsequent sweep step if LFO:SWE:MODE MAN.

Use a separate command for each sweep step.

Parameters:

<Manual> float

You can select any value within the setting range, where:
`STARt` is set with `[:SOURce<hw>]:LFOutput:FREQuency:STARt`
`STOP` is set with `[:SOURce<hw>]:LFOutput:FREQuency:STOP`

Range: STARt to STOP
Increment: 0.1
*RST: 1000

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See " Current Frequency" on page 125

[:SOURce<hw>]:LFOutput:FREQuency:MODE <Mode>

Sets the mode for the output of the LF generator frequency, and determines the commands to be used for frequency settings.

Parameters:

<Mode> CW | FIXed | SWEep

CW|FIXed
Sets the fixed-frequency mode. `CW` and `FIXed` are synonyms.
To set the output frequency, use command `[:SOURce]:LFOutput<ch>:FREQuency`

SWEep
Sets sweep mode.
To set the frequency, use the commands:
`[:SOURce<hw>]:LFOutput:FREQuency:STARt` and `[:SOURce<hw>]:LFOutput:FREQuency:STOP`
Or `[:SOURce<hw>]:LFOutput:FREQuency:MANual`

*RST: CW

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See "State (LF frequency sweep)" on page 97

[:SOURce<hw>]:LFOutput:FREQuency:STOP <Stop>
[:SOURce<hw>]:LFOutput:FREQuency:STARt <Start>

Sets the start/stop frequency for `[:SOURce<hw>]:LFOutput:FREQuency:MODE SWEep`.

Parameters:

<Start> float

Range: 0.1 Hz to 1 MHz
Increment: 0.1
*RST: 1 KHz

<Stop> float

Range: 0.1 Hz to 1 MHz
Increment: 0.1 Hz
*RST: 100 KHz

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See " Start Frequency/Stop Frequency " on page 129

[:SOURce]:LFOutput<ch>:OFFSet <Offset>

Sets a DC offset at the selected LF Output.

Parameters:

<Offset> float

Range: -3.6 to 3.6
Increment: 0.001
*RST: 0
Default unit: V

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "DC-Offset" on page 103

[:SOURce]:LFOutput<ch>:SOURce <Source>

Defines which signal is output

Parameters:

<Source> LF1 | LF2 | NOISe | EXT1 | EXT2 | AM | FMPM

LF1|LF2
Selects the internally generated LF signal.

NOISe
Selects the internally generated noise signal.

EXT1|EXT2
Selects the externally supplied LF signal

AM|FMPM
Selects the AM or FM/PM signal.

*RST: LF1

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Source" on page 103

[:SOURce]:LFOutput<ch>:SOURce:PATH <SourPath>

Determines the path of the LF output source.

Parameters:

<SourPath> A | B

*RST: A

Example: `LFO:SOUR:PATH?`
Queries the currently set path for the LF output signal source.

[:SOURce]:LFOutput<ch>[:STATe] <State>

Activates LF signal output

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "State" on page 103

[:SOURce]:LFOutput<ch>:VOLTage <Voltage>

Sets the output voltage of the selected LF output.

Parameters:

<Voltage> float

Range: dynamic (see data sheet)
Increment: 0.001
*RST: 1
Default unit: V

Example: `SOURce:LFOutput:VOLTage 3`

Manual operation: See "Output Voltage" on page 103

[:SOURce]:LFOutput<ch>:INTernal:VOLTage <Voltage>

Sets the output voltage for the LF generators.

Suffix:

<ch> [1]
Optional suffix
The set value applies to the LF generator selected with `[:SOURce]:LFOutput<ch>:SOURce`

Parameters:

<Voltage> float

Range: 0 to 4
*RST: 0.5

Example: See Example "Configuring the LF generator" on page 401.

[:SOURce<hw>]:LFOutput<ch>:SHAPe <Shape>

Selects the waveform shape of the LF signal.

Parameters:

<Shape> SINE | SQUare | TRIangle | TRAPeze

*RST: SINE

Example: See Example "Configuring the LF generator" on page 401.

Options: TRIangle|TRAPeze require R&S SMAB-K24

Manual operation: See "Shape" on page 97

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:DCYCle <DCycle>

Sets the duty cycle for the shape pulse.

Parameters:

<DCycle> float

Range: 1E-6 to 100
Increment: 1E-6
*RST: 50
Default unit: PCT

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Pulse Duty Cycle" on page 99

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:PERiod <Period>

Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>	float Range: 1E-6 to 100 Increment: 1E-8 *RST: 1E-3

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Period" on page 98

[:SOURce<hw>]:LFOutput<ch>:SHAPe:PULSe:WIDTh <Width>

Sets the pulse width of the generated pulse.

Parameters:

<Width>	float Range: 1E-6 to 100 Increment: 1E-8 *RST: 5E-4

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Pulse Width" on page 99

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:FALL <Fall>

Selects the fall time for the trapezoid shape of the LF generator.

Parameters:

<Fall>	float Range: 1E-6 to 100 Increment: 10E-9 *RST: 250E-6

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Trapezoid Rise / Fall" on page 99

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:HIGH <High>

Sets the high time for the trapezoid signal of the LF generator.

Parameters:

<High>	float Range: 1E-6 to 100 Increment: 10E-9 *RST: 250E-6

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Trapezoid High" on page 99

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:PERiod <Period>

Sets the period of the generated trapezoid shape. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>	float	
	Range:	1E-6 to 100
	Increment:	1E-8
	*RST:	1E-3

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Period" on page 98

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRAPeze:RISE <Rise>

Selects the rise time for the trapezoid shape of the LF generator.

Parameters:

<Rise>	float	
	Range:	1E-6 to 100
	Increment:	10E-9
	*RST:	250E-6

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Trapezoid Rise / Fall" on page 99

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:PERiod <Period>

Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>	float	
	Range:	1E-6 to 100
	Increment:	10E-9
	*RST:	0.001

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Period" on page 98

[:SOURce<hw>]:LFOutput<ch>:SHAPe:TRIangle:RISE <Rise>

Selects the rise time for the triangle single of the LF generator.

Parameters:

<Rise>	float	
	Range:	1E-6 to 100
	Increment:	10E-9
	*RST:	0.5E-3

Example: See Example "Configuring the LF generator" on page 401.

Manual operation: See "Triangle Rise" on page 99

12.15.5.2 LF Sweep Settings

With the commands described in this section, you can configure the sweep of the LF signal.

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:DWELl <Dwell>

Sets the dwell time for each frequency step of the sweep.

Parameters:

<Dwell> float

Range: 1E-3 to 100
Increment: 100E-6
*RST: 15E-3
Default unit: s

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See " Dwell Time " on page 127

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:EXECute

Immediately starts an LF sweep.

`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE` determines which sweep is executed, e.g. `SOURce:LFOutput:SWEep:FREQuency:MODE STEP`.

Example: See Example "Setup an LF sweep" on page 400.

Usage: Event

Manual operation: See " Execute Single Sweep " on page 128

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE <Mode>

Sets the cycle mode of the LF sweep.

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 determines the time period until the signal switches to the next step.

MANual
Performs a single sweep step when a manual trigger event occurs.
The trigger system is not active. To trigger each frequency step of the sweep individually, use the command `[:SOURce<hw>]:LFOutput:FREQuency:MANual` on page 404.

STEP
Each trigger command triggers one sweep step only.
The frequency increases by the value set with the coammnds:
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear]` (linear spacing)
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic`(logarithmic spacing)

*RST: AUTO

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See "Mode" on page 125

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:POINts <Points>

Sets the number of steps in an LF sweep.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118

Parameters:

<Points> integer

Range: 2 to POINts
Increment: 1
*RST: 100

Example: See Example "Setup an LF sweep" on page 400.

[: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

Manual operation: See "Retrace" on page 126

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:RUNNing?

Queries the current status of the LF frequency sweep mode.

Return values:

<State> 0 | 1 | OFF | ON

Example: See Example "Setup an LF sweep" on page 400.

Usage: Query only

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SHAPe <Shape>

Sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape> SAWTooth | TRIangle

*RST: SAWTooth

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See " Shape " on page 126

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:SPACing <Spacing>

Selects linear or logarithmic sweep spacing.

Parameters:

<Spacing> LINear | LOGarithmic

*RST: LINear

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See " Spacing" on page 127

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

Sets the step width factor for logarithmic sweeps to calculate the frequencies of the steps.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118

Parameters:
<Logarithmic> float

The unit is mandatory

Range: 0.01 to 100
Increment: 0.01
*RST: 1
Default unit: PCT

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See " Step Linear/Step Logarithmic " on page 129

[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step width for the linear sweep.

For information on how the value is calculated and the interdependency with other parameters, see Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118

Parameters:
<Linear> float

Range: 0 to STOP-STARt
Increment: 0.1
*RST: 1000

Example: See Example "Setup an LF sweep" on page 400.

Manual operation: See " Step Linear/Step Logarithmic " on page 129

12.15.6 SOURce:LIST Subsystem

The `SOURce:LIST` subsystem contains all commands for defining lists and for handling of list files.

List files have the predefined file extension `*.lsw`.

Refer to Chapter 12.5.2, "Accessing Files in the Default or in a Specified Directory", on page 313 for general information on file handling in the default and in a specific directory.

- `*RST` does not affect data lists.
- SCPI refers to the individual lists as segments.

Example: Create an RF list and activate the list mode

The following example shows a command sequence to create an RF list and to activate the list mode. Further hardware settings are not considered.

```
// Reset the instrument to start from an initial state
// Query the available list files in the default
// directory /var/user
```

```
// Select the list file or create it (if not existing)
*RST; *CLS
SOUR1:LIST:CAT?
// Response:- shows the name of available list files (if applicable)
SOUR1:LIST:SEL "/var/user/list1.lsw"

// Write the frequency/level/dwell time values in the selected list file
// existing data is overwritten
// Query the number of frequency/power/dwell time entries in the selected list
// Query the amount of free memory (in bytes) for list mode lists
SOUR1:LIST:FREQ 58 MHz, 61 MHz, 73 MHz, 86 MHz, 91 MHz, 92 MHz, 98 MHz
SOUR1:LIST:POW 13 dBm, 12 dBm, 5 dBm, 3 dBm, 0 dBm, 4 dBm, 6 dBm
SOUR1:LIST:DWEL:LIST 10000, 100000, 200000, 19000, 10000, 150000, 220000
SOUR1:LIST:FREQ:POIN?
// 7
SOUR1:LIST:POW:POINT?
// 7
SOUR1:LIST:DWEL:LIST:POIN?
// 7
SOUR1:LIST:FREE?
// 2147483647 (bytes of free memory)

// Use dwell times from list
// Configure the list mode parameters
// Enable RF output
SOUR1:LIST:MODE AUTO
SOUR1:LIST:TRIG:SOUR AUTO
SOUR1:LIST:DWEL:MODE "LIST"

OUTP1:STAT ON

// Use global dwell time
// Set only a part of the list (value pairs 3 to 5) to be processed
// Configure the list mode parameters using global dwell time
// Enable RF output
SOUR1:LIST:IND:START 2
SOUR1:LIST:IND:STOP 4
SOUR1:LIST:MODE AUTO
SOUR1:LIST:TRIG:SOUR AUTO
SOUR1:LIST:DWEL:LIST 500 ms
OUTP1:STAT ON

// Enable the list mode
// Trigger the list (depending on the mode, not needed with trigger
// mode AUTO); query the current index
// Reset the list to the starting point
SOUR1:FREQ:MODE LIST
SOUR1:LIST:TRIG:EXEC
SOUR1:LIST:RUNN?
SOUR1:LIST:IND?
// 3
```

```
// value changes when the value is queried again
SOUR1:LIST:RES

// For list mode STEP use the following commands
*RST; *CLS
// Change list mode to STEP
SOUR1:LIST:MODE STEP
// Activate RF Output1
OUTP1:STAT 1
// Activate the list mode
SOUR1:FREQ:MODE LIST
// For each step: select frequency/powerlevel pair as index from the list
SOUR1:LIST:IND 2
SOUR1:LIST:IND 3
SOUR1:LIST:IND 4

// Use the selected list for path B (with List Mode B default settings)
SOUR2:LIST:SEL "/var/user/list1.lsw"
OUTP2:STAT ON
SOUR2:FREQ:MODE LIST
SOUR2:LIST:IND?
// 2
// value canges when the value is queried again

// Deactivate the list mode
SOUR1:FREQ:MODE CW
```

Example: List mode data exchange

The following example shows a command sequence to export a list (here the RF list created with the example before) into an ASCII file. Further hardware settings are not considered.

```
*RST; *CLS
LIST:DEXC:MODE EXP

// Set ASCII data parameters
// Set the ASCII file extension, the decimal separator
// and the column separator for the ASCII data
SOUR1:LIST:DEXC:AFIL:EXT CSV
SOUR1:LIST:DEXC:AFIL:SEP:DEC DOT
SOUR1:LIST:DEXC:AFIL:SEP:COL COMM

// Select source and destination path/directory
// Query available listfiles in default directory "/var/user"
SOUR1:LIST:CAT?
// list1
SOUR1:LIST:DEXC:AFIL:SEL "/var/user/list1ASCII"
SOUR1:LIST:DEXC:SEL "/var/user/list1"

// Export the list file data into the ASCII file
```

```
SOUR1:LIST:DEXC:EXEC

// Query the available ASCII files with extension .csv
SOUR1:LIST:DEXC:AFIL:CAT?
// Response: "list1ASCII"

// Deactivate the list mode
SOUR1:FREQ:MODE CW
```


12.15.6.1 List Mode Settings

With the following commands, you can create list mode data, select the trigger mode and determine the dwell time.

[:SOURce<hw>]:LIST:DWELl <Dwell>

Sets the global dwell time. The instrument generates the signal with the frequency / power value pairs of each list entry for that particular period.

See also Significant Parameters and Functions.

Parameters:

<Dwell> float

Range: 7E-4 to 100
Increment: 1E-4
*RST: 15E-3
Default unit: s

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Global Dwell Time" on page 133

[:SOURce<hw>]:LIST:DWELl:MODE <DwelMode>

Selects the dwell time mode.

Parameters:

<DwelMode> LIST | GLOBal

LIST
uses the dwell time, specified in the data table for each value pair individually.

GLOBal
uses a constant dwell time, set with command `[:SOURce<hw>]:LIST:DWELl`.

*RST: GLOBal

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Dwell Time Mode" on page 133

[:SOURce<hw>]:LIST:DWELl:LIST <Dwell>

Enters the dwell time values in the selected list in µs.

Parameters:

<Dwell> <Dwell#1>{, <Dwell#2>, ...} | block data

You can either enter the data as a list of numbers, or as binary block data. The list of numbers can be of any length, with the list entries separated by commas.
In binary block format, 8 (4) bytes are always interpreted as a floating-point number with double accuracy. See also `:FORMat[:DATA]` on page 340 for more details.

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Edit List Mode Data" on page 139

[:SOURce<hw>]:LIST:DWELl:LIST:POINts?

Queries the number (points) of dwell time entries in the selected list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Query only

[:SOURce<hw>]:LIST:FREQuency <Frequency>

Enters the frequency values in the selected list.

Parameters:

<Frequency> <Frequency#1>{, <Frequency#2>, ...} | block data

You can either enter the data as a list of numbers, or as binary block data.
The list of numbers can be of any length, with the list entries separated by commas.
In binary block format, 8 (4) bytes are always interpreted as a floating-point number with double accuracy.
See also `:FORMat[:DATA]`.

Range: 300 kHz to RFmax (depends on the installed options)

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Edit List Mode Data" on page 139

[:SOURce<hw>]:LIST:FREQuency:POINts?

Queries the number (points) of frequency entries in the seleced list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Query only

[:SOURce<hw>]:LIST:INDex <Index>

Sets the list index in LIST:MODE STEP.

After the trigger signal, the instrument processes the frequency and level settings of the selected index.

Parameters:

<Index> integer

*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See " Current Index " on page 132

[:SOURce<hw>]:LIST:INDex:STARt <Start>
[:SOURce<hw>]:LIST:INDex:STOP <Stop>

Sets the start and stop index of the index range which defines a subgroup of frequency/level value pairs in the current list.

Parameters:

<Start>/<Stop> integer

Index range
Only values inside this range are processed in list mode

Range: 0 to list length
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See " List Range from/to " on page 135

[:SOURce<hw>]:LIST:MODE <Mode>

Sets the list mode.

The instrument processes the list according to the selected mode and trigger source, see LIST:TRIG:SOUR AUTO, SING or EXT.

Parameters:

<Mode> AUTO | STEP

AUTO
Each trigger event triggers a complete list cycle.

STEP
Each trigger event triggers only one step in the list processing cycle. The list is processed in ascending order.
In this mode, you can select between LIST:TRIG:SOUR SING or EXT.

*RST: AUTO

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Mode" on page 133

[:SOURce<hw>]:LIST:POWer <Power>

Enters the level values in the selected list. The number of level values must correspond to the number of frequency values. Existing data is overwritten.

Parameters:

<Power> <Power#1>{, <Power#2>, ...} | block data

You can either enter the data as a list of numbers, or as binary block data.
The list of numbers can be of any length, with the list entries separated by commas.
In binary block format, 8 (4) bytes are always interpreted as a floating-point number with double accuracy.
See also `:FORMat[:DATA]`.

Range: depends on the installed options
Default unit: dBm

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Edit List Mode Data" on page 139

[:SOURce<hw>]:LIST:POWer:POINts?

Queries the number (points) of level entries in the selected list.

Return values:

<Points> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Query only

[:SOURce<hw>]:LIST:RMODe <RMode>

Selects the run mode for processing the list.

Parameters:

<RMode> LIVE

LIVE
Generates the signal by processing the list directly.

*RST: LIVE

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Run Mode" on page 133

[:SOURce<hw>]:LIST:TRIGger:EXECute

Starts the processing of a list in list mode.

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Event

Manual operation: See " Execute Single" on page 134

[:SOURce<hw>]:LIST:TRIGger:SOURce <Source>

Selects the trigger source for processing lists.

The names of the parameters correspond to those in sweep mode. SCPI standard 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. For an overview, see the following table:

Rohde & Schwarz name	SCPI name	Command in manual control
AUTO	IMMediate	`MODE AUTO`
SINGle	BUS	`MODE SINGLE` or `STEP`
EXTernal	EXTernal	`MODE EXT TRIG SINGLE` or `EXT TRIG STEP`

Parameters:

<Source> SINGle | BUS | AUTO | EXTernal | IMMediate

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. The selected list is restarted as soon as it is finished.

SINGle|BUS
The list is triggered by the command `[:SOURce<hw>]:LIST:TRIGger:EXECute`. The list is executed once.

EXTernal
The list is triggered externally and executed once.

*RST: AUTO

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See "Mode" on page 133

[:SOURce<hw>]:LIST:RUNNing?

Queries the current state of the list mode.

Return values:

<State> 0 | 1 | OFF | ON

1
Signal generation based on the list mode is active.

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Query only

12.15.6.2 List Mode File Operation

The following section covers basic commands to file handling in list mode.

[:SOURce<hw>]:LIST:CATalog?

Queries the available list files in the specified directory.

Return values:

<Catalog> string

List of list filenames, separated by commas

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Query only

Manual operation: See " List Mode Data " on page 135

[:SOURce<hw>]:LIST:DELete <Filename>

Deletes the specified list.

Setting parameters:

<Filename> string

Filename or complete file path; file extension is optional.

Example: See [:SOURce<hw>]:LIST:DELete:ALL on page 422.

Usage: Setting only

Manual operation: See " List Mode Data " on page 135

[:SOURce<hw>]:LIST:DELete:ALL

Deletes all lists in the set directory.

This command can only be executed, if:

- No list file is selected.
- List mode is disabled.

Example:

```
SOUR1:LIST:CAT?
// list,my_list
SOUR1:LIST:DEL "/var/user/list1"
SOUR1:LIST:CAT?
// my_list
SOUR1:FREQ:MODE?
// LIST
SOUR1:LIST:SEL?
// /var/user/my_list.lsw
//deactivate list mode
SOUR1:FREQ:MODE CW
SOUR1:LIST:DELete:ALL
SOUR1:LIST:CAT?
// -
// all list files are deleted
```

Usage: Event

Manual operation: See " List Mode Data " on page 135

[:SOURce<hw>]:LIST:FREE?

Queries the amount of free memory (in bytes) for list mode lists.

Return values:

<Free> integer

Range: 0 to INT_MAX
*RST: 0

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Query only

[:SOURce<hw>]:LIST:RESet

Jumps to the beginning of the list.

Example: See Example "Create an RF list and activate the list mode" on page 413.

Usage: Event

Manual operation: See " Reset " on page 134

[:SOURce<hw>]:LIST:SELect <Filename>

Selects or creates a data list in list mode.

If the list with the selected name does not exist, a new list is created.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted.

Example: See Example "Create an RF list and activate the list mode" on page 413.

Manual operation: See " List Mode Data " on page 135

12.15.6.3 List Mode Data Exchange

With the following commands, you can configure lists in ASCII format and export or import them accordingly.

[: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.

Return values:

<Catalog> string

List of ASCII files `*.txt` or `*.csv`, separated by commas.

Example: See Example "List mode data exchange" on page 415.

Usage: Query only

Manual operation: See "Select Source/Select Destination" on page 93

[: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: See Example "List mode data exchange" on page 415.

Usage: Event

Manual operation: See "Import / Export" on page 94

[: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: See Example "List mode data exchange" on page 415.

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

Parameters:
<Filename> string
Filename or complete file path; file extension can be omitted.

Example: See Example "List mode data exchange" on page 415.

Manual operation: See "Select Source/Select Destination" on page 93

[: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: See Example "List mode data exchange" on page 415.

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal <Decimal>

Sets "." (decimal point) or "," (comma) as the decimal separator used in the ASCII data with floating-point numerals.

Parameters:
<Decimal> DOT | COMMa
*RST: DOT

Example: See Example "List mode data exchange" on page 415.

Manual operation: See "ASCII File Settings" on page 92

[:SOURce<hw>]:LIST:DEXChange:MODE <Mode>

Determines the import or export of a list.

Specify the source or destination file with the command `[:SOURce<hw>]:LIST:DEXChange:SELect`.

Parameters:

<Mode>	IMPort | EXPort *RST: IMPort
Example:	See Example "List mode data exchange" on page 415.
Manual operation:	See " Mode " on page 92

[:SOURce<hw>]:LIST:DEXChange:SELect <Filename>

Selects the ASCII file for import or export, containing a list.

Parameters:

<Filename>	string Filename or complete file path; file extension can be omitted.
Example:	See Example "List mode data exchange" on page 415.
Manual operation:	See "Select Source / Select ASCII Destination" on page 93

12.15.7 SOURce:NOISe Subsystem

The `SOURce:NOISe` subsystem contains the commands for setting the noise modulation signal. The noise generator is optional.

Example: Configuring the noise generator

```
SOURce1:NOISe:DISTribution GAUSs
SOURce1:NOISe:BANDwidth 10000000
SOURce1:NOISe:BANDwidth:STATe 1

SOURce1:LFOutput1:SOURce NOIS
SOURce1:LFOutput1:STATe 1
SOURce1:NOISe:LEVel:RELative?
// -83.86
SOURce1:NOISe:LEVel:ABSolute?
// -13.86
```


[:SOURce<hw>]:NOISe:BANDwidth|BWIDth <BWidth>

Sets the noise level in the system bandwidth when bandwidth limitation is enabled.

Bandwidth range	Step size
100 kHz to 1 MHz	100 kHz
1 MHz to 5 MHz	1 MHz
5 MHz to 10 MHz	5 MHz

Parameters:

<BWidth> float

Range: 100E3 to 10E6
Increment: 100E3
*RST: 100E3

Example: See Example "Configuring the noise generator" on page 426.

Manual operation: See "Bandwidth" on page 101

[:SOURce<hw>]:NOISe:BWIDth:STATe <State>

Activates noise bandwidth limitation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the noise generator" on page 426.

Manual operation: See "Bandwidth" on page 101

[:SOURce<hw>]:NOISe:DISTribution <Distribution>

Sets the distribution of the noise power density.

Parameters:

<Distribution> GAUSs | EQUal

*RST: GAUSs

Example: See Example "Configuring the noise generator" on page 426.

Manual operation: See "Distribution" on page 101

[:SOURce<hw>]:NOISe:LEVel:RELative?

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: See Example "Configuring the noise generator" on page 426.

Usage: Query only

Manual operation: See "Noise Density" on page 104

[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?

Queries the level of the noise signal in the system bandwidth within the enabled bandwidth limitation.

Return values:

<Absolute> float

Noise level within the bandwidth limitation

*RST: 3.84 MHz

Example: See Example "Configuring the noise generator" on page 426.

Usage: Query only

Manual operation: See "Noise Level" on page 104

12.15.8 SOURce:PGEN Subsystem

The PGEN subsystem contains the commands for setting output of the pulse modulation signal.

Example: Using pulse generator as source for pulse modulation

```
// select pulse generator as source for pulse modulation
// enable pulse modulation
SOURce1:PULM:SOURce INT
SOURce1:PULM:STATe 1
// pulse generator and signal output are also activated
SOURce1:PGENerator:STATe?
// 1
SOURce1:PGENerator:OUTPut:STATe?
// 1
PGENerator:OUTPut:POLarity NORMal
// to disable pulse generator
SOURce1:PGENerator:STATe 0
// activate the pulse modulation of the RF carrier
SOURce1:PULM:STATe 1
```


[:SOURce<hw>]:PGENerator:OUTPut:POLarity <Polarity>

Sets the polarity of the pulse output signal.

Parameters:

<Polarity> NORMal | INVerted

NORMal
Outputs the pulse signal during the pulse width, that means during the high state.

INVerted
Inverts the pulse output signal polarity. The pulse output signal is suppressed during the pulse width, but provided during the low state.

*RST: NORMal

Example: See Example "Using pulse generator as source for pulse modulation" on page 428.

Manual operation: See "Pulse Output Polarity" on page 87

[:SOURce<hw>]:PGENerator:OUTPut[:STATe] <State>

Activates the output of the pulse modulation signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Using pulse generator as source for pulse modulation" on page 428.

Manual operation: See "Pulse Output State" on page 87

[:SOURce<hw>]:PGENerator:STATe <State>

Enables the output of the video/sync signal.

If the pulse generator is the current modulation source, activating the pulse modulation automatically activates the signal output and the pulse generator.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Using pulse generator as source for pulse modulation" on page 428.

12.15.9 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.

Example: Programming Example

```
// change the phase relative to the current phase
SOURce1:PHASe 2 DEG
// adopt the setting as the current phase
SOURce1:PHASe:REFerence
```

The following commands are available:

[:SOURce<hw>]:PHASe <Phase>

Specifies the phase variation relative to the current phase.

Parameters:

<Phase> float

Range: -720 to 720
Increment: 0.1
*RST: 0
Default unit: DEG

Example: See Example "Programming Example" on page 430.

Manual operation: See "Delta Phase" on page 73

[:SOURce<hw>]:PHASe:REFerence

Assigns the value set with command `[:SOURce<hw>]:PHASe` as the reference phase.

Example: See Example "Programming Example" on page 430.

Usage: Event

Manual operation: See "Reset Delta Phase Display" on page 73

12.15.10 SOURce:POWer Subsystem

The `SOURce:POWer` subsystem contains the commands for setting the output level, level control and level correction of the RF signal.

The default units are dBm. To change the units, perform on of the following:

- Enter the unit after the numerical value
  Example: `:POW 0.5V`
- Set the unit with the command `:UNIT:POWer`.

[:SOURce<hw>]:POWer:ALC:DSENsitivity <Sensitivity>

Sets the sensitivity of the ALC detector.

Parameters:

<Sensitivity> AUTO | FIXed

AUTO
Selects the optimum sensitivity automatically.

FIXed
Fixes the internal level detector.

*RST: AUTO

Example: `POW:ALC:DSEN FIX`

Manual operation: See "Detector Sensitivity" on page 147

[:SOURce<hw>]:POWer:ALC:OMODe <OffMode>

Sets the level control mode. It is activated when automatic level control is switched off (ALC Off).

Parameters:

<OffMode> SHOLd

Activates level control temporarily, when the level or frequency changes ("ALC Off Sample & Hold").

*RST: SHOLd

Example: `POW:ALC OFF`
Deactivates automatic level control at the RF output.
`POW:ALC:OMOD SHOL`
Activates the level control briefly when changing the frequency or level.

[:SOURce<hw>]:POWer:ALC:SEARch <Search>

Recalculates the instrument internal settings optimized for the current level. Not required for automatic modes.

Parameters:

<Search> ON

*RST: ON

Example: `POW:ALC:SEAR ON`
Executes readjustment.

[:SOURce<hw>]:POWer:ALC:SONCe

Activates level control for correction purposes temporarily.

Example: `POW:ALC OFF`
Deactivates automatic level control at the RF output.
`POW:ALC:SONC`
Executes level control (once).

Usage: Event

Manual operation: See "Readjust" on page 72

[:SOURce<hw>]:POWer:ALC[:STATe] <State>

Parameters:

<State> 0 | OFF | AUTO | 1 | ON | ONTable | PRESet | OFFTable

AUTO
Adjusts the output level to the operating conditions automatically.

1|ON
Activates internal level control permanently.

OFFTable
Controls the level by means of attenuation values of the internal ALC table.

0|OFF
Provided only for backward compatibility with other Rohde & Schwarz signal generators.
The R&S SMA100B accepts these values and maps them automatically as follows:
`0|OFF = OFFTable`

ONTable
Starts with the attenuation setting from the table and continues with automatic level control.

*RST: AUTO

Example: `POW:ALC ON`
Activates internal level control.

Manual operation: See "State" on page 147

[:SOURce<hw>]:POWer:ATTenuation:RFOFf:MODE <Mode>

Selects the state the attenuator is to assume if the RF signal is switched off.

Parameters:

<Mode> UNCHanged | FATTenuation

FATTenuation
The attenuator switches to maximum attenuation

UNCHanged
Retains the current setting and keeps the output impedance constant during RF off.

*RST: n.a. (factory preset: FATTenuation)

Example:
```
SOURce1:POWer:ATTenuation:RFOFf:MODE FATTenuation
// maximum attenuation is used when the RF output is deactivated
```

Manual operation: See " RF OFF Mode " on page 145

[: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: n.a. (factory preset: 0)

Example:
```
POW:EMF:STAT 1
```
Activates voltage level display.

Manual operation: See " Display Level as Voltage of EMF " on page 221

[:SOURce<hw>]:POWer:LBEHaviour <Behaviour>

Selects the level behavior at the RF output over time.

Parameters:

<Behaviour> AUTO | UNINterrupted | MONotone | CVSWr

UNINterrupted|MONotone
Uninterrupted level settings and strictly monotone modes

CWSWr
Constant VSWR

*RST: AUTO

Example:
```
SOURce1:POWer:LBEHaviour AUTO
```

Manual operation: See " Setting Characteristics " on page 70

[: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 query `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]`.

Parameters:

<Amplitude> float

Range: depends on the installed options
Increment: 0.01
*RST: n.a. (factory preset: 30)

Example: `SOURce1:POWer:LIMit:AMPLitude 10`

Manual operation: See " Limit " on page 70

[:SOURce<hw>]:POWer:LMODe <LevMode>

Sets the RF level mode.

Parameters:

<LevMode> NORMal | LOWNoise | LOWDistortion

NORMal
Supplies the RF signal with the standard power level of the instrument.

LOWNoise
Supplies a very low noise sinewave signal.

LOWDistortion
Supplies a very pure sinewave signal.

*RST: NORMal

Example: `SOURce1:POWer:LMODe LOWD`
Sets low distortion mode. The instrument reduces distortions of the RF signal to a minimum.

Manual operation: See " Mode " on page 71

[:SOURce<hw>]:POWer:MANual <Manual>

Sets the level for the subsequent sweep step if SWE:POW:MODE MAN.

Use a separate command for each sweep step.

Parameters:

<Manual> float

You can select any level within the setting range, where:
`STARt` is set with [:SOURce<hw>]:POWer:STARt
`STOP` is set with [:SOURce<hw>]:POWer:STOP
`OFFSet` is set with [:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet

Range: (STARt + OFFSet) to (STOP + OFFSet)
Increment: 0.01
Default unit: dBm

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See " Current Level" on page 125

[:SOURce<hw>]:POWer:MODE <Mode>

Selects the operating mode of the instrument 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
Sets sweep mode.
Set the range and current level with the commands:
[:SOURce<hw>]:POWer:STARt and [:SOURce<hw>]:POWer:STOP,
[:SOURce<hw>]:POWer:MANual.

*RST: CW

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See "State (RF level sweep)" on page 124

[:SOURce<hw>]:POWer:POWer <Power>

Sets the level **at the RF output** connector.

This value does not consider a specified offset.

The command [:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] sets the level of the "Level" display, that means the level containing offset.

See "RF frequency and level display with a downstream instrument" on page 64.

Parameters:

<Power> float

Level at the RF output, without level offset

Range: See data sheet
Increment: 0.01
Default unit: dBm

Example: `SOURce1:POWer:POWer 15`
Sets the level at RF output

Manual operation: See "Amplitude" on page 69

[:SOURce<hw>]:POWer:STARt <Start>
[:SOURce<hw>]:POWer:STOP <Stop>

Sets the RF start/stop level in sweep mode.

Parameters:

<Stop> float

Sets the setting range calculated as follows:
`(Level_min + OFFSet) to (Level_max + OFFSet)`
Where the values are set with the commands:
`[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`
`[:SOURce<hw>]:POWer:STARt`
`[:SOURce<hw>]:POWer:STOP`

Range: Minimum level to maximum level
*RST: -30 (Start)/ -10 (Stop)
Default unit: dBm

Example: See Example "Setup an RF frequency or power sweep" on page 445

Manual operation: See " Start Level / Stop Level " on page 130

[:SOURce<hw>]:POWer:STEP:MODE <Mode>

Defines the type of step width to vary the RF output power step-by-step with the commands POW UP or POW DOWN.

Parameters:

<Mode> DECimal | USER

DECimal
Increases or decreases the level in steps of ten.

USER
Increases or decreases the level in increments, determined with the command `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

*RST: DECimal

Example:

```
// increasing the RF level with a step size of 2 dB
SOURce1:POWer:STEP:INCRement 2
SOURce1:POWer:STEP:MODE USER
SOURce1:POWer:LEVel:IMMediate:AMPLitude UP
```

Manual operation: See "Variation Active" on page 67

[:SOURce<hw>]:POWer:STEP[:INCRement] <Increment>

Specifies the step width in the appropriate path for POW:STEP:MODE USER.

To adjust the level step-by-step with this increment value, use the command POW UP, or POW DOWN.

Note: The command also sets "Variation Step" in the manual control, that means the user-defined step width for setting the level with the rotary knob or the UP/DOWN arrow keys.

Parameters:

<Increment> float

Range: 0 to 100
Increment: 0.01
*RST: 1
Default unit: dB

Example: See `[:SOURce<hw>]:POWer:STEP:MODE` on page 436.

Manual operation: See "Variation Step" on page 67

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Sets the level offset of a downstream instrument.

The level at the RF output is not changed.

To query the resulting level, as it is at the output of the downstream instrument, use the command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]`.

See "RF frequency and level display with a downstream instrument" on page 64.

Note: The level offset also affects the RF level sweep.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.01
*RST: 0
Default unit: dB
Level offset is always expreced in dB; linear units (V, W, etc.) are not supported

Example: `POWer:OFFSet 10`
Sets the RF level offset to 10 dB

Manual operation: See " Offset " on page 70

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL <Rcl>

Determines whether the current level is retained or if the stored level setting is adopted when an instrument configuration is loaded.

Parameters:

<Rcl> INCLude | EXCLude

INCLude
Takes the current level when an instrument configuration is loaded.

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 198

[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

Sets the RF level applied to the DUT.

To activate the RF output use command `:OUTPut<hw>[:STATe]` ("RF On"/"RF Off").

The following applies `POWer = RF output level + OFFSet`, where:

- `POWer` is the values set with `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]`
- RF output level is set with `[:SOURce<hw>]:POWer:POWer`
- `OFFSet` is set with `[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`

Parameters:

<Amplitude> float

The following settings influence the value range:
`OFFSet` set with the command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet`

Numerical value
Sets the level

UP|DOWN
Varies the level step by step.
The level is increased or decreased by the value set with the command `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

Range: (Level_min + OFFSet) to (Level_max + OFFStet)
*RST: -30
Default unit: dBm

Example: `POWer -30`
Sets the RF level

Example: See also [:SOURce<hw>]:POWer:STEP:MODE on page 436.

Manual operation: See "Amplitude" on page 69

[:SOURce<hw>]:POWer:RANGe:LOWer?
[:SOURce<hw>]:POWer:RANGe:UPPer?

Queries the current interruption-free range of the level.

Return values:

<Upper> float

Increment: 0.01
Default unit: dBm

Example:

```
SOURce1:POWer:RANGe:UPPer?
// -15
SOURce1:POWer:RANGe:LOW?
// -50
```

Usage: Query only

Manual operation: See " Level Range " on page 71

[:SOURce]:POWer:WIGNore <State>

Ignores level range warnings.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: `SOURce:POWer:WIGNore 1`

12.15.11 SOURce:ROSCillator Subsystem

The `SOURce:ROSCillator` subsystem contains the commands for setting the external and internal reference frequency.

The commands of this subsystem are not affected by an instrument reset (*RST on page 308).

Example: Configuring the reference oscillator

```
// Using 100 MHz external reference source
SOURce:ROSCillator:PRESet
SOURce:ROSCillator:SOURce EXT
SOURce:ROSCillator:EXTernal:RFOFf:STATe 1
SOURce:ROSCillator:EXTernal:FREQuency 100MHZ
SOURce:ROSCillator:EXTernal:SBANdwidth WIDE
// 100 MHz (loop thought) and 1 GHz output
SOURce:ROSCillator:OUTPut:FREQuency:MODE LOOP
SOURce:ROSCillator:OUTPut:ALTernate:FREQuency:MODE DER1G
SOURce:ROSCillator:INTernal:ADJust:STATe 0

// Variable external reference frequency
// SOURce:ROSCillator:EXTernal:FREQuency VAR
// SOURce:ROSCillator:EXTernal:FREQuency:VARiable 100000000

// Using the internal reference frequency
SOURce:ROSCillator:SOURce INT
SOURce:ROSCillator:INTernal:TUNing:STATe 1
SOURce:ROSCillator:INTernal:TUNing:SLOPe LOW
// 10 MHz and 1 GHz output
SOURce:ROSCillator:OUTPut:FREQuency:MODE DER10M
SOURce:ROSCillator:OUTPut:ALTernate:FREQuency:MODE DER1G
```

[:SOURce]:ROSCillator:PRESet

Resets the reference oscillator settings.

Example: See Example "Configuring the reference oscillator" on page 440.

Usage: Event

Manual operation: See "Set to Default" on page 179

[:SOURce]:ROSCillator:SOURce <Source>

Selects between internal or external reference frequency.

Parameters:

<Source> INTernal | EXTernal

*RST: n.a. (factory preset: INTernal)

Example: See Example "Configuring the reference oscillator" on page 440.

Manual operation: See "Source" on page 179

[:SOURce]:ROSCillator:INTernal:TUNing[:STATe] <State>

Activates the EFC (external frequency control).

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 1)

Example: See Example "Configuring the reference oscillator" on page 440.

Manual operation: See "External Tuning Active" on page 180

[:SOURce]:ROSCillator:INTernal:TUNing:SLOPe <State>

Sets the sensitivity of the external tuning volatge.

Parameters:

<State> LOW | HIGH

*RST: n.a. (factory preset: LOW)

Example: See Example "Configuring the reference oscillator" on page 440.

Manual operation: See "External Tuning Slope" on page 180

[:SOURce]:ROSCillator:EXTernal:RFOFf[:STATe] <State>

Determines that the RF output is turned off when the external reference signal is selected, but missing.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: See Example "Configuring the reference oscillator" on page 440.

Manual operation: See "Deactivate RF Output (if external reference is missing)" on page 179

[:SOURce]:ROSCillator:EXTernal:FREQuency <Frequency>

Sets the frequency of the external reference.

Parameters:

<Frequency> 100MHZ | 1GHZ | VARiable | 10MHZ

*RST: n.a. (factory preset: 10MHZ)

Example: See Example "Configuring the reference oscillator" on page 440.

Options: VARiable requires R&S SMAB-K704
100MHZ|1GHZ require R&S SMAB-K703

Manual operation: See "External Reference Frequency" on page 179

[:SOURce]:ROSCillator:EXTernal:FREQuency:VARiable <Frequency>

Specifies the user-defined external reference frequency.

Parameters:

<Frequency> float

Range: 1E6 to 100E6
Increment: 0.1
*RST: n.a. (factory preset: 1E7)
Default unit: Hz

Example: See Example "Configuring the reference oscillator" on page 440.

Options: R&S SMAB-K704

Manual operation: See "Variable Reference Frequency" on page 180

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <SBandwidth>

Selects the PLL synchronization bandwidth depending on the used external reference signal.

For more information, see data sheet.

Parameters:

<SBandwidth> WIDE | NARRow

NARRow
The synchronization bandwidth is a few Hz.
Suitable for external reference sources with phase noise worse than the R&S SMA100B.

WIDE
Uses the widest possible synchronization bandwidth; achieves best residual phase noise performance and phase stability between the synchronized devices.
For more information, see data sheet.

*RST: n.a. (factory preset: WIDE)

Example: See Example "Configuring the reference oscillator" on page 440.

Manual operation: See "Synchronization Bandwidth" on page 180

[:SOURce]:ROSCillator:OUTPut:FREQuency:MODE <OutpFreqMode>

Sets the output reference frequency.

Parameters:

<OutpFreqMode> DER10M | DER100M | OFF | LOOPthrough

OFF
Disables the output.

DER10M|DER100M
Sets the output reference frequency to 10 MHz or 100 MHz.
The reference frequency is derived from the internal reference frequency.

LOOPthrough
Forwards the input reference frequency to the reference frequency output.

*RST: n.a. (factory preset: DER10M)

Example: See Example "Configuring the reference oscillator" on page 440.

Manual operation: See "Reference Output/1GHz Reference Output" on page 181

[:SOURce]:ROSCillator:OUTPut:ALTernate:FREQuency:MODE <OutpFreqMode>

Sets the output reference frequency.

Parameters:

<OutpFreqMode> LOOPthrough | DER1G | OFF

OFF
Disables the output.

DER1G
Sets the output reference frequency to 1 GHz.
The reference frequency is derived from the internal reference frequency.

LOOPthrough
Forwards the 1 GHz input reference frequency to the reference frequency output.

*RST: n.a. (factory preset: OFF)

Example: See Example "Configuring the reference oscillator" on page 440.

Manual operation: See "Reference Output/1GHz Reference Output" on page 181

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue <Value>

Specifies the frequency correction value (adjustment value).

Parameters:

<Value> integer

*RST: 0

Example: See `[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]` on page 444

Manual operation: See "Adjustment DAC Value" on page 182

[: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.

Parameters:

<State> 0 | 1 | OFF | ON

0
Fine adjustment with the calibrated frequency value

1
User-defined adjustment value
The instrument is no longer in the calibrated state.
The calibration value is, however, not changed. The instrument resumes the calibrated state if you send
`SOURce:ROSCillator:INTernal:ADJust:STATe 0`.

*RST: n.a. (factory preset: 0)

Example:

```
// query calibration value
CALibration:ROSCillator?
// 32767
// Set an internal source
// Activate user-defined adjustment value of 1000
SOURce:ROSCillator:SOURce INT
SOURce:ROSCillator:INTernal:ADJust:STATe 1
SOURce:ROSCillator:INTernal:ADJust:VALue 1000

// to resume calibrated state
SOURce:ROSCillator:INTernal:ADJust:VALue 0
SOURce:ROSCillator:INTernal:ADJust:STATe 0
// or
// SYSTem:FPRest
```

Manual operation: See "Adjustment Active" on page 182

12.15.12 SOURce:SWEep Subsystem

The `SOURce:SWEep` subsystem contains the commands for configuring RF sweep signals.

- The keyword `[:FREQuency]` can be omitted, then the commands are SCPI-compliant.
- To activate an 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 of each other.

For detailed information on the sweep modes and the triggering, see Chapter 5.1, "Signal Generation and Triggering in the Sweep and List Modes", on page 110.

Example: Setup an RF frequency or power sweep

The following example shows a command sequence to set up an RF frequency sweep, triggered by the execute command. For an RF power sweep, replace `FREQuency` in the `SWEep` commands with `POWer`.

Exceptions are the power spacing (defined with `LINear` only) and the power step width (defined with `LOGarithmic` only).

```
// Reset the instrument to start from an initial state
// Switch off display update to improve performance
// (especially with short dwell times)
// Set the sweep mode (first two commands) and the sweep range
// Select linear spacing
// Select the waveform shape for the frequency sweep
*RST; *CLS
SYSTem:DISPlay:UPDate OFF
TRIGger1:FSWeep:SOURce SINGle
SOURce1:SWEep:FREQuency:MODE AUTO
SOURce1:FREQuency:SPAN 300 MHz
SOURce1:FREQuency:CENTer 200 MHz
// Alternatively use
// SOURce1:FREQuency:STARt 50 MHz
// SOURce1:FREQuency:STOP 350 MHz
SOURce1:SWEep:FREQuency:SPACing LINear
SOURce1:SWEep:FREQuency:SHAPe SAWTooth

// Activate change to start frequency while waiting for next trigger
// Prerequisites: sweep mode single and sweep waveform sawtooth
SOURce1:SWEep:FREQuency:RETRace 1
// Alternatively reset all sweeps to their initial value
SOURce1:SWEep:RESet:ALL

// Set the step width and dwell time
SOURce1:SWEep:FREQuency:STEP:LINear 1 MHz
// Alternatively set the number of steps, then the sweep step width is
// set automatically
SOURce1:SWEep:FREQuency:POINts 301
```

```
SOURce1:SWEep:FREQuency:DWELl 500 ms
// With logarithmic spacing select the step width as follows
// (steps of 10 percent of the previous frequency in each instance)
SOURce1:SWEep:FREQuency:SPACing LOG
SOURce1:SWEep:FREQuency:STEP:LOGarithmic 10PCT

// Activate the sweep
// Trigger the sweep (depending on the set mode) and query the status
SOURce1:FREQuency:MODE SWEep
// Perform a one-off RF frequency sweep
SOURce1:SWEep:FREQuency:EXECute
SOURce1:SWEep:FREQuency:RUNNing?
// 1
// the frequency sweep is running

// For manual step RF sweep use the following commands
*RST; *CLS
// Activate manual step RF sweep
SOURce1:SWEep:FREQuency:MODE MANual
// Activate the RF frequency sweep.
SOURce1:FREQuency:MODE SWEep
// Activate RF Output1.
Output1:STATe 1
// Input the frequency manually for each step
SOURce1:FREQuency:MANual 200 MHz
SOURce1:FREQuency:MANual 201 MHz
// Alternatively use the UP or DOWN commands with the set step width.
SOURce1:SWEep:FREQuency:STEP:LINear 1 MHz
SOURce1:FREQuency:MANual UP
```

[:SOURce<hw>]:SWEep:POWer:DWELl <Dwell>

Sets the dwell time for a level sweep step.

Parameters:

<Dwell> float

Range: 1E-3 to 100
Increment: 100E-6
*RST: 15E-3
Default unit: s

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See " Dwell Time " on page 127

[:SOURce<hw>]:SWEep:POWer:MODE <Mode>

Sets the cycle mode for the level sweep.

Parameters:

<Mode> AUTO | MANual | STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. You can trigger every step individually with the command `[:SOURce<hw>]:POWer:MANual`.
The level value increases at each step by the value that you define with `[:SOURce<hw>]:POWer:STEP[:INCRement]`.
Values directly entered with the command `[:SOURce<hw>]:POWer:MANual` are not taken into account.

STEP
Each trigger triggers one sweep step only. The level increases by the value entered with `[:SOURce<hw>]:POWer:STEP[:INCRement]`.

*RST: AUTO

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See "Mode" on page 125

[:SOURce<hw>]:SWEep:POWer:POINts <Points>

Sets the number of steps within the RF level sweep range.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Parameters:

<Points> integer

Range: 2 to Max

Example: See Example "Setup an RF frequency or power sweep" on page 445.

[:SOURce<hw>]:SWEep:POWer:SPACing:MODE?

Queries the level sweep spacing. 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 step width for the RF level sweep. The level is increased by a logarithmically calculated fraction of the current level.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Parameters:

<Logarithmic> float

The unit `dB` is manatory.

Range: 0.01 to 139 dB
Increment: 0.01
*RST: 1
Default unit: dB

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See " Step " on page 131

[:SOURce<hw>]:SWEep[:FREQuency]:DWELl <Dwell>

Sets the dwell time for a frequency sweep step.

Parameters:

<Dwell> float

Range: 2E-3 to 100
Increment: 100E-6
*RST: 15E-3
Default unit: s

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See " Dwell Time " on page 127

[:SOURce<hw>]:SWEep[:FREQuency]:MODE <Mode>

Sets the cycle mode for the frequency sweep.

Parameters:

<Mode> AUTO | MANual | STEP

AUTO
Each trigger event triggers exactly one complete sweep.

MANual
The trigger system is not active. You can trigger every step individually by input of the frequencies with the command `[:SOURce<hw>]:FREQuency:MANual`.

STEP
Each trigger event triggers one sweep step. The frequency increases by the value entered with `[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]` (linear spacing) or `[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic` (logarithmic spacing).

*RST: AUTO

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See "Mode" on page 125

[:SOURce<hw>]:SWEep[:FREQuency]:POINts <Points>

Sets the number of steps within the RF frequency sweep range.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Two separate `POINts` values are used for linear or logarithmic sweep spacing (`[:SOURce<hw>]:SWEep[:FREQuency]:SPACing` LIN | LOG). The command always affects the currently set sweep spacing.

Parameters:

<Points> integer

Range: 2 to Max

Example: See Example "Setup an RF frequency or power sweep" on page 445.

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing <Spacing>

Selects the mode for the calculation of the frequency intervals, with which the current frequency at each step is increased or decreased.

The keyword `[:FREQuency]` can be omitted; then the command is SCPI-compliant.

Parameters:

<Spacing> LINear | LOGarithmic

LINear
Sets a fixed frequency value as step width and adds it to the current frequency.
The linear step width is entered in Hz, see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]`.

LOGarithmic
Sets a constant fraction of the current frequency as step width and adds it to the current frequency.
The logarithmic step width is entered in %, see `[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic`.

*RST: LINear

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See " Spacing" on page 127

[:SOURce<hw>]:SWEep:POWer:SHAPe <Shape>
[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe <Shape>

Determines the waveform shape for a frequency sweep sequence.

Parameters:

<Shape> SAWTooth | TRIangle

*RST: SAWTooth

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See " Shape " on page 126

[:SOURce<hw>]:SWEep:POWer:EXECute
[:SOURce<hw>]:SWEep[:FREQuency]:EXECute

Executes an RF frequency sweep.

The command performs a single sweep and is therefore only effective in manual sweep mode.

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Usage: Event

Manual operation: See " Execute Single Sweep " on page 128

[:SOURce<hw>]:SWEep:POWer:RETRace <State>
[: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:	See Example "Setup an RF frequency or power sweep" on page 445.
Manual operation:	See "Retrace" on page 126

[:SOURce<hw>]:SWEep:POWer:RUNNing?
[:SOURce<hw>]:SWEep[:FREQuency]:RUNNing?

Queries the current sweep state.

Return values:

<State>	0 | 1 | OFF | ON
Example:	See Example "Setup an RF frequency or power sweep" on page 445.
Usage:	Query only

[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

Sets a logarithmically determined step width for the RF frequency sweep. The value is added at each sweep step to the current frequency.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Parameters:

<Logarithmic>	float The unit is mandatory. Range: 0.01 to 100 Increment: 1E-3 *RST: 1 Default unit: PCT
Example:	See Example "Setup an RF frequency or power sweep" on page 445.
Manual operation:	See " Step Linear/Step Logarithmic " on page 129

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] <Linear>

Sets the step width for linear sweeps.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

See Chapter 5.2.1, "Correlating Parameters in Sweep Mode", on page 118.

Omit the optional keywords so that the command is SCPI-compliant.

Parameters:

<Linear> float

Range: 0.001 Hz to (STOP - STARt)

Increment: 0.01

Example: See Example "Setup an RF frequency or power sweep" on page 445.

Manual operation: See " Step Linear/Step Logarithmic " on page 129

[:SOURce<hw>]:SWEep:RESet[:ALL]

Resets all active sweeps to the starting point.

Usage: Event

Manual operation: See " Reset Sweep " on page 128

12.16 SYSTem Subsystem

The `SYSTem` subsystem contains a series of commands for general functions which do not directly affect signal generation.

Example: Retrieving information on network-related settings

```
SYSTem:COMMunicate:NETWork:STATus?
// 1
SYSTem:PROTection1:STATe 0,123456

SYSTem:COMMunicate:NETWork:IPADdress:MODE STAT
SYSTem:COMMunicate:NETWork:IPADdress "10.113.0.104"
SYSTem:COMMunicate:NETWork:IPADdress:DNS "10.0.2.166"
SYSTem:COMMunicate:NETWork:COMMon:HOSTname?
// "SMA100B-102030"
SYSTem:COMMunicate:NETWork:COMMon:WORKgroup "instrument"
SYSTem:COMMunicate:NETWork:COMMon:DOMain "rsint.net"
SYSTem:COMMunicate:NETWork:IPADdress:GATeway "10.113.0.1"
SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK "255.255.252.0"
SYSTem:COMMunicate:NETWork:MACaddress "08 00 27 a3 a1 70"
SYSTem:PROTection1:STATe 1
```

Example: Finding out the used VISA ressource strings

```
SYSTem:COMMunicate:NETWork:RESource?
// "TCPIP::10.113.0.104::inst0::INSTR"

SYSTem:COMMunicate:HISLip:RESource?
// "TCPIP::10.113.0.104::hislip0::INSTR"

SYSTem:COMMunicate:GPIB:RESource?
// "GPIB::28::INSTR"
SYSTem:COMMunicate:GPIB:SELF:ADDRess?
// 28
SYSTem:COMMunicate:GPIB:LTERminator?
// STAN

SYSTem:COMMunicate:SERial:RESource?
// "ASRL1::INSTR"
SYSTem:COMMunicate:SERial:SBITs?
// 1
SYSTem:COMMunicate:SERial:BAUD?
// 115200
SYSTem:COMMunicate:SERial:PARity?
// NONE

SYSTem:COMMunicate:SOCKet:RESource?
// "TCPIP::10.113.0.104::5025::SOCKET"
SYSTem:COMMunicate:USB:RESource?
// "USB::0x0AAD::0x0092::0::INSTR"
```

Example: Querying the error queue

```
SYSTem:ERRor:STATic?
// -221,"Settings conflict", 153,"Input voltage out of range", ...
// returns all static errors that are collectred in the error queue

SYSTem:ERRor:HISTory?
// 90,"Info;(*)Instrument startup... (Mar-13-2017/ 10:25:16-601 ms)",
90,"Info;(*)Information generated while processing license keys.,
Repaired Error!
COND: ( hr == false )
FILE: /home/sa_okbuildserver/jenkins/workspace/OK-Legacy-Distribution-30/
ok_services_oklib/Src/CServiceExtension.cpp
LINE: 3554
ADDITIONAL INFO: Init ServiceExtension failed, 2877, -2147218613
HRESULT = 80001007
", 90,"Info;(A)Baseband info, [RF A] No frequency calibration data found.
Please run Adjust All!", 90,"Info;(A)Baseband info, [RF B] No frequency
calibration data found. Please run Adjust All!", 90,"Info;
(A)Baseband info, [BB A],...
// returns all entries of the error queue

SYSTem:ERRor:HISTory:ClEar
// Deletes the history entries
```

: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

Manual operation: See "Clear History" on page 501

: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> integer

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 "Show History / Show Static" on page 501

:SYSTem:ERRor:HISTory?

Queries the error history.

Note that the result can amount several kilobytes.

Return values:

<ErrorHistory> string

Example: See Example "Querying the error queue" on page 454

Usage: Query only

:SYSTem:ERRor:HISTory:CLEar

Clears the error history.

Example: See Example "Querying the error queue" on page 454

Usage: Event

Manual operation: See "Clear History" on page 501

:SYSTem:ERRor:STATic?

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: See Example "Querying the error queue" on page 454

Usage: Query only

:SYSTem:ULOCk <Mode>

Locks or unlocks the user interface of the instrument.

Parameters:

<Mode> ENABled | DONLy | DISabled | TOFF | VNConly

ENABled
Unlocks the display, the touchscreen and all controls for the manual operation.

DONLy
Locks the touchscreen and controls for the rmanual operation of the instrument. The display shows the current settings.

VNConly
Locks the touchscreen and controls for the rmanual operation, and enables remote operation over VNC. The display shows the current settings.

TOFF
Locks the touchscreen for the rmanual operation of the instrument. The display shows the current settings.

DISabled
Locks the display, the touchscreen and all controls for the manual operation.

*RST: n.a. (factory preset: ENABled)

Example: SYST:ULOC ON
activates the user interface lock.

Manual operation: See "User Interface" on page 234

:SYSTem:DLOCk <DispLockStat>

Disables the manual operation via the display, including the front panel keyboard of the instrument and the LOCAL key.

Parameters:

<DispLockStat> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: SYST:DLOC ON
Activates the display lock. The instrument cannot be operated via the display until it has been enabled with SYST:DLOC OFF.

Manual operation: See "User Interface" on page 234

:SYSTem:KLOCk <State>

Disables the front panel keyboard of the instrument including the LOCAL key.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 0)

Example: SYST:KLOC ON
Locks the front panel and external controls.
To enable the controls, send SYST:KLOC OFF.

Manual operation: See "User Interface" on page 234

:SYSTem:PROTect<ch>[:STATe] <State>[, <Key>]

Activates and deactivates the specified protection level.

Suffix:

<ch> Indicates the protection level.
See also "Protection" on page 230

Parameters:

<State> 0 | 1 | OFF | ON

*RST: n.a. (factory preset: 1)

Setting parameters:

<Key> integer

The respective functions are disabled when the protection level is activated. No password is required for activation of a level.
A password must be entered to deactivate the protection level.
The default password for the first level is 123456.
This protection level is required to unlock internal adjustments for example.

Example:

```
// to activate protection level
SYSTem:PROTect1:STATe 1
// internal adjustments or hostname cannot be changed
// to unlock protection level 1
SYSTem:PROTect1:STATe 0,123456
// internal adjustments are accessible
```

Manual operation: See "Protection Level/Password" on page 232

:SYSTem:SECurity:VOLMode[:STATe] <SecPassWord>, <MmemProtState>

Activates volatile mode, so that no user data can be written to the internal memory permanently.

To enable volatile mode, reboot the instrument. Otherwise the change has no effect.

Parameters:

<MmemProtState> 0 | 1 | OFF | ON

*RST: 0

Setting parameters:

<SecPassWord> string

Current security password
The default password is 123456.

Example:

```
SYSTem:SECurity:VOLMode:STATe "123456", 1
SYSTem:REBoot
```

Manual operation: See "Volatile Mode" on page 233

:SYSTem:COMMunicate:GPIB:LTERminator <LTerminator>

Sets the terminator recognition for remote control via GPIB interface.

Parameters:

<LTerminator> STANdard | EOI

EOI
Recognizes an LF (Line Feed) as the terminator only when it is sent with the line message EOI (End of Line). This setting is recommended particularly for binary block transmissions, as binary blocks may coincidentally contain a characater with value LF (Line Feed), although it is not determined as a terminator.

STANdard
Recognizes an LF (Line Feed) as the terminator regardless of whether it is sent with or without EOI.

*RST: n.a. (factory preset: STANdard)

Example: See Example "Finding out the used VISA ressource strings" on page 453.

: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: See Example "Finding out the used VISA ressource strings" on page 453.

Usage: Query only

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

Sets the GPIB address.

Parameters:

<Address> integer

Range: 0 to 30
*RST: 28

Example: See Example "Finding out the used VISA ressource strings" on page 453.

:SYSTem:COMMunicate:HISLip:RESource?

Queries the VISA resource string . This string is used for remote control of the instrument with HiSLIP protocol.

Return values:

<Resource> string

Example: See Example "Finding out the used VISA ressource strings" on page 453.

Usage: Query only

:SYSTem:COMMunicate:NETWork:IPADdress <IpAddress>

Sets the IP address.

Parameters:

<IpAddress> string

Range: 0.0.0.0. to ff.ff.ff.ff

Example: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "IP Address" on page 257

:SYSTem:COMMunicate:NETWork:IPADdress:MODE <Mode>

Selects manual or automatic setting of the IP address.

Parameters:

<Mode> AUTO | STATic

*RST: n.a. (factory preset: AUTO)

Example: See Example "Retrieving information on network-related settings" on page 452.

Example:

```
SYSTem:COMMunicate:NETWork:IPADdress:MODE STATic
SYSTem:COMMunicate:NETWork:IPADdress "10.113.0.105"
```

Manual operation: See "Address Mode" on page 256

:SYSTem:COMMunicate:NETWork:MACaddress <MacAddress>

Queries the MAC address of the network adapter.

This is a password-protected function. Unlock the protection level 1 to access it, see `:SYSTem:PROTect<ch>[:STATe]`.

Parameters:

<MacAddress> string

Example: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "MAC Address" on page 256

:SYSTem:COMMunicate:NETWork:RESource?

Queries the visa resource string for Ethernet instruments.

Return values:

<Resource> string

Example: See Example "Finding out the used VISA ressource strings" on page 453.

Usage: Query only

:SYSTem:COMMunicate:NETWork:RESTart

Restarts the network.

Example:

```
SYSTem:COMMunicate:NETWork:RESTart
// Terminates the network connection and sets it up again
```

Usage: Event

Manual operation: See "Restart Network" on page 258

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Return values:

<State> 0 | 1 | OFF | ON

Example: See Example "Retrieving information on network-related settings" on page 452.

Usage: Query only

Manual operation: See "Network Status" on page 256

:SYSTem:COMMunicate:NETWork[:COMMon]:DOMain <Domain>

Determines the primary suffix of the network domain.

Parameters:

<Domain> string

Example: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "DNS Suffix" on page 257

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

Sets an individual hostname for the Signal Generator.

Note: We recommend that you do not change the hostname to avoid problems with the network connection. If you change the hostname, be sure to use a unique name.

This is a password-protected function. Unlock the protection level 1 to access it, see `:SYSTem:PROTect<ch>[:STATe]`.

Parameters:

<Hostname> string

Example: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "Hostname" on page 256

:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup <Workgroup>

Sets an individual workgroup name for the instrument.

Parameters:

<Workgroup> string

Example: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "Workgroup" on page 256

:SYSTem:COMMunicate:NETWork[:IPADdress]:DNS <DNS>

Determines or queries the network DNS server to resolve the name.

Parameters:

<DNS> string

Example: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "DNS Server" on page 258

: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: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "Default Gateway" on page 257

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

Sets the subnet mask.

Parameters:

<Mask> string

Example: See Example "Retrieving information on network-related settings" on page 452.

Manual operation: See "Subnet Mask" on page 257

:SYSTem:COMMunicate:SERial:BAUD <Baud>

Defines the baudrate for the serial remote control interface.

Parameters:

<Baud> 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200

*RST: n.a. (factory preset: 115200)

Example: See Example "Finding out the used VISA ressource strings" on page 453.

Manual operation: See "Baud Rate" on page 260

:SYSTem:COMMunicate:SERial:PARity <Parity>

Enters the parity for the serial remote control interface.

Parameters:

<Parity> NONE | ODD | EVEN

*RST: n.a. (factory preset: NONE)

Example: See Example "Finding out the used VISA ressource strings" on page 453.

Manual operation: See "Parity" on page 260

: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: See Example "Finding out the used VISA ressource strings" on page 453.

Usage: Query only

:SYSTem:COMMunicate:SERial:SBITs <SBits>

Defines the number of stop bits for the serial remote control interface.

Parameters:

<SBits> 1 | 2

*RST: n.a. (factory preset: 1)

Example: See Example "Finding out the used VISA ressource strings" on page 453.

Manual operation: See "Stop Bits" on page 260

: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: See Example "Finding out the used VISA ressource strings" on page 453.

Usage: Query only

:SYSTem:COMMunicate:USB:RESource?

Queries the visa resource string for remote control via the USB interface.

Return values:
<Resource> string

Example: See Example "Finding out the used VISA ressource strings" on page 453.

Usage: Query only

:SYSTem:HELP:EXPort

Saves the online help as zip archive in the user directory.

Example:
```
:SYSTem:HELP:EXPort
MMEM:CDIR?
// "/var/user"
MMEM:CAT?
// ..,"Log,DIR,4096","help.tgz,BIN,69836600"
// confirms that help zip archive is saved.
```

Usage: Event

Manual operation:: "Setup > Help > Export Help to User Path"

:SYSTem:IDENtification <Identification>

Selects the mode to determine the "IDN String" and the "OPT String" for the instrument, selected with command `:SYSTem:LANGuage`.

Note: While working in a emulation mode, the R&S SMA100B specific command set is disabled, that is, the SCPI command `SYST:IDEN` will be discarded.

Parameters:

<Identification> AUTO | USER

AUTO
Automatically determines the "IDN String" and the "OPT String".

USER
Enables the selection of user definable "IDN String" and "OPT String".

*RST: n.a. (factory preset: AUTO)

Example: `SYST:IDEN AUTO`
automatically asigns the OPT and IDN strings accoording to the selected instrument language.

Manual operation: See "Mode" on page 261

:SYSTem:IDENtification:PRESet

Sets the `*IDN` and `*OPT` strings in user defined mode to default values.

Example:
```
SYST:IDEN USER
SYST:IDEN:PRES
```

Usage: Event

Manual operation: See "Set to Default" on page 261

:SYSTem:LANGuage <Language>

Sets the remote control command set.

Parameters:

<Language> string

Example:
```
SYSTem:LANGuage "SCPI"
// selects SCPI command set
```

Manual operation: See "Language" on page 261

:SYSTem:INFormation:SCPI <InfoString>

Inserts system information in recorded SCPI command lists, for example information on a missing command.

Parameters:

<InfoString> string

Example: `SYST:INF:SCPI "missing command"`
enters the information into a recorded SCPI command list.

:SYSTem:SECurity:SANitize[:STATe] <SecPassWord>, <MmemProtState>

Sanitizes the internal memory.

Parameters:
<MmemProtState> 0 | 1 | OFF | ON
*RST: 0

Setting parameters:
<SecPassWord> string

Example:
```
SYSTem:SECurity:SANitize[:STATe] 1
//
```

Manual operation: See "Sanitize" on page 234

:SYSTem:SPECification? <Id>

Retrieves data sheet information for a specific parameter.

Setting parameters:
<Id> string
Identifies the name of the entry in the data sheet, as quieried with the command `:SYSTem:SPECification:IDENtification:CATalog?` on page 469

Return values:
<ValList> float
Comma-separated list with the specified and, if available, the typical value of the parameter, as specified in the data sheet.
See also "Data Sheet" on page 270.

Example: Retrieving instruments specification
Note: The following values are merely an example.

```
// query the data sheet versions stored in the instrument
:SYSTem:SPECification:VERSion:CATalog?
// "04.03,04.02,04.01,04.00,03.04,03.03,03.02,03.01,03.00,
// 02.96,02.95,02.94,02.02,02.01,02.00,01.03,01.02,01.01,01.00"

// query the data sheet version with that the instrument was delivered
:SYSTem:SPECification:VERSion:FACTory?
// "04.00"

// select a data sheet version
:SYSTem:SPECification:VERSion?
// 04.00
:SYSTem:SPECification:VERSion "04.01"
// selects one particular data sheet version
// queries regarding data sheet parameters (IDs) and their values
// refer to this particular data sheet

// query the IDs of all parameters
// listed in the selected data sheet version
:SYSTem:SPECification:IDENtification:CATalog?
// "ID_RF_FREQ_SETTING_TIME_ALC_ON_MS,ID_RF_FREQ_SETTING_TIME_MS,..."

// query the data sheet information on a specific parameter,
// defined by its ID
:SYSTem:SPECification? "ID_RF_FREQ_SETTING_TIME_ALC_ON_MS"
// returned is the specified and, if available,
// the typical value of the parameter
```

Usage: Query only

:SYSTem:SPECification:VERSion <Version>

Selects a data sheet version from the data sheets saved on the instrument.

Further queries regarding the data sheet parameters (`<Id>`) and their values refer to the selected data sheet.

To query the list of data sheet versions, use the command `:SYSTem:SPECification:VERSion:CATalog?` on page 470.

Parameters:
<Version> string

Example: See `:SYSTem:SPECification?` on page 468.

:SYSTem:SPECification:IDENtification:CATalog?

Queries the parameter identifiers (`<Id>`) available in the data sheet.

Return values:

<IdList> string

Comma-separated string of the parameter identifiers (`<Id>`)

Example: See `:SYSTem:SPECification?` on page 468.

Usage: Query only

:SYSTem:SPECification:PARameter? <Id>[, <Parameter>]

Retrieves data sheet information for a specific parameter.

Setting parameters:

<Id> string

Identifies the name of the entry in the data sheet.
Query the data sheet parameters with the command `:SYSTem:SPECification:IDENtification:CATalog?`.

<Parameter> float

An additional value the result (`ValList`) depends on.

Return values:

<ValList> float

Comma-separated list with the specified and, if available, the typical value of the parameter, as specified in the data sheet.

Example: **Note:** The following values are merely an example. Your instrument may not support the same parameters.

```
SYST:SPEC:PAR? "ID_RF_FREQ_SETTING_TIME_MS",0.1
SYST:SPEC:PAR? "ID_RF_LEVEL_MAX_GENERAL_DBM",
0.1
```

Usage: Query only

:SYSTem:SPECification:VERSion:CATalog?

Queries all data sheet versions stored in the instrument.

Return values:

<VersCatalog> string

Example: See `:SYSTem:SPECification?` on page 468.

Usage: Query only

:SYSTem:SPECification:VERSion:FACTory?

Queries the data sheet version of the factory setting.

Return values:

<Version> string

Example: See `:SYSTem:SPECification?` on page 468.

Usage: Query only

Manual operation: See "Versions" on page 497

:SYSTem:SRData?

Queris the SCPI recording data from the internal file.

This feature enables you to transfer an instrument configuration to other test environments, as e.g. laboratory virtual instruments.

Return values:

<FileData> block data

Example:

```
SYSTem:SRData?
// #3118:SOURce1:ROSCillator:SOURce EXT
:SOURce1:FREQuency:CW 4000000000
:SOURce1:FREQuency:OFFSet 1000000
:SOURce1:AM1:STATe 1
:OUTPut1:STATe 1
```

Usage: Query only

: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:DATE <Year>, <Month>, <Day>

Queries or sets the date for the instrument-internal calendar.

This is a password-protected function. Unlock the protection level 1 to access it, see `:SYSTem:PROTect<ch>[:STATe]`.

Parameters:

<Year> integer

<Month> integer

Range: 1 to 12

<Day> integer

Range: 1 to 31

Example:
```
:SYSTem:DATE?
// 2016,05,01
```

Manual operation: See "Date" on page 487

:SYSTem:TIME <Hour>, <Minute>, <Second>

Queries or sets the time for the instrument-internal clock.

This is a password-protected function. Unlock the protection level 1 to access it, see :SYSTem:PROTect<ch>[:STATe].

Parameters:

<Hour> integer
Range: 0 to 23

<Minute> integer
Range: 0 to 59

<Second> integer
Range: 0 to 59

Example:
```
SYSTem:TIME?
// 10,27,14
```

Manual operation: See "Time" on page 487

:SYSTem:TIME:ZONE <TimeZone>

Sets the timezone. You can query the list of the available timezones with :SYSTem:TIME:ZONE:CATalog?.

Parameters:

<TimeZone> string

Manual operation: See "Timezone" on page 487

:SYSTem:TIME:ZONE:CATalog?

Querys the list of available timezones.

Return values:

<Catalog>

Usage: Query only

Manual operation: See "Timezone" on page 487

:SYSTem:UPTime?

Queries the up time of the operating system.

Return values:
<UpTime> "<ddd.hh:mm:ss>"

Example: `SYSTem:UPTime?`
Response: "`0.08:11:00`"

Usage: Query only

:SYSTem:BIOS:VERSion?

Queries the BIOS version of the instrument.

Return values:
<Version> string

Example: `SYST:BIOS:VERS?`
queries the BIOS version.
`Response: 123456`

Usage: Query only

: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 R&S SMA100B stores user files on.

Return values:
<PathUser> string

Example: `SYSTem:MMEMory:PATH:USER?`
Response: "'/var/user/"

Usage: Query only

:SYSTem:DFPR?

Queries the device footprint of the instrument. The retrieved information is in machine-readable form suitable for automatic further processing.

Return values:
<DeviceFootprint> string

Information on the instrument type and details on the installed FW version, hardware and software options.

Example: `:SYSTem:DFPR?`

Usage: Query only

:SYSTem:REBoot

Reboots the instrument including the operating system.

Usage: Event

:SYSTem:RESTart

Restarts the instrument without restarting the operating system.

Usage: Event

:SYSTem:SHUTdown

Shuts down the instrument.

Usage: Event

: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.

See Chapter 10.2.3, "Assigning Actions to the User Key", on page 225.

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

Manual operation: See "Wizard" on page 224

12.17 STATus Subsystem

This system contains the commands for the status reporting system. See also Chapter A.1.5, "Status Reporting System", on page 517 for detailed information.

`*RST` on page 308 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 SMA100B 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 457.

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

12.18 TEST Subsystem

The `TEST` subsystem contains the commands for performing test routines directly at the hardware assemblies.

The selftetst responses with a 0 if the test is performed successfully, otherwise a value other than 0 is returned. None of the commands of this system has a *RST value.

:TEST<hw>:ALL:STARt

Usage: Event

Starts the selftest. Use the command :TEST<hw>:ALL:RESult? to query the result.

:TEST<hw>:ALL:RESult?

Queries the result of the performed selftest. Start the selftest with :TEST<hw>:ALL:STARt.

Return values:

<Result> 0 | 1 | RUNning | STOPped

*RST: STOPped

Usage: Query only

12.19 TRIGger Subsystem

The TRIGger system contains the commands for selecting the trigger source for the RF and LF sweep.

You can work with an internal or with an externally applied trigger signal. In this case, use the commands in the SOURce:INPut subsystem to configure the signal.

The trigger system of the R&S SMA100B 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.
- The trigger source names correspond directly to the various settings of manual control. SCPI uses different names which are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

In addition to these commands, see more trigger-related commands in the modulation and RF signal subsystems.

Table 12-1: Cross-reference between the manual and remote control

R&S proprietary value name	SCPI conform value name	Parameter in manual control
AUTO	IMMediate	"Auto" mode
SINGle	BUS	"Single" mode.

R&S proprietary value name	SCPI conform value name	Parameter in manual control
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>
:TRIGger<hw>:LFFSweep:SOURce <Source>
:TRIGger<hw>:PSWeep:SOURce <Source>
:TRIGger<hw>[:SWEep]:SOURce <Source>

Selects the trigger source for the corresponding sweeps:

- `FSWeep` - RF frequency
- `LFFSweep` - LF frequency
- `PSWeep` - RF level
- `SWEep` - all sweeps

The source names of the parameters correspond to the values provided in manual control of the instrument. They differ from the SCPI-compliant names, but the instrument accepts both variants.

Use the SCPI name, if compatibility is an important issue. Find the corresponding SCPI-compliant commands in Cross-reference between the manual and remote control .

Setting parameters:

<Source> AUTO | IMMediate | SINGle | BUS | EXTernal | EAUTo

AUTO [IMMediate]
Executes a sweep automatically.
In this free-running mode, the trigger condition is met continuously. I.e. when a sweep is completed, the next one starts immediately.

SINGle [BUS]
Executes one complete sweep cycle.
The following commands initiate a trigger event:
`*TRG` on page 309
`[:SOURce<hw>]:SWEep:POWer:EXECute`
`[:SOURce<hw>]:SWEep[:FREQuency]:EXECute`
`:TRIGger<hw>[:SWEep][:IMMediate]`, `:TRIGger<hw>:PSWeep[:IMMediate]` and `:TRIGger<hw>:FSWeep[:IMMediate]`.
Set the sweep mode with the commands:
`[:SOURce<hw>]:SWEep:POWer:MODE AUTO|STEP`
`[:SOURce<hw>]:SWEep[:FREQuency]:MODE AUTO|STEP`
`[:SOURce<hw>]:LFOutput:SWEep[:FREQuency]:MODE AUTO|STEP`
In step mode (`STEP`), the instrument executes only one step.

EXTernal
An external signal triggers the sweep.

EAUTo
An external signal triggers the sweep. When one sweep is finished, the next sweep starts.
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: See Example "Setup an LF sweep" on page 400

Usage: Setting only

Manual operation: See "Mode" on page 125

:TRIGger<hw>:FSWeep[:IMMediate]
:TRIGger<hw>:PSWeep[:IMMediate]
:TRIGger<hw>:LFFSweep:IMMediate
:TRIGger<hw>[:SWEep][:IMMediate]

Performs a single sweep and immediately starts the activated, corresponding sweep:

- `FSWeep` - RF frequency
- `PSWeep` - RF level
- `LFFSweep` - LF frequency
- `SWEep` - all sweeps

Effective in the following configuration:

- `TRIG:FSW|LFFS|PSW|[:SWE]:SOUR` **SING**
- `SOUR:SWE:FREQ|POW:MODE` **AUTO** or `SOUR:LFO:SWE:[FREQ:]MODE` **AUTO**

Alternativelly, you can use the `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 128

:TRIGger<hw>:LFFSweep

Executes an LF frequency sweep in the following configuration:

- `TRIG:LFFS:SOUR` **SING**
- `LFO:SWE:MODE` **AUTO**

Example:

```
LFO:SWE:MODE AUTO
TRIG:LFFS:SOUR SING
TRIG:LFFSweep
```

Usage: Event

12.20 UNIT Subsystem

The `UNIT` subsystem is used to set default units for parameters if no unit is indicated in a command. These settings are valid for the entire instrument.

Example: Setting default units for remote control

```
UNIT:POW V
UNIT:ANGL DEG
```

Sets V (volts) as unit of all power parameters, DEG (degrees) for the phase modulation angle and KMH for the speed.

:UNIT:ANGLe <Angle>

Sets the default unit for phase modulation angle. The command affects no other parameters, such as RF phase, or the manual control or display.

Parameters:

<Angle> DEGree | DEGRee | RADian
*RST: RADian

:UNIT:POWer <Power>

Sets the default unit for all 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

13 Maintenance

The instrument does not need periodic maintenance. Only the cleaning of the instrument is essential.

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.

NOTICE

Risk of damage during shipment

Insufficient protection against mechanical and electrostatic effects during shipment can damage the instrument.

- When shipping an instrument, use the original packaging. If you do not have the original packaging, use sufficient padding to prevent the instrument from moving around inside the box.
- Pack the instrument in antistatic wrap to protect it from electrostatic charging.
- Secure the instrument to prevent any movement and other mechanical effects during transportation.

13.1 Cleaning

WARNING

Risk of electric shock

If moisture enters the casing, for example if you clean the instrument using a moist cloth, contact with the instrument can lead to electric shock. Before cleaning the instrument other than with a dry cloth, 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 such as solvents (thinners, acetone, etc.), acids, bases, or other substances. Solvents can damage the front panel labeling, plastic parts, or screens, for example.

Never use cleaning agents to clean the outside of the instrument. Use a soft, dry, lint-free dust cloth instead.

NOTICE

Risk of instrument damage due to obstructed fans

If the instrument is operated in dusty areas, the fans become obstructed by dust or other particles over time. Check and clean the fans regularly to ensure that they always operate properly. If the instrument is run with obstructed fans for a longer period, the instrument overheats, which can disturb the operation and even cause damage.

1. Clean the outside of the instrument using a soft, dry, lint-free dust cloth.
2. Check and clean the fans regularly to ensure that they always operate properly.
3. Clean the touchscreen as follows:
   a) Apply a small amount of standard screen cleaner to a soft cloth.
   b) Wipe the screen gently with the moist, but not wet, cloth.
   c) If necessary, remove any excess moisture with a dry, soft cloth.

13.2 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.

13.3 Performing Maintenance Tasks

The R&S SMA100B is accurate due to integrated adjustment procedures, which you can execute directly on the instrument.

Internal Adjustments

NOTICE

Risk of DUT damage

During internal adjustments, the instrument temporarily applies high power at the RF output. This high power can destroy a connected DUT (device under test).

Do not start internal adjustments if DUT is connected.

Disconnect the DUT and replace it by a terminating resistor with adequate power rating. We recommend that you use a 50 Ohm, 10 W or larger terminating resistor.

NOTICE

Risk of invalid adjustment

Wait until the instrument has reached its operating temperature before you start the adjustment procedure. The warm-up time is 30 minutes.

Self-calibration routines that require additional (external) equipment are performed at an authorized Rohde & Schwarz service center.

See also "Protection levels" on page 230.

When to perform adjustments?

We recommend that you perform internal adjustments in the following cases:

- Before starting any application, that requires a maximum of level and frequency accuracy
- When a long period of time has passed since the last adjustments
- If the ambient temperature of the instrument significantly differs from the one of the last adjustments.

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.

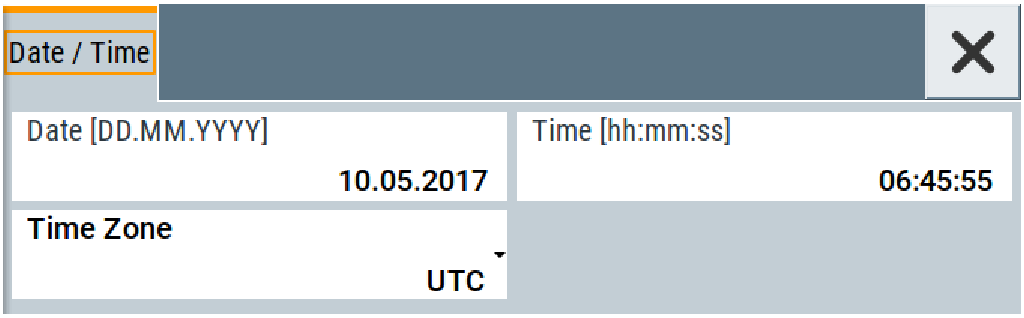
13.3.1 Date and Time Settings

The R&S SMA100B 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 licenses.

You can see the current date and time as follows:

► Select "System Config > Setup > Maintenance > Date / Time".



The "Date / Time" dialog contains the time and data settings of the operating system.
This function is password-protected. Unlock the protection level 1 to access it, see "Protection Level/Password" on page 232.
To set the date and time, proceed as described in "To set the date and time" on page 30.

The required remote commands are described in Chapter 12.16, "SYSTem Subsystem", on page 452.

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

Remote command:
`:SYSTem:DATE` on page 471

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

The time setting corresponds to the selected Timezone.

Remote command:
`:SYSTem:TIME` on page 472

Timezone
Selects the timezone.

You can select the timezone 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 472
:SYSTem:TIME:ZONE:CATalog? on page 472

13.3.2 Check Front Panel

With the functions provided in this dialog, you can verify the functionality of the control keys and the touchscreen.

For Instructions on how to perform the tests and the expected results, see Chapter 13.3.2.2, "How to Perform the Front Panel Tests", on page 489

In case of malfunctions:

Contact the Rohde & Schwarz customer support, see Chapter 14.6, "Obtaining Technical Support", on page 503.

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.

13.3.2.1 Check Front Panel Settings

Access:

► Select "System Config > Setup > Maintenance > Check Front Panel".

Reflecting the front panel, the "Check Front Panel" dialog contains all functions to test the operating elements of the instrument. In addition, you can check the touch-sensitive functionality by dragging one or more lines across the screen with your finger.

13.3.2.2 How to Perform the Front Panel Tests

How to perform the touchscreen calibration

The screen responds to the touch of your finger, that means you can select or activate an item by tapping it. Due to the design of the touchscreen, the capture area is firmly set to a certain size and you do not need to define a range. But if the instrument does not respond correctly to the touch, we recommend that you calibrate the touchscreen.

How to perform the key panel test

To perform the key 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, check each key of the front panel. The test is only completed, when you have verified all keys.

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

1. Press the SETUP key.
2. Select "Maintenance > 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, except for 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.

► Press the ESC key a third time.
Exits the "Check Front Panel" dialog.

Expected responses:

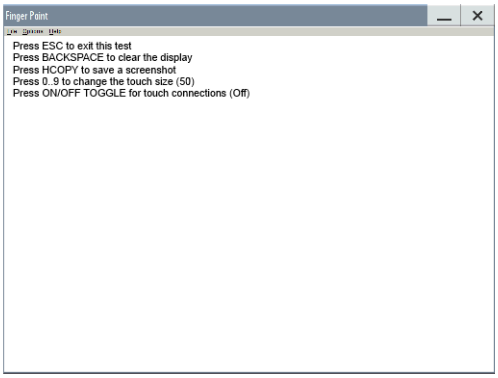
- Pressing a key once (green), pressing twice (red)
- Pressing the ESC key a third time exits the dialog.

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.

Contact the Rohde & Schwarz customer support, see Chapter 14.6, "Obtaining Technical Support", on page 503.

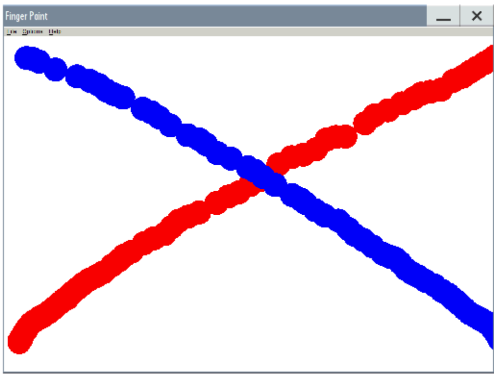
How to perform the touchscreen test

1. Press the SETUP key.
2. Select "Maintenance > Check Touch Panel"
3. Select "Touchscreen Test" to access the "Finger Paint" test window.

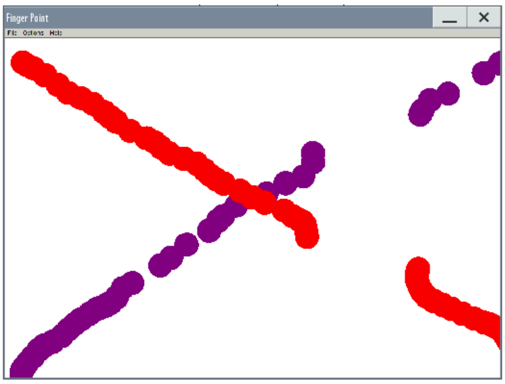


4. Drag with your finger one or more lines, for example diagonally across the screen. The test traces the movements of your finger on the screen.

   The following results are expected:
   - If the lines are uninterrupted, the touchscreen works properly.

   - If there are any gaps, the touch-sensitive functionality is damaged.



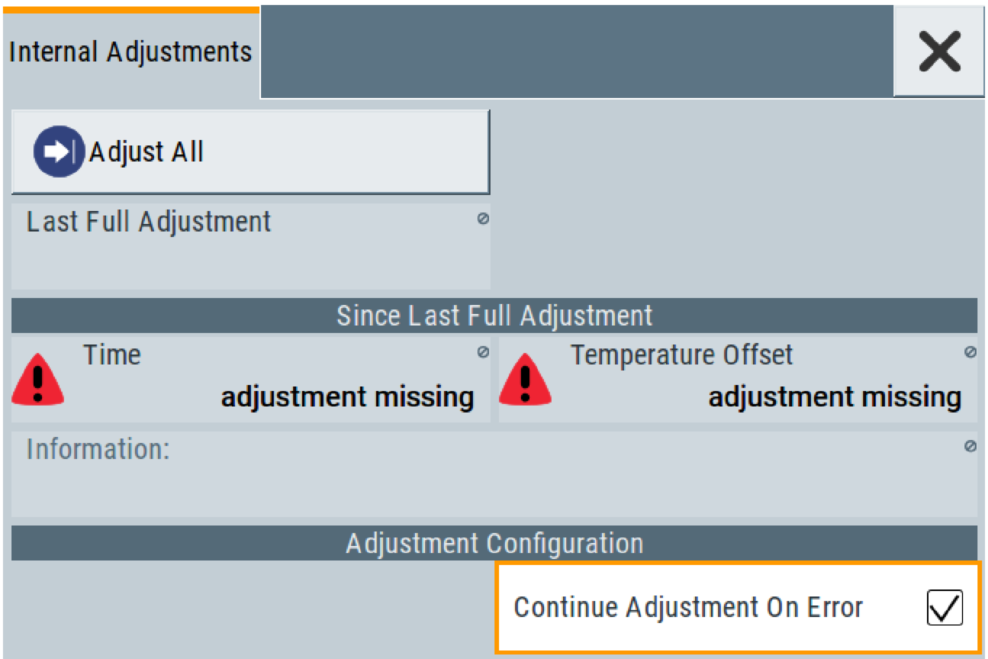
- To return to the "Check Front Panel" dialog, press ESC.

In case of malfunctions:
Contact the Rohde & Schwarz customer support, see Chapter 14.6, "Obtaining Technical Support", on page 503.

13.3.3 Internal Adjustment Settings

Access:

► Select "System Config > Setup > System > Internal Adjustments".



In this dialog, you can perform internal calibration routines, and get information on the last performed calibration.

The remote commands required to define these settings are described in Chapter 12.6, "CALibration Subsystem", on page 321.

The information fields show by their background color whether the calibration state of the instrument is still sufficient. We recommend that you perform internal adjustments when either the temperature offset or the time since the last full adjustment exceeds the specified criteria, see Time Since Last Full Adjustment and Temperature Offset To Last Full Adjustment.

Further functions and individually targeted calibration routines are also available but password-protected.

- "Continue Adjustment On Error"
  These functions are password-protected. Unlock the protection level 1 to access them, see"Protection Level/Password" on page 232
- Calibration routines
  Self-calibration routines that require additional (external) equipment are performed in the Rohde & Schwarz service center.
  These functions are password-protected and require higher-level protection password, see "Protection levels" on page 230

For more information, see R&S SMA100B Service Manual.

Adjust All

Performs all available internal calibration routines of the instrument.

NOTICE! Risk of DUT damage. During internal adjustments, the instrument temporarily applies high power at the RF output. This high power can destroy a connected DUT (device under test).
Do not start internal adjustments if DUT is connected.

Disconnect the DUT and replace it by a terminating resistor with adequate power rating. We recommend that you use a 50 Ohm, 10 W or larger terminating resistor.

Remote command:
`:CALibration:ALL[:MEASure]?` on page 322

Last Full Adjustment

Displays the date and time of the last fully performed adjustments.

Remote command:
`:CALibration<hw>:ALL:DATE?` on page 324

Time Since Last Full Adjustment

Displays the elapsed days since the last full adjustment.

If the last adjustment has been performed more than 100 days ago, the background color of the parameter turns red.

Temperature Offset To Last Full Adjustment

Displays the temperature difference compared to the calibration temperature.

If the temperature deviates more than ± 5 K, the background of the parameter turns red.

Remote command:
`:CALibration<hw>:ALL:TEMP?` on page 324

Information
Displays information to the current adjustment state.

Continue Adjustment on Error
Continues the calibration even though an error was detected. By default adjustments are aborted on error.

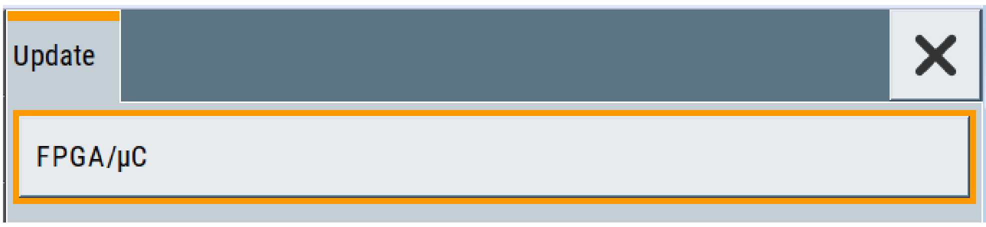
This function is password-protected. Unlock the protection level 1 to access it, see "Protection Level/Password" on page 232.

Remote command:
`:CALibration<hw>:CONTinueonerror` on page 323

13.3.4 FPGA/uC Update Settings

Access:

► Select "System Config > Setup > Maintenance > FPGA/μC Update".



This dialog enables you to update the PCI-FPGA.

FPGA/μC
Updates the FPGA/μC.

Remote command:
n.a.

13.3.5 Requesting Instrument Configuration and Specifications

The R&S SMA100B is equipped with various hardware and software components. To get an overview of what your instrument is equipped with, you can request the assemblies, hardware and software options, and the firmware version. The components are structured according to the hardware configuration, software options, including the license management, and externally used Rohde & Schwarz equipment, like R&S NRP power sensors.

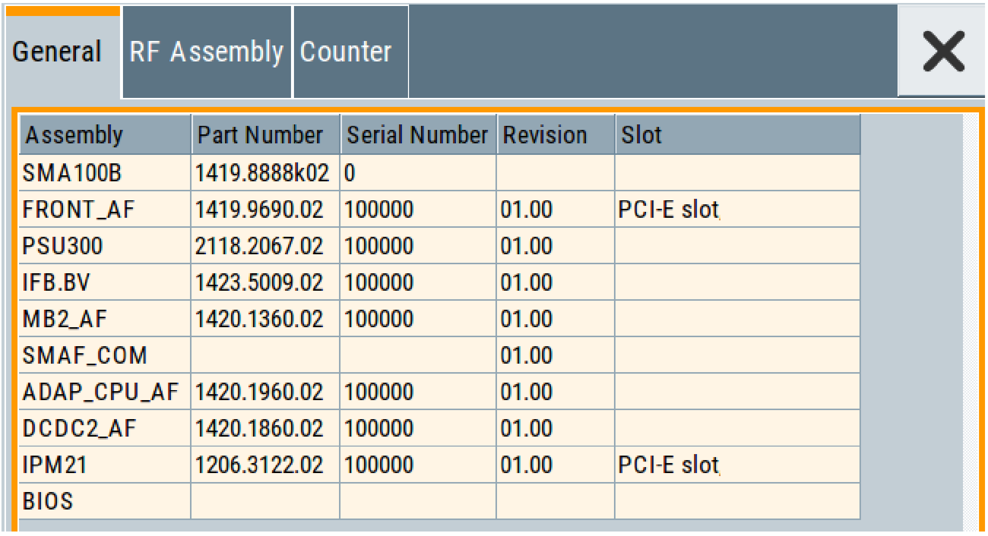
Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in chapter 4 of the R&S SMA100B service manual.

The installation of hardware options purchased at a later stage is also described in chapter 4 of the service manual. Most of the hardware options have to be installed at an authorized Rohde & Schwarz service center.

13.3.5.1 Hardware Configuration Settings

Access:

► Select "System Config > Setup > Instrument Assembly > Hardware Config".



Assembly	Part Number	Serial Number	Revision	Slot
SMA100B	1419.8888k02	0		
FRONT_AF	1419.9690.02	100000	01.00	PCI-E slot
PSU300	2118.2067.02	100000	01.00	
IFB.BV	1423.5009.02	100000	01.00	
MB2_AF	1420.1360.02	100000	01.00	
SMAF_COM			01.00	
ADAP_CPU_AF	1420.1960.02	100000	01.00	
DCDC2_AF	1420.1860.02	100000	01.00	
IPM21	1206.3122.02	100000	01.00	PCI-E slot
BIOS				

The "Hardware Config" dialog lists all installed assemblies and externally connected instruments with information on their part and serial numbers, and revision states. The dialog is divided in tabs, according to the hardware components of the signal domains. The "Counter" tab provides information on the operation time and number of times the instrument was powered on.

The remote commands required to query the hardware configuration are described in Chapter 12.8, "DIAGnostic Subsystem", on page 332.

Assembly

The tables in the tabs show characteristics of the installed assemblies.

"Assembly" Assembly designation.

"Part Number" Part number of the assembly.

"Serial Number"
Serial number of the assembly.

"Revision" Revision state of the assembly.

"Slot" Indicates whether the assembly is connected to the serial bus or PCI bus.

Remote command:
`:DIAGnostic<hw>:BGINfo?` on page 333

Counter
Displays information on the operation times of the R&S SMA100B.

Operation Time / h ← Counter
Displays the operation time in hours.

Remote command:
n.a.

Power On Count ← Counter
Displays the number of power-on.

Remote command:
n.a.

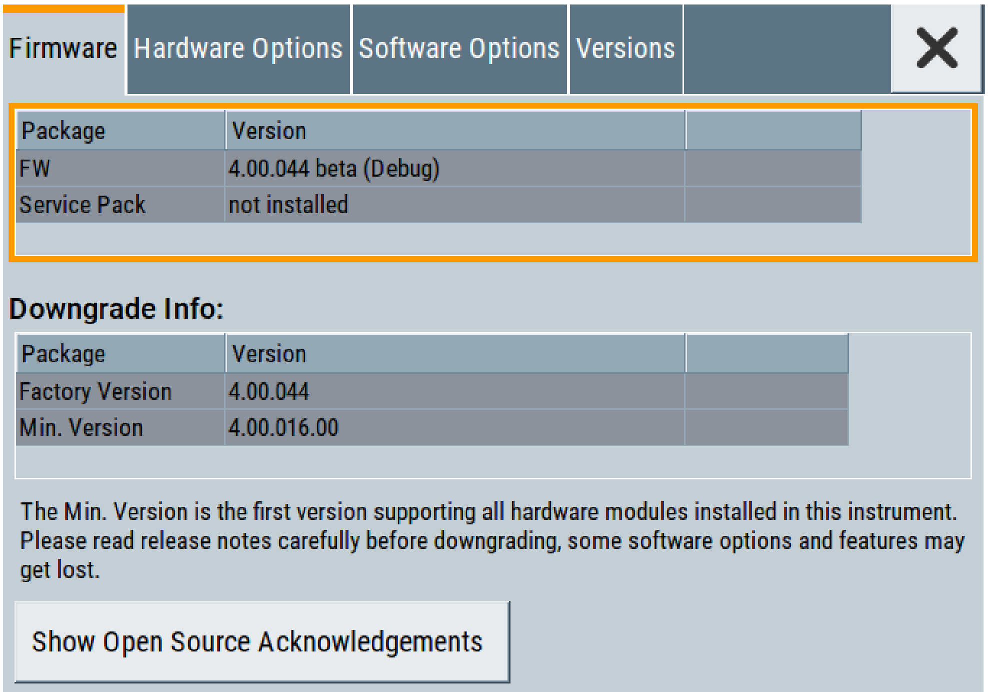
Last Factory Calibration ← Counter
Displays the date of the last factory calibration.

Remote command:
`:CALibration:DATA:FACTory:DATE?` on page 322

13.3.5.2 Versions/Options Settings

Access:

► Select "System Config > Setup > Instrument Assembly > Versions / Options".



The "Versions/Options" dialog shows the version of the installed instrument firmware, the hardware and software options, the data sheet and the software components of the firmware.

The remote commands required to query the hardware configuration are described in Chapter 12.8, "DIAGnostic Subsystem", on page 332.

Firmware
Shows the firmware version and the version of the software platform.

Note: Your instrument is delivered with the latest firmware version available.
You can download firmware updates and the "Release Notes" that describe the modifications and the firmware update procedure.

See www.rohde-schwarz.com/firmware/sma100b

Remote command:
n.a.

Downgrade Info
Shows downgrade information, like factory firmware version and minimum firmware version to that the instrument can be downgraded.

Remote command:
n.a.

Show Open Source Acknowledgments
Accesses the list of the used open source software packages and the corresponding verbatim license texts.

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

"Option" Short name of option

"Designation" Name of option

"Expiration Date"
For regular options, "Permanent" is indicated in this column. Some options are available as trial versions. This column shows their expiration date. After this date, the option is no longer available on the instrument.

Remote command:
`*OPT?` on page 307
`*IDN?` on page 306

Versions
The "Versions" tab shows the versions of the technical specification of the R&S SMA100B and of the software components that comprise the firmware.

"Package" Name of the component.

"Version" Current issue of the component.
E.g. the data sheet covers the technical data of the hardware components of the factory settings.
See also "Data Sheet" on page 270.

Remote command:
`:SYSTem:SPECification:VERSion:FACTory?` on page 470

14 Troubleshooting and Error Messages

The R&S SMA100B distinguishes between various 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 types of error messages and warnings. The status reporting system is described in detail in Chapter A.1.5, "Status Reporting System", on page 517.

You can also access an Info window with detailed information about all messages in a history list. For details, see Chapter 14.4, "Querying Error Messages & Info Key", on page 500

14.1 Error Messages

Error messages indicate errors in the instrument. They are displayed 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).

Some error messages require that the error must be eliminated before correct instrument operation can be ensured. To access the "Info" dialog with a list of current messages and a detailed description of each message, select "Info".

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.

14.1.1 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:CODE[:NEXT]?`

14.1.2 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 continued.

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:ERRor:STATic?`

14.2 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.

14.3 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 to 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.	
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
182	Adjustment data missing	Adjustment data is missing.	The adjustment data has to be generated first by an internal or external adjustment or to be loaded into the instrument.

Error Code	Error	Description	Remedy
183	Adjustment data invalid	Adjustment data is invalid and must be restored.	The adjustment data has 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	An 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 dialog. 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.	Check the selected list type.
460	Cannot open file	The selected file cannot be opened.	Check the path and file name.
461	Cannot write file	The file cannot be written.	Check if the file is read-only.
462	Cannot read file	The file cannot 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.	Enter file name when creating list.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extension.
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 is therefore invalid.	Check the file extension.

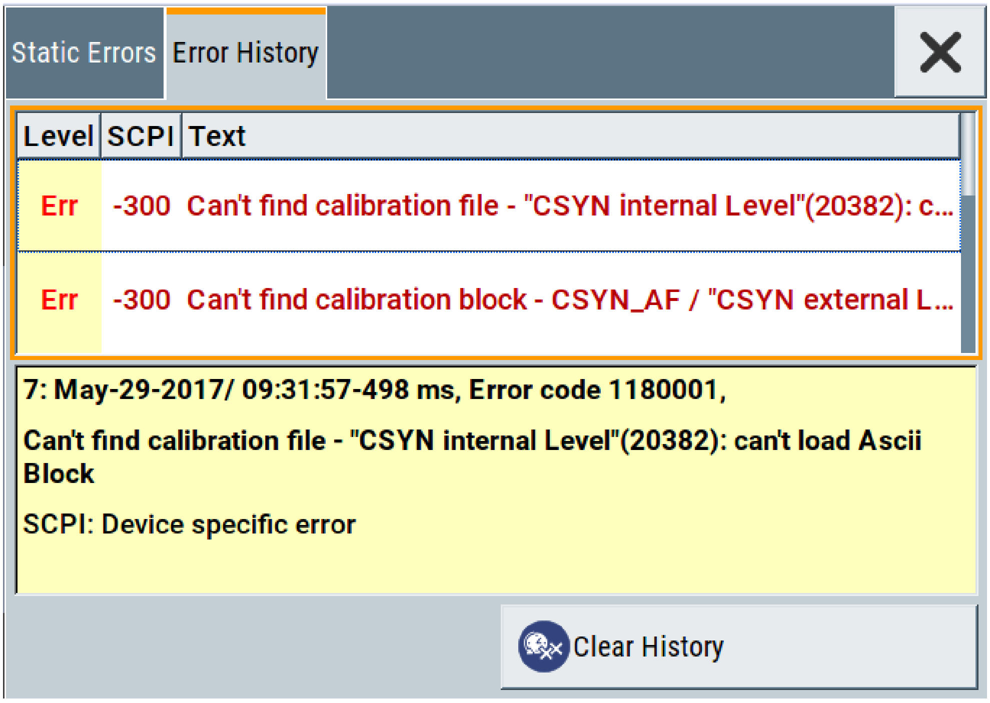
14.4 Querying Error Messages & Info Key

The R&S SMA100B monitors the functions performed and automatically detects errors and irregularities. The instrument displays the messages in the info-line and records them in the background with a detailed description.

Find details to the system messages in Chapter 14, "Troubleshooting and Error Messages", on page 498.

To display information on static errors and error history

1. In the taskbar, select the "Info" icon.
2. For some messages, the information line appears briefly on the home screen.
   To open the dialog, select the "Info" button.

   The "Static Errors" dialog list the last monitored messages chronologically and displays additional information on the highlighted message.
   In "Error History" dialog lists all accumulated messages with a short description.

If any critical error occurs, the R&S SMA100B automatically shows the icon in the taskbar. Select the icon to obtain information on the error and the number of occurrences.

The icon is assigned to permanent messages. The message and icon are displayed until the error is eliminated.

Clear History

Clears all messages in the "History" view.

Remote command:

`:SYSTem:ERRor:ALL?` on page 455

Each time a `SYST:ERR:ALL?` query is sent, the error queue is returned and at the same time cleared.

`:SYSTem:ERRor:HISTory:CLEar` on page 458

Clears the messages in the "History" view.

Show History / Show Static

Toggles between "History" and "Static" view of the info dialog.

Remote command:
:SYSTem:ERRor[:NEXT]? on page 457
Each time a SYST:ERR? query is sent, the oldest entry in the error queue is returned and at the same time cleared in the list.

14.5 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 SMA100B and certain switches or routers available on the market
- An invalid IP address assigned to the instrument

Possible solutions

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses
- Exchanging hardware

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 R&S SMA100B or 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 Chapter 10.4.3, "Configuring LAN Services", on page 236.
- Check whether the IP address of the instrument is within the network's address range.
  (See also "IP Address" on page 257).
  Check whether IP addresses that were set manually or obtained via the Zeroconf (APIPA) protocol are valid.

14.6 Obtaining Technical Support

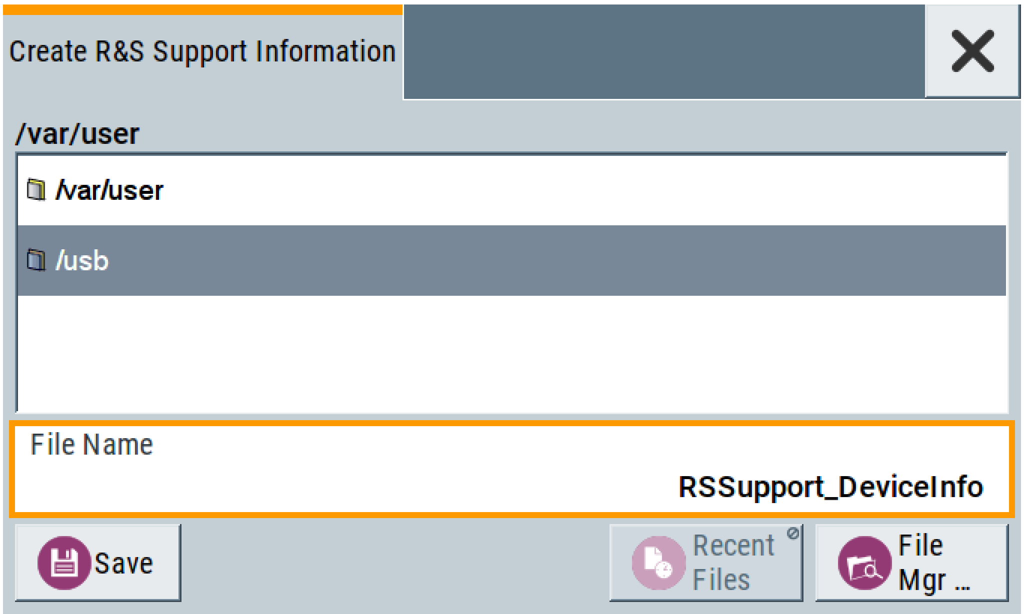
If problems occur, the instrument generates error messages which usually are sufficient for you to detect the cause of an error and find a remedy. Error message types are described in Chapter 14, "Troubleshooting and Error Messages", on page 498.

In addition, our customer support centers are there to assist you in solving any problems that you may encounter with your R&S SMA100B. We will find solutions more quickly and efficiently if you provide us with the following information.

- The following dialog boxes in the "Setup > Instrument Assembly" menu provide useful information:
  – **Hardware Configuration:** hardware assemblies
  – **Software and 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 have occurred
- **Support file:** a special file (`*.tar.gz` file) with important support information that can be created automatically.
  The support `*.tar.gz` file has a user definable name and contains the following files and information:
  – `SgErrors.txt`: chronological record of errors
  – `SystemRestaurationSMAB.savrcltxt`: instrument settings at the last correct shutdown of the instrument
  – `UndoHistSuppInfo.xml`: list of the last user interactions
  – `DeviceFootprint_<SerialNumber>_<Date>_<Time>.xml`: service-related information on the instrument's configuration.
  – `crashlog.txt`, `coredump`: Postmortem debug info
  – Several files with information on the last performed adjustment and self-test.

To collect error information in a support file

1. Connect a USB device to the R&S SMA100B.
2. Select "System Config > Setup > Maintenance > Create R&S Support Information".
3. In the "Create R&S Support Information" dialog, navigate to the `/usb` directory.
   Enter the support filename, for example `RSSupport_DeviceInfo`.



The error information and further required data is collected automatically.
The support file `RSSupport_DeviceInfo.tar.gz` is created and stored in the `/usb` directory.
Attach the support file an email in which you describe the problem. Send the email to the customer support address for your region as listed in the internet (http://www.customersupport.rohde-schwarz.com).

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 SMA100B".

Packing and transporting the instrument

If the instrument has to be transported or shipped, for example due to damage during delivery, observe the notes described Chapter 2.1.1.2, "Unpacking and Checking the Instrument", on page 20.

Annex

A Reference Information for Remote Control

A.1 Additional Basics on Remote Control

This section provides basic information using the remote control.

A.1.1 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 A.1.3, "SCPI Command Structure", on page 506. 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.

A.1.2 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.

A.1.3 SCPI Command Structure

SCPI commands consist of a 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.

A.1.3.1 Syntax for Common Commands

Common (= device-independent) commands consist of a header preceded by an asterisk (*), and possibly one or more parameters.

Table A-1: Examples of common commands

*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.

A.1.3.2 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.

A.1.3.3 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).

The parameters required for each command and the allowed range of values are specified in the command description.

Allowed parameters are:

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.

Example:

`SENS:FREQ:STOP 1500000` = `SENS:FREQ:STOP 1.5E6`

Units

For physical quantities, the unit can be entered. If the unit is missing, the basic unit is used. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)

- N (nano)

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 following mnemonics are special numeric values. In the response to a query, the numeric value is provided.

- **MIN and MAX**: denote the minimum and maximum value.
- **DEF**: 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 and 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 and DOWN.
- **INF and NINF**: INFinity and 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 mnemonic after 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 response to 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"`

`HCOP:ITEM:LABel 'Test1'`

Block Data

Block data is a format which is suitable for the transmission of large amounts of data. For example, a command using a block data parameter has the following structure:

`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.

A.1.3.4 Overview of Syntax Elements

The following tables provide an overview of the syntax elements and special characters.

Table A-2: Syntax elements

:	The colon separates the mnemonics of a command.
;	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.

Table A-3: Special characters

|	**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:
	Definition`SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
	The two following commands with identical meaning can be created:
	`SENS:BAND:RES 1`
	`SENS:BWID:RES 1`

[ ]	Mnemonics in square brackets are optional and may be inserted into the header or omitted. Example: `HCOPy[:IMMediate]` `HCOP:IMM` is equivalent to `HCOP`

{ }	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`

A.1.3.5 Structure of a Command Line

A command line may consist of one or several commands. It is terminated by one of the following:

- <New Line>
- <New Line> with EOI
- EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";".

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 next command belongs to a different command system, the semicolon is followed by a colon.

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.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. 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
```

Example:

```
HCOP:ITEM ALL
HCOP:IMM
```

A new command line always begins with the complete path.

A.1.3.6 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`
- Invalid numerical results
  In some cases, particularly when a result consists of multiple numeric values, invalid values are returned as 9.91E37 (not a number).

A.1.4 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command always completes executing before the next command starts. Commands that are processed quickly are defined as sequential commands. They are not implemented in the instrument. However, the execution time of most of the commands is so short that they act as sequential commands, if they are sent in separate command lines.
- An overlapping command is still running when the next command starts. Usually, an overlapping command takes a certain time to process its task, and thus allows the program to execute other tasks, while it is still running. If overlapping commands have to follow a specific order, for example to avoid incorrect measurement readings, they must be executed in sequence. This is called synchronization between the controller and the instrument.

Several setting commands within a command line are not necessarily processed in the order they are received. Even if they are implemented as sequential commands. To follow a particular sequence, send each command in a separate line.

As a rule, send commands and queries in different program messages.

A.1.4.1 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. The controller can be forced to wait for the corresponding action to occur.

*Table A-4: Synchronization using *OPC, *OPC? and *WAI*

Com-mand	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 occurs when all pending operations are completed.	Send *OPC? directly after the command whose processing must be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Send *WAI directly after the command whose processing must 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 (with a timer) using the sequence: `*OPC; *ESR?`

   A return value (LSB) of 1 indicates that the overlapped command has finished.

A.1.4.2 Examples to Command Sequence and Synchronization

See the following examples to command sequences and synchronization. Some examples given illustrate possible constellations for overlapping tasks.

Example: Commands and queries in one message

The response to a query combined in a program message with commands that affect the queried value is not predictable.

The following commands always return the specified result:

`:FREQ:STAR 1GHZ;SPAN 100 :FREQ:STAR?`

Result:

`1000000000` (1 GHz)

Whereas the result for the following commands is not specified by SCPI:

`:FREQ:STAR 1GHz;STAR?;SPAN 1000000`

The result could be the value of `STARt` before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1 GHz if the instrument executes commands as they are received.

Example: Overlapping command with *OPC

The instrument implements `*RST` as an overlapped command. Assuming that `*RST` takes longer to execute than `*OPC`, sending the following command sequence results in initiating a reset and, after some time, setting the `OPC` bit in the `ESR`:

`*RST; *OPC`

Sending the following commands still initiates a reset:

`*RST; *OPC; *CLS`

However, since the operation is still pending when the instrument executes `*CLS`, forcing it into the "Operation Complete Command Idle" State (OCIS), `*OPC` is effectively skipped. The `OPC` bit is not set until the instrument executes another `*OPC` command.

Example: Overlapped command followed by non-conflicting commands

Suppose that the instrument is switched on to provide a real time test signal that requires some calculation time. At the same time, some settings for the configuration of a different signal are made which do not interact with the generated signal (for example the signal may be used later on). The signal generation and the signal configuration are independent from each other, so there is no need to synchronize the following overlapped commands:

```
SOUR:BB:3GPP:STAT ON
SOUR:BB:GSM:FORM FSK2
```

Example: Overlapped command followed by conflicting commands

Suppose that the generator is switched on to provide a real time test signal that requires some calculation time. This signal is to be added to a waveform from the second baseband generator. In this case, the application program has to make sure that the real signal is available in the added signal before further action is started. This involves an appropriate synchronization technique for the first command (the following sequence assumes an appropriate routing):

`SOUR:BB:3GPP:STAT ON`

The instrument waits until command has finished.

`SOUR2:BB:GSM:STAT ON`

Depending on the selected synchronization techniques, non-conflicting commands can be executed while waiting until the synchronized overlapped command has finished.

Example: Polling the progress of the zeroing process

Suppose that you start the zeroing for a connected power sensor via the remote control command `SENS1:ZERO`. This process blocks the processing of further tasks during execution. The query for completeness is performed with the `*OPC?` command. It returns a `1` in the output buffer when the process is completed.

`SENS:ZERO;*OPC?`

Instead of waiting via `*OPC?`, you can perform alternative tasks while the zeroing is running, as for example updating the GUI or adjusting other instruments. Synchronize the commands by querying the progress of the zeroing process periodically via the event status register `*ESR?`:

`*SRE 32`

Sets the service request enable. The bit is set when an event in the event status register occurs.

`*ESE 1`

Configures the mask of the event status register to "Operation Complete".

`SENS:ZERO;*OPC`

Sets the evaluation via the status byte query. It uses `*OPC?` as the reference.

`*CLS`

Clears all status registers.

Even if the instrument is busy, you can perform this procedure, since the query is executed in a subchannel.

A.1.5 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.

A.1.5.1 Hierarchy of the Status Registers

The Figure A-1 shows the hierarchical structure of information in the status registers (ascending from left to right).

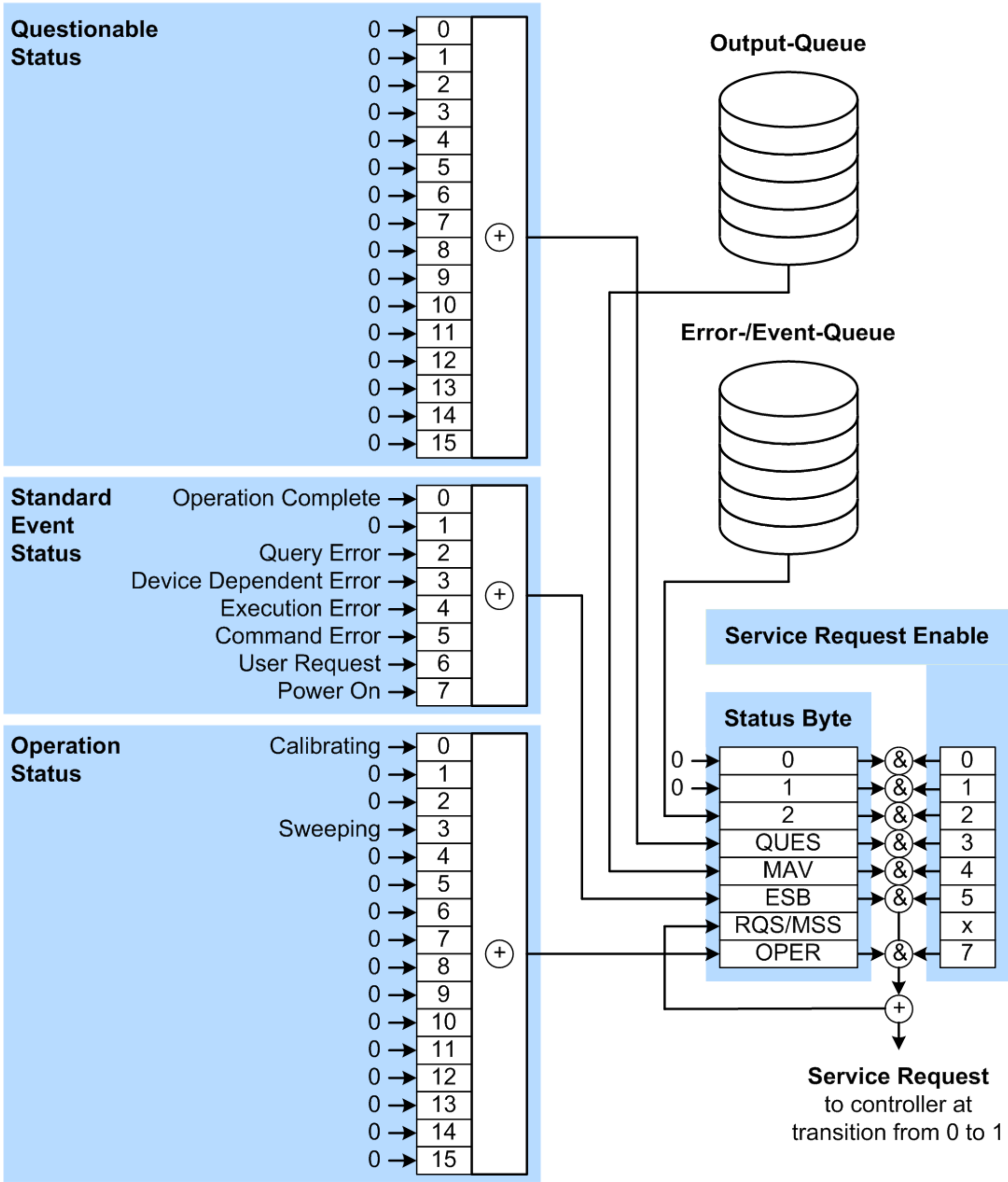


Figure A-1: Graphical overview of the status registers hierarchy

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 SMA100B uses the following status registers:

- **Status Byte** (STB) and **Service Request Enable** (SRE), see Chapter A.1.5.3, "Status Byte (STB) and Service Request Enable Register (SRE)", on page 521.
- **Standard Event Status**, i.e. the Event status Register (ESR) and the Event Status Enable (ESE), see Chapter A.1.5.4, "Event Status Register (ESR) and Event Status Enable Register (ESE)", on page 522.
- **Questionable Status** and **Operation Status**, the (SCPI status registers, see Chapter A.1.5.2, "Structure of a SCPI Status Register", on page 519, Chapter A.1.5.5, "Questionable Status Register (STATus:QUEStionable)", on page 523 and Chapter A.1.5.6, "Operation Status Register (STATus:OPERation)", on page 523.
- **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`.

A.1.5.2 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.

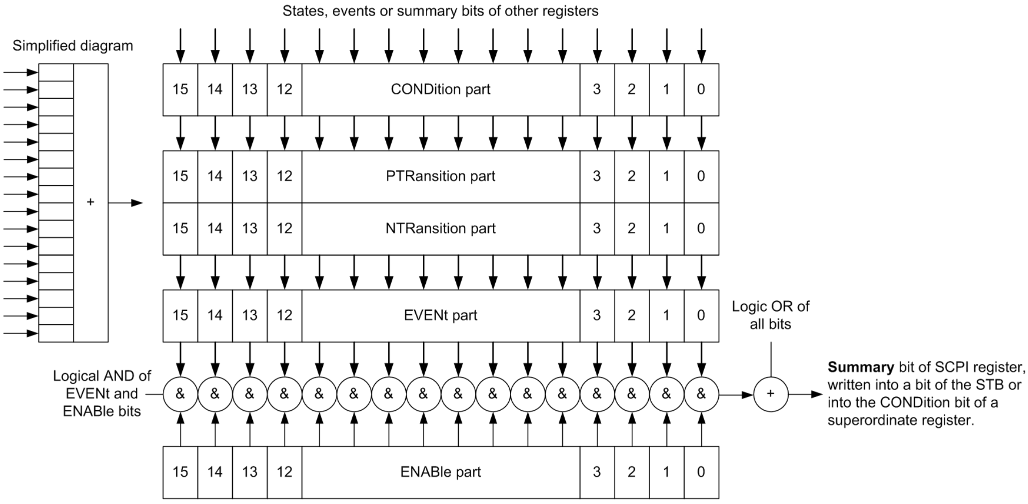


Figure A-2: The status-register model

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.

A.1.5.3 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 A-5: 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.

Bit No.	Meaning
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.

A.1.5.4 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 A-6: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	Not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.

Bit No.	Meaning
5	Command Error This bit is set if a command 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.

A.1.5.5 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 A-7: Meaning of the bits used in the questionable status register

Bit No.	Meaning
0–15	Not used

A.1.5.6 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 A-8: 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

A.1.5.7 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**

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.

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.

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.

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]?`. 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.

A.1.5.8 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 A-9: 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.						

A.1.6 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.

A.2 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 SMA100B 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;
}
```

B Hardware Interfaces

This section covers hardware-related topics, like pin assignment of the IEC 625/IEEE 488 interface.

The remote control interfaces are described in details in Chapter 11, "Network Operation and Remote Control", on page 243.

All other interfaces are described in Chapter 2.2, "Instrument Tour", on page 32.

For specifications, refer to the data sheet.

B.1 GPIB-Bus Interface

Option: R&S SMAB-B86.

Pin assignment

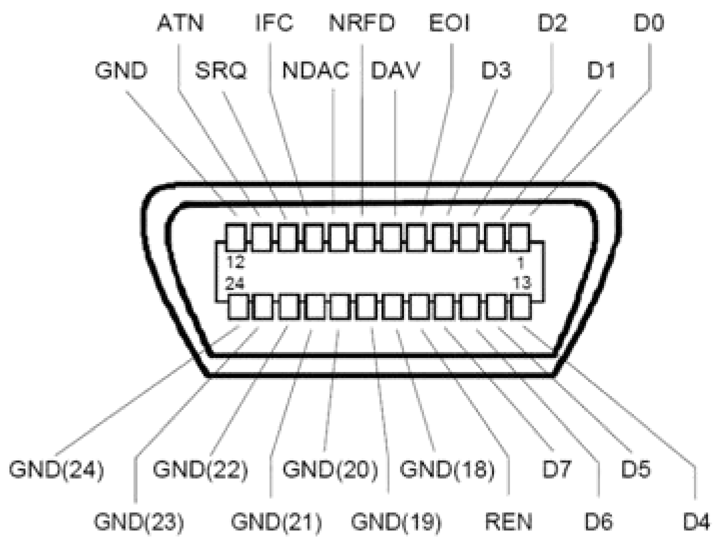


Figure B-1: Pin assignment of GPIB-bus (IEEE 488) interface

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 interface can be equipped with different interface functions. Table B-1 lists the interface functions for the R&S SMA100B.

Table B-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

C Extensions for User Files

The Table C-1 lists all available file extensions for user files. The currently available files on the instrument depend on the installed options.

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

Function	List type	Contents	File suffix
Instrument State	Settings	Instrument settings	`*.savrcltxt`
License Key		License Key	`*.xml`
"User Correction"	List	User-defined level correction values	`*.uco`
"List Mode"	List	User-defined frequency/level value pairs	`*.lsw`
	Settings	Response file	`*.txt`
"Pulse Train"	Settings	Pulse train data	`*.pulstrn`
"NRP Settings"	Settings	R&S NRP Settings	`*.nrp`
SCPI command list	List	Export file containing list of SCPIs	`*.iec`
R&S Support Info Archive	Support File	Automatically collected support information	`*.tar.gz`
Tutorials	Tutorial files	Lists containing SCPIs and explanations	`*.tut`

Glossary: List of the Often Used Terms and Abbreviations

A

Absolute file path: Complete file path

B

Base unit: This term describes a R&S SMA100B equipped with the option R&S SMAB-B103.

C

Clock: A mandatory internal or an external reference clock signal for generating the timing pulse in the instrument.

Complete file path: The complete file path specifies the root directory and all subdirectories that contain a file or folder.
See also Chapter 12.5.2, "Accessing Files in the Default or in a Specified Directory", on page 313.

Computer name: An unambiguous indication of the instrument a LAN that uses a DNS server.
The default computer name follows the syntax `SMAB100A-<serial number>`, e.g. *SMA100B-102030*.
Synonym: Hostname
See Serial number.

D

daisy chain: A connection scheme in which instruments are connected together in sequence, i.e. an output of the first one is the connected to an input of the second one, etc.

DHCP: Dynamic host configuration protocol

DNS: Domain name system server

E

e.g.: For example

External mass memory: External memory, connected to the instrument via mini USB connector. It can hold stored files with user data.
See also System drive and SD card

F

File transfer: The transmission of files from or to the instrument by a remote client.

The instrument supports the standard methods FTP and file sharing according to SAMBA/SMB.

FTP: File transfer protocol

Full file path: Complete file path

G

Glossary: List of the often used terms and abbreviations

GUI: Graphical user interface

H

HDD: Hard disk drive, see System drive

Hostname: Computer name

I

i.e.: That is

L

LF: Low frequency

LSB: Least significant bit

M

MIMO: Multiple input multiple output

MSB: Most significant bit

P

PC: Personal computer

Power: A term describing the signal level of the RF signal

product page: A designation of the R&S SMA100B product page http://www.rohde-schwarz.com/product/SMA100B.html

R

Remote access: Remote operation

Remote control: The operation of the R&S SMA100B by remote control commands or programs to perform automated tests.
The instrument is connected to a system controller via LAN/VXI-11, GPIB or USB using VISA. The instrument is controlled directly or supported by instrument drivers.

Remote device: External device controls the R&S SMA100B in remote operation mode, see Remote operation.
Synonyms: External controller, client device

Remote operation: Allows you to operate the R&S SMA100B from a remote device via VNC.
Both the R&S SMA100B and the remote device are connected in a LAN.
Synonym: Remote access

Removable memory: General term describing mass memory that can be unmounted from the instrument.
See also SD card

RF: Radio frequency

S

SAMBA/SMB: Server message protocol

SD card: Secure digital card is a type of removable memory storage, that can hold files with user data.
Support of this memory type is optional and requires option R&S SMAB-B85.
Throughout this description, the SD card is referred as a removable memory.
See also System drive.

Serial number: Unique instrument identification, provided on the rear panel of the instrument and required to build the Computer name.
The serial number are the last 6 digits in the string `<stock no.>-<serial number>`, e.g. `SMA100B-102030`

Smart device: A mobile, cordless device, such as a smartphone or tablet, capable of Internet browsing.
Synonyms: Smartphone, tablet

System drive: The system drive is a built-in internal memory that holds the operating system, the firmware, and the stored user data.
Throughout this description, the system drive is referred as an internal memory.
See also SD card and Removable memory

T

Trigger: Internally generated or externally supplied signal which starts signal generation at a particular point in time

Trigger event: A trigger event is caused by the received trigger signal or executed manual trigger.

U

UE: User equipment

USBTMC: (USB test & measurement class)
A protocol built on top of USB for communication with USB devices. Using VISA library, it supports service request, triggers, and other specific operations, similar to GPIB.

User directory: Describes the default file storage location for user data.
Depending on the installed options, the user directory is physically located on the System drive or on the Removable memory
In the file system, user directory is always indicated as **`/var/user`**

V

VISA: Virtual instrument software architecture

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