R&S®SGS100A SGMA RF Source
User Manual

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Test & Measurement

User Manual

ROHDE&SCHWARZ

This document describes the R&S®SGS100A, stock no. 1416.0505.02 and its options.

- R&S®SGS-B1 (1416.2408.02)
- R&S®SGS-B26 (1416.1353.02)
- R&S®SGS-B106/106V (1416.2308.02/1416.2350.02)
- R&S®SGS-B112/112V (1416.1553.02/1416.1576.02)
- R&S®SGS-K22 (1416.2650.02)
- R&S®SGS-K90 (1416.2608.02)

This manual describes firmware version FW 3.50.124.xx and later of the R&S®SGS100A.

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The following abbreviations are used throughout this manual: R&S®SGS100A is abbreviated as R&S SGS, R&S®SGMA-GUI is abbreviated as R&S SGMA-GUI, R&S®SGU100A is abbreviated as R&S SGU, R&S®FSW is abbreviated as R&S FSW, R&S®AFQ100B is abbreviated as R&S AFQ100B, R&S®SMW200A is abbreviated as R&S SMW.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

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

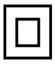
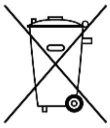
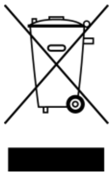
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

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

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

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

Signal words and their meaning

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

DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates information considered important, but not hazard-related, e.g. messages relating to property damage. In the product documentation, the word ATTENTION is used synonymously.

These signal words are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

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

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency, overvoltage category 2, pollution degree 2.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

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

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the mains-supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If there is no power switch for disconnecting the product from the mains, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the mains. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC 60950-1 / EN 60950-1 or IEC 61010-1 / EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

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

2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal/Environmental protection", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).
8. EMC classes (in line with EN 55011/CISPR 11, and analogously with EN 55022/CISPR 22, EN 55032/CISPR 32)
   - Class A equipment:
     Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings
     Note: Class A equipment is intended for use in an industrial environment. This equipment may cause radio disturbances in residential environments, due to possible conducted as well as radiated disturbances. In this case, the operator may be required to take appropriate measures to eliminate these disturbances.
   - Class B equipment:
     Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.

2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

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

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

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
   Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

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

Instrucciones de seguridad elementales

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

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

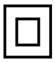
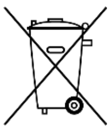
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

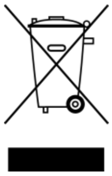
Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto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

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

Señalización de seguridad de los productos

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

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

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

Palabras de señal y su significado

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

⚠ PELIGRO	Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.
⚠ ADVERTENCIA	Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.
⚠ ATENCIÓN	Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.
AVISO	Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales. En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

Estados operativos y posiciones de funcionamiento

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

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

Seguridad eléctrica

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

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.

6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.
5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

Reparación y mantenimiento

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

Baterías y acumuladores o celdas

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

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
6. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
7. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.

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

Eliminación/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado.
   Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

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

Grundlegende Sicherheitshinweise

Lesen und beachten Sie unbedingt die nachfolgenden Anweisungen und Sicherheitshinweise!

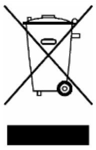
Alle Werke und Standorte der Rohde & Schwarz Firmengruppe sind ständig bemüht, den Sicherheitsstandard unserer Produkte auf dem aktuellsten Stand zu halten und unseren Kunden ein höchstmögliches Maß an Sicherheit zu bieten. Unsere Produkte und die dafür erforderlichen Zusatzgeräte werden entsprechend der jeweils gültigen Sicherheitsvorschriften gebaut und geprüft. Die Einhaltung dieser Bestimmungen wird durch unser Qualitätssicherungssystem laufend überwacht. Das vorliegende Produkt ist gemäß beiliegender EU-Konformitätsbescheinigung gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen. Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muss der Benutzer alle Hinweise, Warnhinweise und Warnvermerke beachten. Bei allen Fragen bezüglich vorliegender Sicherheitshinweise steht Ihnen die Rohde & Schwarz Firmengruppe jederzeit gerne zur Verfügung.

Darüber hinaus liegt es in der Verantwortung des Benutzers, das Produkt in geeigneter Weise zu verwenden. Das Produkt ist ausschließlich für den Betrieb in Industrie und Labor bzw., wenn ausdrücklich zugelassen, auch für den Feldeinsatz bestimmt und darf in keiner Weise so verwendet werden, dass einer Person/Sache Schaden zugefügt werden kann. Die Benutzung des Produkts außerhalb des bestimmungsgemäßen Gebrauchs oder unter Missachtung der Anweisungen des Herstellers liegt in der Verantwortung des Benutzers. Der Hersteller übernimmt keine Verantwortung für die Zweckentfremdung des Produkts.

Die bestimmungsgemäße Verwendung des Produkts wird angenommen, wenn das Produkt nach den Vorgaben der zugehörigen Produktdokumentation innerhalb seiner Leistungsgrenzen verwendet wird (siehe Datenblatt, Dokumentation, nachfolgende Sicherheitshinweise). Die Benutzung des Produkts erfordert Fachkenntnisse und zum Teil englische Sprachkenntnisse. Es ist daher zu beachten, dass das Produkt ausschließlich von Fachkräften oder sorgfältig eingewiesenen Personen mit entsprechenden Fähigkeiten bedient werden darf. Sollte für die Verwendung von Rohde & Schwarz-Produkten persönliche Schutzausrüstung erforderlich sein, wird in der Produktdokumentation an entsprechender Stelle darauf hingewiesen. Bewahren Sie die grundlegenden Sicherheitshinweise und die Produktdokumentation gut auf und geben Sie diese an weitere Benutzer des Produkts weiter.

Die Einhaltung der Sicherheitshinweise dient dazu, Verletzungen oder Schäden durch Gefahren aller Art auszuschließen. Hierzu ist es erforderlich, dass die nachstehenden Sicherheitshinweise vor der Benutzung des Produkts sorgfältig gelesen und verstanden sowie bei der Benutzung des Produkts beachtet werden. Sämtliche weitere Sicherheitshinweise wie z.B. zum Personenschutz, die an entsprechender Stelle der Produktdokumentation stehen, sind ebenfalls unbedingt zu beachten. In den vorliegenden Sicherheitshinweisen sind sämtliche von der Rohde & Schwarz Firmengruppe vertriebenen Waren unter dem Begriff „Produkt“ zusammengefasst, hierzu zählen u. a. Geräte, Anlagen sowie sämtliches Zubehör.

Symbole und Sicherheitskennzeichnungen

Symbol	Bedeutung	Symbol	Bedeutung
	Achtung, allgemeine Gefahrenstelle Produktdokumentation beachten	| ◯	EIN-/AUS (Versorgung)
	Vorsicht beim Umgang mit Geräten mit hohem Gewicht	⏻	Stand-by-Anzeige
	Gefahr vor elektrischem Schlag	⎓	Gleichstrom (DC)
	Warnung vor heißer Oberfläche	∼	Wechselstrom (AC)
	Schutzleiteranschluss	≂	Gleichstrom/Wechselstrom (DC/AC)
	Erdungsanschluss	⧈	Gerät entspricht den Sicherheits-anforderungen an die Schutzklasse II (Gerät durchgehend durch doppelte / verstärkte Isolierung geschützt.
	Masseanschluss des Gestells oder Gehäuses		EU - Kennzeichnung für Batterien und Akkumulatoren. Das Gerät enthält eine Batterie bzw. einen Akkumulator. Diese dürfen nicht über unsortierten Siedlungsabfall entsorgt werden, sondern sollten getrennt gesammelt werden. Weitere Informationen siehe Seite 7.
	Achtung beim Umgang mit elektrostatisch gefährdeten Bauelementen		EU - Kennzeichnung für die getrennte Sammlung von Elektro- und Elektronikgeräten. Elektroaltgeräte dürfen nicht über unsortierten Siedlungsabfall entsorgt werden, sondern müssen getrennt gesammelt werden. Weitere Informationen siehe Seite 7.
	Warnung vor Laserstrahl Produkte mit Laser sind je nach ihrer Laser-Klasse mit genormten Warnhinweisen versehen. Laser können aufgrund der Eigenschaften ihrer Strahlung und aufgrund ihrer extrem konzentrierten elektromagnetischen Leistung biologische Schäden verursachen. Für zusätzliche Informationen siehe Kapitel „Betrieb“ Punkt 7.		

Signalworte und ihre Bedeutung

Die folgenden Signalworte werden in der Produktdokumentation verwendet, um vor Risiken und Gefahren zu warnen.

GEFAHR	kennzeichnet eine unmittelbare Gefährdung mit hohem Risiko, die Tod oder schwere Körperverletzung zur Folge haben wird, wenn sie nicht vermieden wird.
WARNUNG	kennzeichnet eine mögliche Gefährdung mit mittlerem Risiko, die Tod oder (schwere) Körperverletzung zur Folge haben kann, wenn sie nicht vermieden wird.
VORSICHT	kennzeichnet eine Gefährdung mit geringem Risiko, die leichte oder mittlere Körperverletzungen zur Folge haben könnte, wenn sie nicht vermieden wird.
ACHTUNG	weist auf die Möglichkeit einer Fehlbedienung hin, bei der das Produkt Schaden nehmen kann.

Diese Signalworte entsprechen der im europäischen Wirtschaftsraum üblichen Definition für zivile Anwendungen. Neben dieser Definition können in anderen Wirtschaftsräumen oder bei militärischen Anwendungen abweichende Definitionen existieren. Es ist daher darauf zu achten, dass die hier beschriebenen Signalworte stets nur in Verbindung mit der zugehörigen Produktdokumentation und nur in Verbindung mit dem zugehörigen Produkt verwendet werden. Die Verwendung von Signalworten in Zusammenhang mit nicht zugehörigen Produkten oder nicht zugehörigen Dokumentationen kann zu Fehlinterpretationen führen und damit zu Personen- oder Sachschäden führen.

Betriebszustände und Betriebslagen

Das Produkt darf nur in den vom Hersteller angegebenen Betriebszuständen und Betriebslagen ohne Behinderung der Belüftung betrieben werden. Werden die Herstellerangaben nicht eingehalten, kann dies elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen. Bei allen Arbeiten sind die örtlichen bzw. landesspezifischen Sicherheits- und Unfallverhütungsvorschriften zu beachten.

1. Sofern nicht anders vereinbart, gilt für R&S-Produkte folgendes:
   als vorgeschriebene Betriebslage grundsätzlich Gehäuseboden unten, IP-Schutzart 2X, Verschmutzungsgrad 2, Überspannungskategorie 2, nur in Innenräumen verwenden, Betrieb bis 2000 m ü. NN, Transport bis 4500 m ü. NN, für die Nennspannung gilt eine Toleranz von ±10%, für die Nennfrequenz eine Toleranz von ±5%.
2. Stellen Sie das Produkt nicht auf Oberflächen, Fahrzeuge, Ablagen oder Tische, die aus Gewichts- oder Stabilitätsgründen nicht dafür geeignet sind. Folgen Sie bei Aufbau und Befestigung des Produkts an Gegenständen oder Strukturen (z.B. Wände und Regale) immer den Installationshinweisen des Herstellers. Bei Installation abweichend von der Produktdokumentation können Personen verletzt, unter Umständen sogar getötet werden.
3. Stellen Sie das Produkt nicht auf hitzeerzeugende Gerätschaften (z.B. Radiatoren und Heizlüfter). Die Umgebungstemperatur darf nicht die in der Produktdokumentation oder im Datenblatt spezifizierte Maximaltemperatur überschreiten. Eine Überhitzung des Produkts kann elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen.

Elektrische Sicherheit

Werden die Hinweise zur elektrischen Sicherheit nicht oder unzureichend beachtet, kann dies elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen.

1. Vor jedem Einschalten des Produkts ist sicherzustellen, dass die am Produkt eingestellte Nennspannung und die Netznennspannung des Versorgungsnetzes übereinstimmen. Ist es erforderlich, die Spannungseinstellung zu ändern, so muss ggf. auch die dazu gehörige Netzsicherung des Produkts geändert werden.
2. Bei Produkten der Schutzklasse I mit beweglicher Netzzuleitung und Gerätesteckvorrichtung ist der Betrieb nur an Steckdosen mit Schutzkontakt und angeschlossenem Schutzleiter zulässig.
3. Jegliche absichtliche Unterbrechung des Schutzleiters, sowohl in der Zuleitung als auch am Produkt selbst, ist unzulässig. Es kann dazu führen, dass von dem Produkt die Gefahr eines elektrischen Schlags ausgeht. Bei Verwendung von Verlängerungsleitungen oder Steckdosenleisten ist sicherzustellen, dass diese regelmäßig auf ihren sicherheitstechnischen Zustand überprüft werden.
4. Sofern das Produkt nicht mit einem Netzschalter zur Netztrennung ausgerüstet ist, beziehungsweise der vorhandene Netzschalter zu Netztrennung nicht geeignet ist, so ist der Stecker des Anschlusskabels als Trennvorrichtung anzusehen.
   Die Trennvorrichtung muss jederzeit leicht erreichbar und gut zugänglich sein. Ist z.B. der Netzstecker die Trennvorrichtung, darf die Länge des Anschlusskabels 3 m nicht überschreiten.
   Funktionsschalter oder elektronische Schalter sind zur Netztrennung nicht geeignet. Werden Produkte ohne Netzschalter in Gestelle oder Anlagen integriert, so ist die Trennvorrichtung auf Anlagenebene zu verlagern.
5. Benutzen Sie das Produkt niemals, wenn das Netzkabel beschädigt ist. Überprüfen Sie regelmäßig den einwandfreien Zustand der Netzkabel. Stellen Sie durch geeignete Schutzmaßnahmen und Verlegearten sicher, dass das Netzkabel nicht beschädigt werden kann und niemand z.B. durch Stolperfallen oder elektrischen Schlag zu Schaden kommen kann.
6. Der Betrieb ist nur an TN/TT Versorgungsnetzen gestattet, die mit höchstens 16 A abgesichert sind (höhere Absicherung nur nach Rücksprache mit der Rohde & Schwarz Firmengruppe).
7. Stecken Sie den Stecker nicht in verstaubte oder verschmutzte Steckdosen/-buchsen. Stecken Sie die Steckverbindung/-vorrichtung fest und vollständig in die dafür vorgesehenen Steckdosen/-buchsen. Missachtung dieser Maßnahmen kann zu Funken, Feuer und/oder Verletzungen führen.
8. Überlasten Sie keine Steckdosen, Verlängerungskabel oder Steckdosenleisten, dies kann Feuer oder elektrische Schläge verursachen.
9. Bei Messungen in Stromkreisen mit Spannungen U_{eff} > 30 V ist mit geeigneten Maßnahmen Vorsorge zu treffen, dass jegliche Gefährdung ausgeschlossen wird (z.B. geeignete Messmittel, Absicherung, Strombegrenzung, Schutztrennung, Isolierung usw.).
10. Bei Verbindungen mit informationstechnischen Geräten, z.B. PC oder Industrierechner, ist darauf zu achten, dass diese der jeweils gültigen IEC 60950-1 / EN 60950-1 oder IEC 61010-1 / EN 61010-1 entsprechen.
11. Sofern nicht ausdrücklich erlaubt, darf der Deckel oder ein Teil des Gehäuses niemals entfernt werden, wenn das Produkt betrieben wird. Dies macht elektrische Leitungen und Komponenten zugänglich und kann zu Verletzungen, Feuer oder Schaden am Produkt führen.

12. Wird ein Produkt ortsfest angeschlossen, ist die Verbindung zwischen dem Schutzleiteranschluss vor Ort und dem Geräteschutzleiter vor jeglicher anderer Verbindung herzustellen. Aufstellung und Anschluss darf nur durch eine Elektrofachkraft erfolgen.
13. Bei ortsfesten Geräten ohne eingebaute Sicherung, Selbstschalter oder ähnliche Schutzeinrichtung muss der Versorgungskreis so abgesichert sein, dass alle Personen, die Zugang zum Produkt haben, sowie das Produkt selbst ausreichend vor Schäden geschützt sind.
14. Jedes Produkt muss durch geeigneten Überspannungsschutz vor Überspannung (z.B. durch Blitzschlag) geschützt werden. Andernfalls ist das bedienende Personal durch elektrischen Schlag gefährdet.
15. Gegenstände, die nicht dafür vorgesehen sind, dürfen nicht in die Öffnungen des Gehäuses eingebracht werden. Dies kann Kurzschlüsse im Produkt und/oder elektrische Schläge, Feuer oder Verletzungen verursachen.
16. Sofern nicht anders spezifiziert, sind Produkte nicht gegen das Eindringen von Flüssigkeiten geschützt, siehe auch Abschnitt "Betriebszustände und Betriebslagen", Punkt 1. Daher müssen die Geräte vor Eindringen von Flüssigkeiten geschützt werden. Wird dies nicht beachtet, besteht Gefahr durch elektrischen Schlag für den Benutzer oder Beschädigung des Produkts, was ebenfalls zur Gefährdung von Personen führen kann.
17. Benutzen Sie das Produkt nicht unter Bedingungen, bei denen Kondensation in oder am Produkt stattfinden könnte oder ggf. bereits stattgefunden hat, z.B. wenn das Produkt von kalter in warme Umgebung bewegt wurde. Das Eindringen von Wasser erhöht das Risiko eines elektrischen Schlages.
18. Trennen Sie das Produkt vor der Reinigung komplett von der Energieversorgung (z.B. speisendes Netz oder Batterie). Nehmen Sie bei Geräten die Reinigung mit einem weichen, nicht fasernden Staublappen vor. Verwenden Sie keinesfalls chemische Reinigungsmittel wie z.B. Alkohol, Aceton, Nitroverdünnung.

Betrieb

1. Die Benutzung des Produkts erfordert spezielle Einweisung und hohe Konzentration während der Benutzung. Es muss sichergestellt sein, dass Personen, die das Produkt bedienen, bezüglich ihrer körperlichen, geistigen und seelischen Verfassung den Anforderungen gewachsen sind, da andernfalls Verletzungen oder Sachschäden nicht auszuschließen sind. Es liegt in der Verantwortung des Arbeitsgebers/Betreibers, geeignetes Personal für die Benutzung des Produkts auszuwählen.
2. Bevor Sie das Produkt bewegen oder transportieren, lesen und beachten Sie den Abschnitt "Transport".
3. Wie bei allen industriell gefertigten Gütern kann die Verwendung von Stoffen, die Allergien hervorrufen - so genannte Allergene (z.B. Nickel) - nicht generell ausgeschlossen werden. Sollten beim Umgang mit R&S-Produkten allergische Reaktionen, z.B. Hautausschlag, häufiges Niesen, Bindehautrötung oder Atembeschwerden auftreten, ist umgehend ein Arzt aufzusuchen, um die Ursachen zu klären und Gesundheitsschäden bzw. -belastungen zu vermeiden.
4. Vor der mechanischen und/oder thermischen Bearbeitung oder Zerlegung des Produkts beachten Sie unbedingt Abschnitt "Entsorgung", Punkt 1.

5. Bei bestimmten Produkten, z.B. HF-Funkanlagen, können funktionsbedingt erhöhte elektromagnetische Strahlungen auftreten. Unter Berücksichtigung der erhöhten Schutzwürdigkeit des ungeborenen Lebens müssen Schwangere durch geeignete Maßnahmen geschützt werden. Auch Träger von Herzschrittmachern können durch elektromagnetische Strahlungen gefährdet sein. Der Arbeitgeber/Betreiber ist verpflichtet, Arbeitsstätten, bei denen ein besonderes Risiko einer Strahlenexposition besteht, zu beurteilen und zu kennzeichnen und mögliche Gefahren abzuwenden.

6. Im Falle eines Brandes entweichen ggf. giftige Stoffe (Gase, Flüssigkeiten etc.) aus dem Produkt, die Gesundheitsschäden verursachen können. Daher sind im Brandfall geeignete Maßnahmen wie z.B. Atemschutzmasken und Schutzkleidung zu verwenden.

7. Falls ein Laser-Produkt in ein R&S-Produkt integriert ist (z.B. CD/DVD-Laufwerk), dürfen keine anderen Einstellungen oder Funktionen verwendet werden, als in der Produktdokumentation beschrieben, um Personenschäden zu vermeiden (z.B. durch Laserstrahl).

8. EMV Klassen (nach EN 55011 / CISPR 11; sinngemäß EN 55022 / CISPR 22, EN 55032 / CISPR 32)

   Gerät der Klasse A:
   Ein Gerät, das sich für den Gebrauch in allen anderen Bereichen außer dem Wohnbereich und solchen Bereichen eignet, die direkt an ein Niederspannungs-Versorgungsnetz angeschlossen sind, das Wohngebäude versorgt.
   Hinweis: Diese Einrichtung kann wegen möglicher auftretender leitungsgebundener als auch gestrahlten Störgrößen im Wohnbereich Funkstörungen verursachen. In diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen durchzuführen.
   Gerät der Klasse B:
   Ein Gerät, das sich für den Betrieb im Wohnbereich sowie in solchen Bereichen eignet, die direkt an ein Niederspannungs-Versorgungsnetz angeschlossen sind, das Wohngebäude versorgt.

Reparatur und Service

1. Das Produkt darf nur von dafür autorisiertem Fachpersonal geöffnet werden. Vor Arbeiten am Produkt oder Öffnen des Produkts ist dieses von der Versorgungsspannung zu trennen, sonst besteht das Risiko eines elektrischen Schlages.

2. Abgleich, Auswechseln von Teilen, Wartung und Reparatur darf nur von R&S-autorisierten Elektrofachkräften ausgeführt werden. Werden sicherheitsrelevante Teile (z.B. Netzschalter, Netztrafos oder Sicherungen) ausgewechselt, so dürfen diese nur durch Originalteile ersetzt werden. Nach jedem Austausch von sicherheitsrelevanten Teilen ist eine Sicherheitsprüfung durchzuführen (Sichtprüfung, Schutzleitertest, Isolationswiderstand-, Ableitstrommessung, Funktionstest). Damit wird sichergestellt, dass die Sicherheit des Produkts erhalten bleibt.

Batterien und Akkumulatoren/Zellen

Werden die Hinweise zu Batterien und Akkumulatoren/Zellen nicht oder unzureichend beachtet, kann dies Explosion, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen. Die Handhabung von Batterien und Akkumulatoren mit alkalischen Elektrolyten (z.B. Lithiumzellen) muss der EN 62133 entsprechen.

1. Zellen dürfen nicht zerlegt, geöffnet oder zerkleinert werden.

2. Zellen oder Batterien dürfen weder Hitze noch Feuer ausgesetzt werden. Die Lagerung im direkten Sonnenlicht ist zu vermeiden. Zellen und Batterien sauber und trocken halten. Verschmutzte Anschlüsse mit einem trockenen, sauberen Tuch reinigen.

3. Zellen oder Batterien dürfen nicht kurzgeschlossen werden. Zellen oder Batterien dürfen nicht gefahrbringend in einer Schachtel oder in einem Schubfach gelagert werden, wo sie sich gegenseitig kurzschließen oder durch andere leitende Werkstoffe kurzgeschlossen werden können. Eine Zelle oder Batterie darf erst aus ihrer Originalverpackung entnommen werden, wenn sie verwendet werden soll.
4. Zellen oder Batterien dürfen keinen unzulässig starken, mechanischen Stößen ausgesetzt werden.
5. Bei Undichtheit einer Zelle darf die Flüssigkeit nicht mit der Haut in Berührung kommen oder in die Augen gelangen. Falls es zu einer Berührung gekommen ist, den betroffenen Bereich mit reichlich Wasser waschen und ärztliche Hilfe in Anspruch nehmen.
6. Werden Zellen oder Batterien, die alkalische Elektrolyte enthalten (z.B. Lithiumzellen), unsachgemäß ausgewechselt oder geladen, besteht Explosionsgefahr. Zellen oder Batterien nur durch den entsprechenden R&S-Typ ersetzen (siehe Ersatzteilliste), um die Sicherheit des Produkts zu erhalten.
7. Zellen oder Batterien müssen wiederverwertet werden und dürfen nicht in den Restmüll gelangen. Akkumulatoren oder Batterien, die Blei, Quecksilber oder Cadmium enthalten, sind Sonderabfall. Beachten Sie hierzu die landesspezifischen Entsorgungs- und Recycling-Bestimmungen.

Transport

1. Das Produkt kann ein hohes Gewicht aufweisen. Daher muss es vorsichtig und ggf. unter Verwendung eines geeigneten Hebemittels (z.B. Hubwagen) bewegt bzw. transportiert werden, um Rückenschäden oder Verletzungen zu vermeiden.
2. Griffe an den Produkten sind eine Handhabungshilfe, die ausschließlich für den Transport des Produkts durch Personen vorgesehen ist. Es ist daher nicht zulässig, Griffe zur Befestigung an bzw. auf Transportmitteln, z.B. Kränen, Gabelstaplern, Karren etc. zu verwenden. Es liegt in Ihrer Verantwortung, die Produkte sicher an bzw. auf geeigneten Transport- oder Hebemitteln zu befestigen. Beachten Sie die Sicherheitsvorschriften des jeweiligen Herstellers eingesetzter Transport- oder Hebemittel, um Personenschäden und Schäden am Produkt zu vermeiden.
3. Falls Sie das Produkt in einem Fahrzeug benutzen, liegt es in der alleinigen Verantwortung des Fahrers, das Fahrzeug in sicherer und angemessener Weise zu führen. Der Hersteller übernimmt keine Verantwortung für Unfälle oder Kollisionen. Verwenden Sie das Produkt niemals in einem sich bewegenden Fahrzeug, sofern dies den Fahrzeugführer ablenken könnte. Sichern Sie das Produkt im Fahrzeug ausreichend ab, um im Falle eines Unfalls Verletzungen oder Schäden anderer Art zu verhindern.

Entsorgung

1. Batterien bzw. Akkumulatoren, die nicht mit dem Hausmüll entsorgt werden dürfen, darf nach Ende der Lebensdauer nur über eine geeignete Sammelstelle oder eine Rohde & Schwarz-Kundendienststelle entsorgt werden.
2. Am Ende der Lebensdauer des Produktes darf dieses Produkt nicht über den normalen Hausmüll entsorgt werden, sondern muss getrennt gesammelt werden.
   Rohde & Schwarz GmbH & Co.KG ein Entsorgungskonzept entwickelt und übernimmt die Pflichten der Rücknahme- und Entsorgung für Hersteller innerhalb der EU in vollem Umfang. Wenden Sie sich bitte an Ihre Rohde & Schwarz-Kundendienststelle, um das Produkt umweltgerecht zu entsorgen.

3. Werden Produkte oder ihre Bestandteile über den bestimmungsgemäßen Betrieb hinaus mechanisch und/oder thermisch bearbeitet, können ggf. gefährliche Stoffe (schwermetallhaltiger Staub wie z.B. Blei, Beryllium, Nickel) freigesetzt werden. Die Zerlegung des Produkts darf daher nur von speziell geschultem Fachpersonal erfolgen. Unsachgemäßes Zerlegen kann Gesundheitsschäden hervorrufen. Die nationalen Vorschriften zur Entsorgung sind zu beachten.
4. Falls beim Umgang mit dem Produkt Gefahren- oder Betriebsstoffe entstehen, die speziell zu entsorgen sind, z.B. regelmäßig zu wechselnde Kühlmittel oder Motorenöle, sind die Sicherheitshinweise des Herstellers dieser Gefahren- oder Betriebsstoffe und die regional gültigen Entsorgungsvorschriften einzuhalten. Beachten Sie ggf. auch die zugehörigen speziellen Sicherheitshinweise in der Produktdokumentation. Die unsachgemäße Entsorgung von Gefahren- oder Betriebsstoffen kann zu Gesundheitsschäden von Personen und Umweltschäden führen.

Weitere Informationen zu Umweltschutz finden Sie auf der Rohde & Schwarz Home Page.

Consignes de sécurité fondamentales

Lisez et respectez impérativement les instructions et consignes de sécurité suivantes

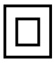
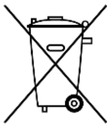
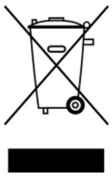
Les usines et sites du groupe Rohde & Schwarz veillent à la conformité des produits du groupe avec les normes de sécurité en vigueur dans un souci constant de garantir aux clients le plus haut niveau de sécurité possible. Nos produits ainsi que les accessoires nécessaires sont fabriqués et testés conformément aux règles de sécurité en vigueur. Le respect de ces règles est vérifié régulièrement par notre système d'assurance qualité. Le présent produit a été fabriqué et contrôlé conformément au certificat de conformité CE ci-joint et a quitté l'usine dans un parfait état de sécurité. Pour le maintenir dans cet état et en garantir une utilisation sans danger, l'utilisateur doit respecter l'ensemble des consignes, remarques de sécurité et avertissements qui se trouvent dans ce manuel. Le groupe Rohde & Schwarz se tient à votre disposition pour toutes questions relatives aux présentes consignes de sécurité.

Il incombe à l'utilisateur d'employer ce produit de manière appropriée. Le produit est exclusivement destiné à l'utilisation en industrie et en laboratoire et/ou, si cela a été expressément autorisé, également aux travaux extérieurs ; il ne peut en aucun cas être utilisé à des fins pouvant causer des dommages corporels ou matériels. L'exploitation du produit en dehors de son utilisation prévue ou le non-respect des consignes du fabricant se font sous la responsabilité de l'utilisateur. Le fabricant décline toute responsabilité en cas d'utilisation non conforme du produit.

Le produit est présumé faire l'objet d'une utilisation conforme lorsqu'il est utilisé conformément aux consignes de la documentation produit correspondante et dans la limite de ses performances (voir fiche technique, documentation, consignes de sécurité ci-après). L'utilisation du produit exige des compétences en la matière et des connaissances de base de l'anglais. Par conséquent, le produit ne devra être utilisé que par un personnel qualifié ou des personnes formées de manière approfondie et possédant les compétences requises. Si, pour l'utilisation des produits Rohde & Schwarz, l'emploi d'un équipement personnel de protection s'avère nécessaire, il en est fait mention dans la documentation produit à l'emplacement correspondant. Conservez les consignes de sécurité fondamentales et la documentation produit dans un lieu sûr et transmettez ces documents aux autres utilisateurs du produit.

La stricte observation des consignes de sécurité a pour but d'exclure des blessures ou dommages causés par des dangers de toutes sortes. A cet effet, il est nécessaire de lire avec soin et de bien comprendre les consignes de sécurité ci-dessous avant l'utilisation du produit et de les respecter lors de l'utilisation du produit. Toutes les autres consignes de sécurité présentées à l'emplacement correspondant de la documentation produit, par exemple, celles concernant la protection des personnes, doivent également être impérativement respectées. Dans les présentes consignes de sécurité, toutes les marchandises commercialisées par le groupe Rohde & Schwarz, notamment les appareils, les systèmes ainsi que les accessoires, sont dénommés « produit ».

Symboles et marquages de sécurité

Symbole	Signification	Symbole	Signification
	Avis, source générale de danger Se référer à la documentation produit		MARCHE / ARRET (tension d'alimentation)
	Attention lors de la manipulation d'appareils ayant un poids élevé		Indicateur de veille
	Risque de choc électrique		Courant continu (CC)
	Avertissement, surface chaude		Courant alternatif (CA)
	Borne de conducteur de protection		Courant continu/alternatif (CC/CA)
	Borne de mise à la terre		L'appareil est conforme aux exigences de sécurité du degré de protection II (appareil entièrement protégé par isolation double/renforcée).
	Borne de mise à la masse du bâti ou du boîtier		Marquage UE pour batteries et accumulateurs. L'appareil contient une batterie ou un accumulateur. Ces pièces ne peuvent pas être éliminées avec les déchets urbains non triés, mais doivent faire l'objet d'une collecte séparée. Pour plus d'informations, voir la page 7.
	Avis : prudence lors de la manipulation de composants sensibles aux décharges électrostatiques		Marquage UE pour la collecte séparée d'équipements électriques et électroniques. Les déchets d'équipements électriques et électroniques ne peuvent pas être éliminés avec les déchets urbains non triés, mais doivent faire l'objet d'une collecte séparée. Pour plus d'informations, voir la page 7.
	Avertissement, rayon laser Les produits laser sont munis d'avertissements normalisés d'après leur catégorie laser. En raison des caractéristiques de leur rayonnement ainsi que de leur puissance électromagnétique extrêmement concentrée, les lasers peuvent causer des dommages biologiques. Pour plus d'informations, voir le chapitre « Fonctionnement »", point 7.		

Mots d’alerte et significations

Les mots d’alerte suivants sont utilisés dans la documentation produit pour avertir des risques et dangers.

⚠ DANGER	Indique une situation dangereuse immédiate qui, si elle n’est pas évitée, comporte un risque élevé de blessures graves ou mortelles.
⚠ AVERTISSEMENT	Indique une situation dangereuse possible qui, si elle n’est pas évitée, comporte un risque modéré de blessures (graves) ou mortelles.
⚠ ATTENTION	Indique une situation dangereuse qui, si elle n’est pas évitée, comporte un risque faible de blessures mineures ou modérées.
AVIS	Indique la possibilité d’une fausse manœuvre susceptible d’endommager le produit.

Ces mots d’alerte correspondent à la définition habituelle utilisée pour des applications civiles dans l’espace économique européen. Des définitions divergentes peuvent cependant exister dans d’autres espaces économiques ou dans le cadre d’applications militaires. Il faut donc veiller à ce que les mots d’alerte décrits ici ne soient utilisés qu’en relation avec la documentation produit correspondante et seulement avec le produit correspondant. L’utilisation des mots d’alerte en relation avec des produits ou des documentations non correspondants peut conduire à des erreurs d’interprétation et par conséquent à des dommages corporels ou matériels.

États et positions de fonctionnement

L’appareil ne doit être utilisé que dans les états et positions de fonctionnement indiqués par le fabricant. Tout obstacle à la ventilation doit être empêché. Le non-respect des indications du fabricant peut provoquer des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort. Pour tous les travaux, les règles locales et/ou nationales de sécurité et de prévention des accidents doivent être respectées.

1. Sauf stipulations contraires, les produits Rohde & Schwarz répondent aux exigences ci-après :
   faire fonctionner le produit avec le fond du boîtier toujours en bas, degré de protection IP 2X, degré de pollution 2, catégorie de surtension 2, utilisation uniquement à l’intérieur, fonctionnement à une altitude max. de 2000 m au-dessus du niveau de la mer, transport à une altitude max. de 4500 m au-dessus du niveau de la mer, tolérance de ±10 % pour la tension nominale et de ±5 % pour la fréquence nominale.
2. Ne jamais placer le produit sur des surfaces, véhicules, dépôts ou tables non appropriés pour raisons de stabilité ou de poids. Suivre toujours strictement les indications d’installation du fabricant pour le montage et la fixation du produit sur des objets ou des structures (par exemple parois et étagères). En cas d’installation non conforme à la documentation produit, il y a risque de blessures, voire de mort.
3. Ne jamais placer le produit sur des dispositifs générant de la chaleur (par exemple radiateurs et appareils de chauffage soufflants). La température ambiante ne doit pas dépasser la température maximale spécifiée dans la documentation produit ou dans la fiche technique. Une surchauffe du produit peut provoquer des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort.

Sécurité électrique

Si les consignes relatives à la sécurité électrique ne sont pas ou sont insuffisamment respectées, il peut s'ensuivre des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort.

1. Avant chaque mise sous tension du produit, il faut s'assurer que la tension nominale réglée sur le produit correspond à la tension nominale du réseau électrique. S'il est nécessaire de modifier le réglage de la tension, il faut remplacer le fusible du produit, le cas échéant.
2. L'utilisation des produits du degré de protection I pourvus d'un câble d'alimentation mobile et d'un connecteur n'est autorisée qu'avec des prises munies d'un contact de protection et d'un conducteur de protection raccordé.
3. Toute déconnexion intentionnelle du conducteur de protection, dans le câble ou dans le produit lui-même, est interdite. Elle entraîne un risque de choc électrique au niveau du produit. En cas d'utilisation de câbles prolongateurs ou de multiprises, ceux-ci doivent être examinés régulièrement quant à leur état de sécurité technique.
4. Si le produit n'est pas doté d'un interrupteur d'alimentation pour le couper du réseau électrique ou si l'interrupteur d'alimentation disponible n'est pas approprié pour couper le produit du réseau électrique, le connecteur mâle du câble de raccordement est à considérer comme dispositif de séparation.
   Le dispositif de séparation doit être à tout moment facilement accessible. Si, par exemple, le connecteur d'alimentation sert de dispositif de séparation, la longueur du câble de raccordement ne doit pas dépasser 3 m.
   Les commutateurs fonctionnels ou électroniques ne sont pas appropriés pour couper l'appareil du réseau électrique. Si des produits sans interrupteur d'alimentation sont intégrés dans des bâtis ou systèmes, le dispositif de séparation doit être reporté au niveau du système.
5. Ne jamais utiliser le produit si le câble d'alimentation est endommagé. Vérifier régulièrement le parfait état du câble d'alimentation. Prendre les mesures préventives appropriées et opter pour des types de pose tels que le câble d'alimentation ne puisse pas être endommagé et que personne ne puisse subir de préjudice, par exemple en trébuchant sur le câble ou par des chocs électriques.
6. L'utilisation des produits est uniquement autorisée sur des réseaux d'alimentation de type TN/TT protégés par des fusibles d'une intensité max. de 16 A (pour toute intensité supérieure, consulter le groupe Rohde & Schwarz).
7. Ne pas brancher le connecteur dans des prises d'alimentation sales ou poussiéreuses. Enfoncer fermement le connecteur jusqu'au bout de la prise. Le non-respect de cette mesure peut provoquer des étincelles, incendies et/ou blessures.
8. Ne pas surcharger les prises, les câbles prolongateurs ou les multiprises, cela pouvant provoquer des incendies ou chocs électriques.
9. En cas de mesures sur les circuits électriques d'une tension efficace > 30 V, prendre les précautions nécessaires pour éviter tout risque (par exemple équipement de mesure approprié, fusibles, limitation de courant, coupe-circuit, isolation, etc.).
10. En cas d'interconnexion avec des équipements informatiques comme par exemple un PC ou un ordinateur industriel, veiller à ce que ces derniers soient conformes aux normes IEC 60950-1 / EN 60950-1 ou IEC 61010-1 / EN 61010-1 en vigueur.
11. Sauf autorisation expresse, il est interdit de retirer le couvercle ou toute autre pièce du boîtier lorsque le produit est en cours de service. Les câbles et composants électriques seraient ainsi accessibles, ce qui peut entraîner des blessures, des incendies ou des dégâts sur le produit.

12. Si un produit est connecté de façon stationnaire, établir avant toute autre connexion le raccordement du conducteur de protection local et du conducteur de protection du produit. L'installation et le raccordement ne peuvent être effectués que par un électricien ou électronicien qualifié.
13. Sur les appareils stationnaires sans fusible ni disjoncteur automatique ou dispositif de protection similaire intégrés, le circuit d'alimentation doit être sécurisé de sorte que toutes les personnes ayant accès au produit et le produit lui-même soient suffisamment protégés contre tout dommage.
14. Chaque produit doit être protégé de manière appropriée contre les éventuelles surtensions (par exemple dues à un coup de foudre). Sinon, les utilisateurs sont exposés à des risques de choc électrique.
15. Ne jamais introduire d'objets non prévus à cet effet dans les ouvertures du boîtier, étant donné que cela peut entraîner des courts-circuits dans le produit et/ou des chocs électriques, incendies ou blessures.
16. Sauf spécification contraire, les produits ne sont pas protégés contre l'infiltration de liquides, voir aussi la section « États et positions de fonctionnement », point 1. Il faut donc protéger les produits contre l'infiltration de liquides. La non-observation de cette consigne entraîne le risque de choc électrique pour l'utilisateur ou d'endommagement du produit, ce qui peut également mettre les personnes en danger.
17. Ne pas utiliser le produit dans des conditions pouvant occasionner ou ayant déjà occasionné, le cas échéant, des condensations dans ou sur le produit, par exemple lorsque celui-ci est déplacé d'un environnement froid dans un environnement chaud. L'infiltration d'eau augmente le risque de choc électrique.
18. Avant le nettoyage, débrancher le produit de l'alimentation (par exemple réseau électrique ou batterie). Pour le nettoyage des appareils, utiliser un chiffon doux non pelucheux. N'utiliser en aucun cas de produit de nettoyage chimique, tel que de l'alcool, de l'acétone ou un diluant nitrocellulosique.

Fonctionnement

1. L'utilisation du produit exige une formation spécifique ainsi qu'une grande concentration. Il est impératif que les personnes qui utilisent le produit présent les aptitudes physiques, mentales et psychiques requises, vu qu'autrement des dommages corporels ou matériels ne peuvent pas être exclus. Le choix du personnel qualifié pour l'utilisation du produit est sous la responsabilité de l'employeur/l'exploitant.
2. Avant de déplacer ou de transporter le produit, lire et respecter la section « Transport ».
3. Comme pour tous les biens produits de façon industrielle, l'utilisation de matériaux pouvant causer des allergies (allergènes, comme par exemple le nickel) ne peut être totalement exclue. Si, lors de l'utilisation de produits Rohde & Schwarz, des réactions allergiques surviennent, telles qu'éruption cutanée, éternuements fréquents, rougeur de la conjonctive ou difficultés respiratoires, il faut immédiatement consulter un médecin pour en clarifier la cause et éviter toute atteinte à la santé.
4. Avant le traitement mécanique et/ou thermique ou le démontage du produit, il faut impérativement observer la section « Élimination des déchets », point 1.

5. Selon les fonctions, certains produits, tels que des systèmes de radiocommunication RF, peuvent produire des niveaux élevés de rayonnement électromagnétique. Étant donné la vulnérabilité de l'enfant à naître, les femmes enceintes doivent être protégées par des mesures appropriées. Les porteurs de stimulateurs cardiaques peuvent également être menacés par les rayonnements électromagnétiques. L'employeur/l'exploitant est tenu d'évaluer et de repérer les lieux de travail soumis à un risque particulier d'exposition aux rayonnements et de prévenir les dangers éventuels.
6. En cas d'incendie, il se peut que le produit dégage des matières toxiques (gaz, liquides, etc.) susceptibles de nuire à la santé. Il faut donc, en cas d'incendie, prendre des mesures adéquates comme par exemple le port de masques respiratoires et de vêtements de protection.
7. Si un produit laser est intégré dans un produit Rohde & Schwarz (par exemple lecteur CD/DVD), il ne faut pas utiliser de réglages ou fonctions autres que ceux décrits dans la documentation produit pour éviter tout dommage corporel (par exemple causé par rayon laser).
8. Classes CEM (selon EN 55011 / CISPR 11 ; selon EN 55022 / CISPR 22, EN 55032 / CISPR 32 par analogie)
   - Appareil de la classe A :
     Appareil approprié à un usage dans tous les environnements autres que l'environnement résidentiel et les environnements raccordés directement à un réseau d'alimentation basse tension qui alimente des bâtiments résidentiels.
     Remarque : ces appareils peuvent provoquer des perturbations radioélectriques dans l'environnement résidentiel en raison de perturbations conduites ou rayonnées. Dans ce cas, on peut exiger que l'exploitant mette en œuvre de mesures appropriées pour éliminer ces perturbations.
   - Appareil de la classe B :
     Appareil approprié à un usage dans l'environnement résidentiel ainsi que dans les environnements raccordés directement à un réseau d'alimentation basse tension qui alimente des bâtiments résidentiels.

Réparation et service après-vente

1. Le produit ne doit être ouvert que par un personnel qualifié et autorisé. Avant de travailler sur le produit ou de l'ouvrir, il faut le couper de la tension d'alimentation ; sinon il y a risque de choc électrique.
2. Les travaux d'ajustement, le remplacement des pièces, la maintenance et la réparation ne doivent être effectués que par des électroniciens qualifiés et autorisés par Rohde & Schwarz. En cas de remplacement de pièces concernant la sécurité (notamment interrupteur d'alimentation, transformateur d'alimentation réseau ou fusibles), celles-ci ne doivent être remplacées que par des pièces d'origine. Après chaque remplacement de pièces concernant la sécurité, une vérification de sécurité doit être effectuée (contrôle visuel, vérification du conducteur de protection, mesure de la résistance d'isolement et du courant de fuite, essai de fonctionnement). Cela permet d'assurer le maintien de la sécurité du produit.

Batteries et accumulateurs/cellules

Si les instructions concernant les batteries et accumulateurs/cellules ne sont pas ou sont insuffisamment respectées, cela peut provoquer des explosions, des incendies et/ou des blessures graves pouvant entraîner la mort. La manipulation de batteries et accumulateurs contenant des électrolytes alcalins (par exemple cellules de lithium) doit être conforme à la norme EN 62133.

1. Les cellules ne doivent être ni démontées, ni ouvertes, ni réduites en morceaux.
2. Ne jamais exposer les cellules ou batteries à la chaleur ou au feu. Ne pas les stocker dans un endroit où elles sont exposées au rayonnement direct du soleil. Tenir les cellules et batteries au sec. Nettoyer les raccords sales avec un chiffon sec et propre.
3. Ne jamais court-circuiter les cellules ou batteries. Les cellules ou batteries ne doivent pas être gardées dans une boîte ou un tiroir où elles peuvent se court-circuiter mutuellement ou être court-circuitées par d'autres matériaux conducteurs. Une cellule ou batterie ne doit être retirée de son emballage d'origine que lorsqu'on l'utilise.
4. Les cellules ou batteries ne doivent pas être exposées à des chocs mécaniques de force non admissible.
5. En cas de manque d'étanchéité d'une cellule, le liquide ne doit pas entrer en contact avec la peau ou les yeux. S'il y a contact, rincer abondamment à l'eau l'endroit concerné et consulter un médecin.
6. Il y a danger d'explosion en cas de remplacement ou chargement incorrect des cellules ou batteries qui contiennent des électrolytes alcalins (par exemple cellules de lithium). Remplacer les cellules ou batteries uniquement par le type Rohde & Schwarz correspondant (voir la liste des pièces de rechange) pour maintenir la sécurité du produit.
7. Il faut recycler les cellules ou batteries et il est interdit de les éliminer comme déchets normaux. Les accumulateurs ou batteries qui contiennent du plomb, du mercure ou du cadmium sont des déchets spéciaux. Observer les règles nationales d'élimination et de recyclage.

Transport

1. Le produit peut avoir un poids élevé. Il faut donc le déplacer ou le transporter avec précaution et en utilisant le cas échéant un moyen de levage approprié (par exemple, chariot élévateur) pour éviter des dommages au dos ou des blessures.
2. Les poignées des produits sont une aide de manipulation exclusivement réservée au transport du produit par des personnes. Il est donc proscrit d'utiliser ces poignées pour attacher le produit à ou sur des moyens de transport, tels que grues, chariots et chariots élévateurs, etc. Vous êtes responsable de la fixation sûre des produits à ou sur des moyens de transport et de levage appropriés. Observer les consignes de sécurité du fabricant des moyens de transport ou de levage utilisés pour éviter des dommages corporels et des dégâts sur le produit.
3. L'utilisation du produit dans un véhicule se fait sous l'unique responsabilité du conducteur qui doit piloter le véhicule de manière sûre et appropriée. Le fabricant décline toute responsabilité en cas d'accidents ou de collisions. Ne jamais utiliser le produit dans un véhicule en mouvement si cela pouvait détourner l'attention du conducteur. Sécuriser suffisamment le produit dans le véhicule pour empêcher des blessures ou dommages de tout type en cas d'accident.

Élimination des déchets

1. Au terme de leur durée de vie, les batteries ou accumulateurs qui ne peuvent pas être éliminés avec les déchets ménagers peuvent uniquement être éliminés par des points de collecte appropriés ou par un centre de service après-vente Rohde & Schwarz.

2. Au terme de sa durée de vie, un produit ne peut pas être éliminé avec les déchets ménagers normaux, mais doit être collecté séparément.
   Rohde & Schwarz GmbH & Co. KG a développé un concept d'élimination des déchets et assume toutes les obligations en matière de reprise et d'élimination, valables pour les fabricants au sein de l'UE. Veuillez vous adresser à votre centre de service après-vente Rohde & Schwarz pour éliminer le produit de manière écologique.
3. Si les produits ou leurs composants sont travaillés mécaniquement et/ou thermiquement au-delà de l'utilisation prévue, ils peuvent, le cas échéant, libérer des substances dangereuses (poussières contenant des métaux lourds comme par exemple du plomb, du béryllium ou du nickel). Le démontage du produit ne doit donc être effectué que par un personnel qualifié et spécialement formé. Le démontage inadéquat peut nuire à la santé. Les règles nationales concernant l'élimination des déchets doivent être observées.
4. Si, lors de l'utilisation du produit, des substances dangereuses ou combustibles exigeant une élimination spéciale sont dégagées, comme par exemple liquides de refroidissement ou huiles moteurs qui sont à changer régulièrement, les consignes de sécurité du fabricant de ces substances dangereuses ou combustibles ainsi que les règles sur l'élimination en vigueur au niveau régional doivent être respectées. Les consignes de sécurité spéciales correspondantes dans la documentation produit doivent également être respectées, le cas échéant. L'élimination non conforme des substances dangereuses ou combustibles peut provoquer des atteintes à la santé et des dommages écologiques.

Pour plus d'informations concernant la protection de l'environnement, voir la page d'accueil de Rohde & Schwarz.

Customer Support

Technical support – where and when you need it

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

Up-to-date information and upgrades

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

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Contents

1 Preface

The R&S SGS is a signal generator intended either for the generation of IQ-modulated signals or as a pure local oscillator (LO) source.

Optimized for use in automated test equipment (ATE), the instrument offers fast settling times in an exceptionally small form factor and low power consumption. The R&S SGS can be equipped optionally with an active electronic step attenuator, a high stability reference oscillator and LO connectors for coupling multiple generators to a common LO source.

1.1 Key Features

The key features of the R&S SGS include the following:

- Compact size and low power consumption
- Remote connection via PCI Express, minimizing the setup time
  Alternatively, LAN or USB connections available
- Coherent LO input and output connectors, also usable as MIMO input/output and phase coherent I/Q demodulation
- Broadband analog input for vector modulation (I, Q)
- Linux operating system
- Graphical user interface R&S SGMA-GUI to set up and control one or more R&S SGS instruments simultaneously from one remote computer, available for Windows and Linux systems

1.2 Documentation Overview

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

www.rohde-schwarz.com/manual/sgs100a

Getting started manual

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

Online help

Embedded in the R&S SGMA-GUI software, it offers quick, context-sensitive access to the complete information.

User manual

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

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

Service manual

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

Instrument security procedures manual

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

Basic safety instructions

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

Data sheet and brochure

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

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

Release notes and open source acknowledgment (OSA)

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

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

See www.rohde-schwarz.com/firmware/sgs100a

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/sgs100a.

1.3 Typographical Conventions

The following text markers are used throughout this documentation:

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

2 Preparing for Use

2.1 Putting into Operation

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

WARNING

Risk of injury and instrument damage

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

- Do not open the instrument casing.
- Read and observe the "Basic Safety Instructions" delivered as a printed brochure with the instrument.
  In addition, read and observe the safety instructions in the following sections. Notice that the data sheet may specify additional operating conditions.

NOTICE

Risk of instrument damage

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

NOTICE

Risk of electrostatic discharge (ESD)

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

For details, refer to the basic safety instructions included at the front of the manual.

NOTICE

Risk of instrument damage during operation

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

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

2.1.1 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

2.1.2 Unpacking and Checking the Instrument

Check the equipment for completeness using the delivery note and the accessory lists for the various items. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. Make sure not to discard the box and packing material.

Packing material

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

NOTICE

Risk of damage during transportation and shipment

Insufficient protection against mechanical and electrostatic effects during transportation and shipment can damage the instrument.

- Always make sure that sufficient mechanical and electrostatic protection is provided.
- When shipping an instrument, the original packaging should be used. 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.

The **carrying handles** at the front and side of the casing are designed to lift or carry the instrument. Do not apply an excessive external force to the handles.

Observe the information on transporting heavy instruments in the basic safety instructions included at the front of the printed manual.

2.1.3 Accessory List

The instrument comes with the following accessories:

- Power cable
- Getting started printed manual

2.1.4 Placing or Mounting the Instrument

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

Bench top operation

If the R&S SGS is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet.

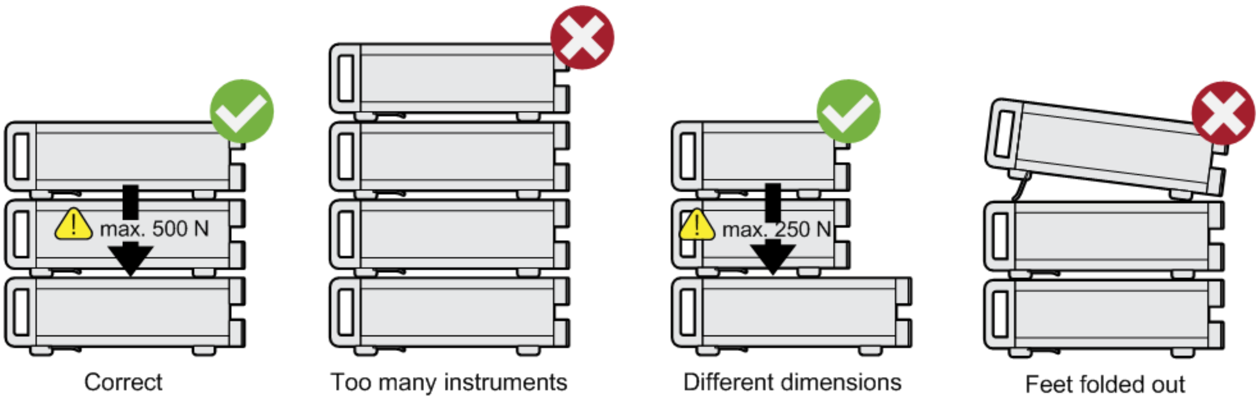
CAUTION

Risk of injury and instrument damage if stacking instruments

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

Observe the following instructions when stacking instruments:

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



Rack mounting

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

NOTICE

Risk of instrument damage in a rack

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

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

2.1.5 Switching the Instrument On and Off

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

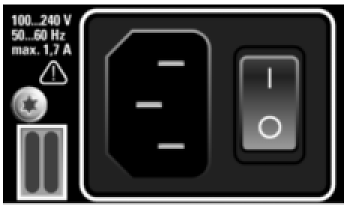
To connect the AC supply

► Connect the R&S SGS to the AC power source using the AC power cable delivered with the instrument.

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

To start up the instrument

1. Connect the instrument to the AC supply.



2. To turn on the power, press the main power switch to position I (On).

To switch between standby and ready state

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

In ready state, the button is green. The instrument is ready for operation. All modules are power-supplied and the R&S SGS initiates its startup procedure.
In standby state, the button is orange. The standby power mode keeps the power switch circuits and the remote control system active.

Start-up and booting

The instrument boots the operating system and starts the instrument firmware. During the booting process, the green POWER ON /STAND BY key blinks. If the previous session was terminated regularly, the instrument uses the last setup with the relevant instrument settings.

Once the startup procedure has been terminated, the instrument is ready for operation.

In the R&S SGMA-GUI, select "Instrument > Preset" function to return the instrument to its defined reset/preset state, if the current setup is no longer relevant.

To customize the start settings, use the "SGMA-GUI > File > Save As/Open" function.

To shut down the instrument

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

NOTICE

Risk of losing data

If you switch off the running instrument using the rear panel switch or by disconnecting the power cord, the instrument loses its current settings.

Always press the POWER ON/STANDBY key first to shut down the application properly.

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

   The POWER ON /STAND BY LED must be orange.

   Tip: If the instrument is operated manually via the R&S SGMA-GUI, select "SGMA-GUI > Instrument Name > Setup > Standby".

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

   None of the front-panel LEDs should be on.

2.1.6 Function Check

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

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

In addition to the automatic monitoring, the R&S SGS offers the following capabilities to ensure correct functioning:

- Internal Adjustments
  In the R&S SGMA-GUI, select the "Instrument > Setup > Internal Adjustments" dialog to access the dialog for performing and configuring the adjustments settings. A maximum level accuracy can be obtained, for instance.
- Selftest
  A selftest is provided for service purposes ("SGMA-GUI > Instrument > Diagnostic/ Test > Self Test").

2.1.7 Default Settings

When the instrument is switched on, it is not the preset state that is active, but rather the instrument state that was set before the instrument was switched off. It is recommended that you use the "SGMA-GUI > Instrument > Preset" function to return the instrument to its defined preset state every time a new configuration is required or the current setup is no longer relevant.

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

- Preset the instrument to a predefined state
  The "SGMA-GUI > Instrument Name > Preset" function calls up a defined instrument setup. All parameters and switching states are preset (also these of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings. However, functions that concern the integration of the instrument into a measurement setup are not changed.
- Preset the instrument to its factory settings
  The instrument can also be forced to load its default factory settings. To access the corresponding dialog box, select the "SGMA-GUI > Instrument Name > Setup > Factory Preset" function.
  For more information and an overview of the settings affected by the factory preset function, see Chapter 8.11, "Factory Preset", on page 135.

User-defined instrument states can be stored and called up using the functions "SGMA-GUI > File > Save As/Open".

2.2 Linux Operating System

The instrument uses an embedded Linux operating system, optimally adapted to the instrument.

Accessing the operating system

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

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

2.3 Connecting an External PC and Devices

As a rule, the R&S SGS is operated exclusively via remote control on a connected PC. Another way to control the instrument is the manual operation via the R&S SGMA-GUI software on the connected PC.

Both the remote control and the manual operation of the instrument require an external controller. For the prerequisites and the instructions on how to configure an external controller for remote control, refer to the user manual. A brief introduction to the remote control capabilities is provided in Chapter 10, "Network and Remote Control Operation", on page 155.

This section gives an introduction on how to configure the external PC for manual operation (see Chapter 2.3.1, "Installing the R&S SGMA-GUI Software on an External PC", on page 21).

In addition to connecting an external controller, it may be useful to connect other external devices, e.g. a memory stick. The following interfaces are provided on the rear panel of the instrument, see also Chapter 3.2, "Rear Panel Tour", on page 28:

- PCI Express (refer to Chapter 2.3.3, "Connecting a Controller via PCI Express", on page 24
- USB interface (refer to Chapter 2.3.4, "Connecting a Controller or a USB Device via USB", on page 24)
- LAN interface (refer to Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22)

2.3.1 Installing the R&S SGMA-GUI Software on an External PC

The R&S SGMA-GUI software is a graphical user interface program for one or more instruments. It runs on a remote PC.

The R&S SGMA-GUI software is provided as separate installation package for the different operating systems. The latest version of the software together with the relese notes is available for download at:

http://www.rohde-schwarz.com/product/SGS100A.html > "Downloads" > "Software"

This page always offers the latest information on your R&S SGMA-GUI.

This description focuses on the handling of the Windows-32 version. The file naming conventions and the installation instructions for the other operating systems are analogous.

The R&S SGMA-GUI installation package for Windows-32 operating system consists of the file `SGMA-GUI_<V.VV.VVV.VVV>.exe`. The version numbers in the file names vary with each update. To install the R&S SGMA-GUI, the following hardware and software requirements have to be met.

Table 2-1: Hardware and software requirements

Requirement	Remark
One of the following operating systems: • Windows XP SP2 • Windows Vista • Windows 7 • Windows 8/ 8.1 • Windows 10 • Linux	R&S SGMA-GUI has to be installed on one of the supported operating systems. **Note:** Any other Windows version or other operating systems are not supported. Windows installer version 4.5 or higher is needed for the installation of the software on a Windows XP computer. During installation, the operation system is checked. The installation is terminated if this requirement is not fulfilled.
R&S VISA	VISA drivers can be obtained on the Rohde & Schwarz website: http://www.rohde-schwarz.com/rsvisa
CPU	At least Pentium or compatible, as from 1 GHz (recommended).
VGA color display resolution	At least 800*600 pixels

Installing a new software version

Administrator rights are necessary for installation and starting.

1. Download the R&S SGMA-GUI software
2. In Windows Explorer, double-click `SGMA-GUI_V.VV.VVV.VVV.exe`. Follow the instructions.

Uninstalling an old software version

An uninstallation of a previous version of the SW can be performed before the installation of the new one, but this is not mandatory.

► To uninstall this version, go to "Start > Settings > Control Panel > Add/Remove Programs" and select the entry `SGMA-GUI_V.VV.VVV.VVV`.

  The script file identifies and removes all currently installed R&S SGMA-GUI software items.

2.3.2 Connecting a Remote PC via LAN

The R&S SGS is equipped with a network interface and can be connected to an Ethernet LAN (local area network). The interface can be used, for example:

- To connect an external computer for manual control of the instrument by the R&S SGMA-GUI software.
- To operate the device by a remote control program.
  See Chapter 10, "Network and Remote Control Operation", on page 155.

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

- Chapter 2.3.2.1, "Connecting the Instrument to the Network", on page 22
- Chapter 2.3.2.2, "Assigning the IP Address", on page 23
- Chapter 2.3.2.3, "Automatically Adding Instruments to the SGMA-GUI ", on page 23

2.3.2.1 Connecting the Instrument to the Network

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

- A non-dedicated network (Ethernet) connection from the instrument to an existing network.
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer.

In both cases, an IP address has to be assigned to the instrument and the computer, see Chapter 2.3.2.2, "Assigning the IP Address", on page 23.

Setting up a network (LAN) connection

NOTICE

Risk of network failure

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

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

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

2.3.2.2 Assigning the IP Address

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

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

The R&S SGS uses the Zeroconf IP addresses 169.254.xxx.yyy., where xxx takes values between 1...254 and yyy the values in the value range 1...255; the subnet mask is always 255.255.0.0. The IP address of the host must be within the same address area for Zeroconf.

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

2.3.2.3 Automatically Adding Instruments to the SGMA-GUI

For information on how to install the R&S SGMA-GUI software, refer to Chapter 2.3.1, "Installing the R&S SGMA-GUI Software on an External PC", on page 21.

1. For each new instrument perform the following steps:
   a) Connect the instrument to the network.
   b) Press the POWER ON /STAND BY key to switch on the instrument.
   c) Wait until the POWER ON /STAND BY LED is green and not blinking.

d) Press the ID key on the front panel of the instrument.

2. Start the SGMA-GUI on a computer connected to the same network.
3. Open the "Instruments" dialog and click "Scan".

   Note: This step is performed automatically on the first start and can also be omitted for instruments with a direct LAN connection to the computer.

   All instruments are added automatically to the main panel of the SIGMA-GUI.

2.3.3 Connecting a Controller via PCI Express

A PCI Express connector is provided on the rear panel of the instrument, see Chapter 3.2, "Rear Panel Tour", on page 28.

NOTICE

Risk of device failure

The R&S SGS is equipped with a single lane PCIe interface that supports hot plugging.

Do not connect an external PC to the PCIe connector of the instrument during operation if this external PC does not support hot-plugging!

Using the PCIe interface for remote control of the instrument requires extended knowledge. Refer to Chapter 10.3, "Advanced Remote Control Using PCIe", on page 165 for detailed information.

2.3.4 Connecting a Controller or a USB Device via USB

The USB interface on the rear panel of the R&S SGS allows you to connect either a USB device or use the R&S SGS as a device and connect it to a controller.

Connecting a controller (host PC or compatible signal generator)

If you connect a controller (host PC or compatible signal generator) to the R&S SGS, the R&S SGS acts as a USB device.

To connect the controller to the USB interface of the R&S SGS, always connect the **USB type Micro-B** connector to the R&S SGS. Refer to the documentation of the controller to find out which USB connector type you can connect to the controller.

The Figure 2-1 illustrates schematically the required connector type to emphasize on the different connector shape.

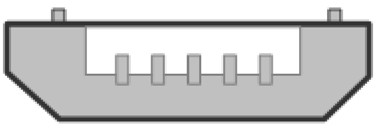


Figure 2-1: USB type Micro-B connectors

An external PC with installed R&S SGMA-GUI is required for manual operation of the R&S SGS.

On the remote PC, perform the steps as described in Chapter 2.3.2.3, "Automatically Adding Instruments to the SGMA-GUI ", on page 23.

Connecting a USB device

If you connect a USB device (memory stick, CD-ROM, an instrument) to the R&S SGS, the R&S SGS acts as a host.

To connect a USB device to the interface of the R&S SGS, always connect the **USB type Micro-A** connector to the R&S SGS. Refer to the documentation of the USB device to find out which USB connector type you can connect to the USB device.

The Figure 2-2 illustrates schematically the required connector type to emphasize on the different connector shape.

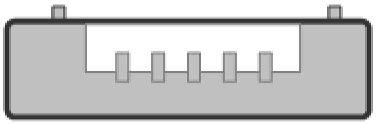


Figure 2-2: USB type Micro-A connectors

If you connect an R&S SGS to an R&S SGU via a USB cable, perform the steps as described in Chapter 5.2, "Setups for Connecting an R&S SGS and an R&S SGU", on page 37.

Using a USB Adapter

You can use a USB adapter to customize the connectors of a USB cable to the requirements of the instrument.

For example, you can use a Type-A / Micro-A adapter to customize a standard USB cable with type A and type Micro-B connectors for the connection of an R&S SGS (acting as a host) to an R&S SGU (acting as a USB device).

In some cases, you can also use a Type-A / Micro-B adapter to establish a connection to the instrument. To check, whether the adapter you have is suitable or not you can connect a USB stick with an LED through the adapter to the instrument. If the LED of the USB stick lights up after a connection to the instrument then you can use this adapter for further applications with the instrument.

3 Instrument Tour

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

- Front Panel Tour
- Rear Panel Tour

This section explains the control elements and the connectors of the R&S SGS with the aid of the front and rear views. Specifications of interfaces can be found in the data sheet.

3.1 Front Panel Tour

This section provides an overview of control elements on the front panel of the R&S SGS. The connectors of the R&S SGS are placed on the rear panel and are described in Chapter 3.2, "Rear Panel Tour", on page 28. As the R&S SGS is intended to be remote-controlled, the front panel of the R&S SGS contains no display but mostly LEDs to inform you about the status of the instrument. The user interface can be displayed on a remote PC station used to manually remote control the instrument.

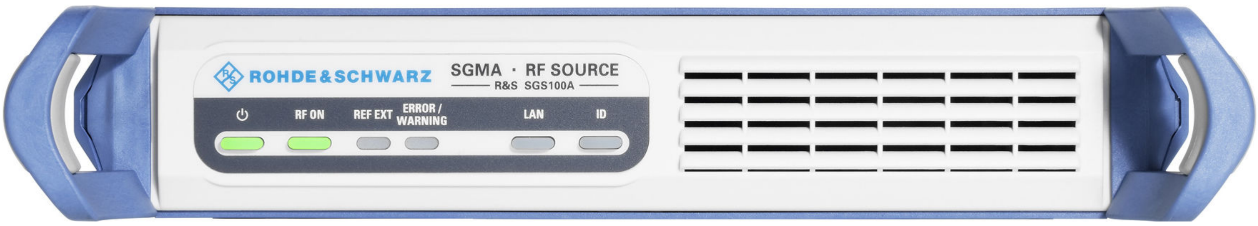


Figure 3-1: Front panel view

POWER ON /STAND BY

The POWER ON /STAND BY key switches the instrument from the standby to ready state or vice versa.

In ready state, the button is green. The instrument is ready for operation.

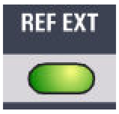
In standby state, the button is orange. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.

A blinking green color indicates that a booting operation is in process.

RF ON

The RF ON key switches the RF signal on or off. If activated, the button is green.

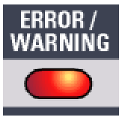
REF EXT



The REF EXT LED indicates the status of the external reference.

- Green indicates that the instrument can synchronize to the external clock.
- Red indicates that the instrument cannot synchronize to the external clock.
- No light indicates that the internal reference is used.

ERROR / WARNING



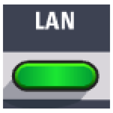
The ERROR / WARNING LED indicates the status of the R&S SGS.

- Red indicates that an error has occurred, e.g. temperature exceeded or power failure.
- Blinking orange indicates a running process (e.g calibration, self test).
- No light indicates that no errors or warnings have occurred.

For details on errors or warnings, refer to the graphical user interface on a remote PC ("SGMA-GUI > Info").

For more information, refer to the "Error Messages" section in the user manual.

LAN



Pressing the key for more than 3 s resets the LAN interface settings, i.e the "IP Adress Mode" is reset to DHCP.

ID

Pressing the ID key while the instrument is active, opens the "SGMA-GUI > Setup > Instruments > Configure Instruments > Edit Instrument" dialog of the corresponding instrument on the remote controller.

Pressing the ID key of an inactive instrument and starting "SGMA-GUI > Setup > Instruments > Scan", leads to an automatic activation of the instrument in the SGMA-GUI.

3.2 Rear Panel Tour

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

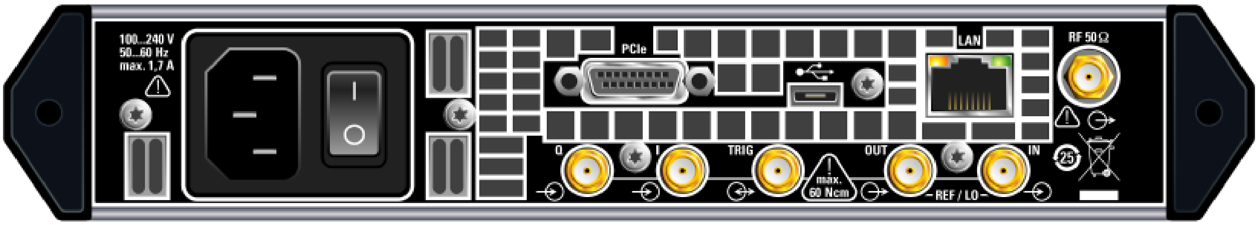


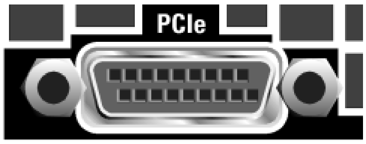
Figure 3-2: Rear panel view

NOTICE

Protection of mechanical components

To avoid damage of the SMA connectors it is essential to limit the tightening torque to 60 Ncm. Use an adequate 8 mm torque wrench and not an ordinary open-end wrench.

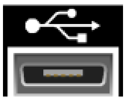
PCI EXPRESS CONNECTOR



The PCIe (Peripheral Component Interconnect Express) single lane interface allows remote control with optimized speed.

For details, see Chapter 2.3.3, "Connecting a Controller via PCI Express", on page 24.

USB CONNECTOR

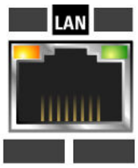


The USB (universal serial bus) interface, type micro, allows you to connect various external devices, e.g.:

- If the interface is configured as a device interface, the R&S SGS can be connected to other devices like a remote computer. On the computer, you can perform a firmware update, manual operation via the R&S SGMA-GUI software or for remote control of the instrument.
- If the interface is configured as a host interface, a memory stick for file transmission can be connected.

For details, see Chapter 2.3.4, "Connecting a Controller or a USB Device via USB", on page 24.

LAN CONNECTOR



The LAN (Ethernet) interface allows you to connect the R&S SGS to other devices like a remote computer. On the computer, you can perform a firmware update, manual operation via the R&S SGMA-GUI software or for remote control of the instrument. The connection to the remote computer can be direct or via a network.

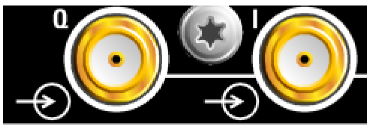
For details, see Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22.

RF OUT

Provides an RF 50 Ohm signal output.

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

I , Q



SMA female type connectors that are inputs of the I/Q modulator, provided for feeding of external signal.

NOTICE! Maximum input levels. Do not overload the I and Q inputs. The maximum permissible voltage is 1V. For details, refer to the data sheet.

Note: The I/Q modulator requires one of the hardware options R&S SGS-B106V/-B112V.

REF / LO IN, REF / LO OUT

SMA female type connectors, for reference or local oscillator signals, and alternatively also in MIMO setups.

Reference input and output:

- REF IN: Input for external reference signal.
- REF OUT: Output of internal reference signal.

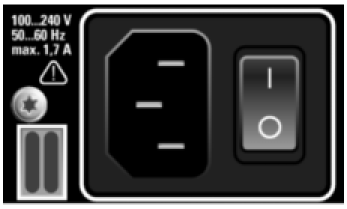
Local oscillator input and output:
- LO IN: Input for external LO signals
- LO OUT: Output of internal LO signals.

Note: The local oscillator input/output requires the additional software option R&S SGS-K90.

TRIG

Multi-purpose connector. The TRIG connector is used mainly as an input connector for an external pulse modulator source.

AC SUPPLY AND POWER SWITCH



The AC supply and power switch allow you to connect the R&S SGS to the power supply and switch on the instrument.

For details, see "To connect the AC supply" on page 18.

4 First Steps with the Instrument

This section provides examples on how to configure the R&S SGS to generate a continuous wave (CW) signal via the R&S SGMA-GUI and the R&S SGS100A Web-GUI.

4.1 Configuring a CW Signal with the R&S SGMA-GUI

The R&S SGS in this example is a base unit equipped with the frequency option R&S SGS-B106.

As a prerequisite for this example, the R&S SGS has to be connected to a remote PC. The R&S SGMA-GUI software has to be installed on this remote PC and the instrument is added to the list of "Available Instruments".

Figure 4-1: Example of the setup

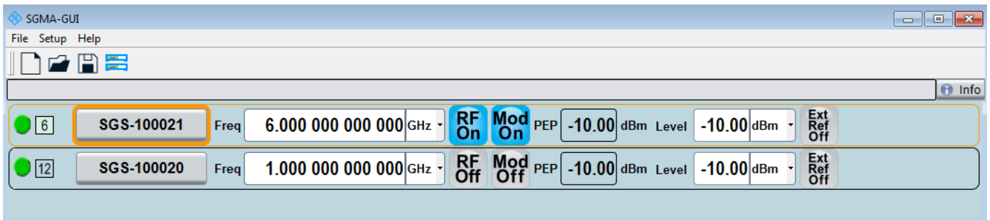
For information on how to fulfill these requirements, refer to
- Chapter 2.3.2.1, "Connecting the Instrument to the Network", on page 22
- Chapter 2.3.1, "Installing the R&S SGMA-GUI Software on an External PC", on page 21
- Chapter 2.3.2.3, "Automatically Adding Instruments to the SGMA-GUI ", on page 23

1. Check the front panel of the R&S SGS.

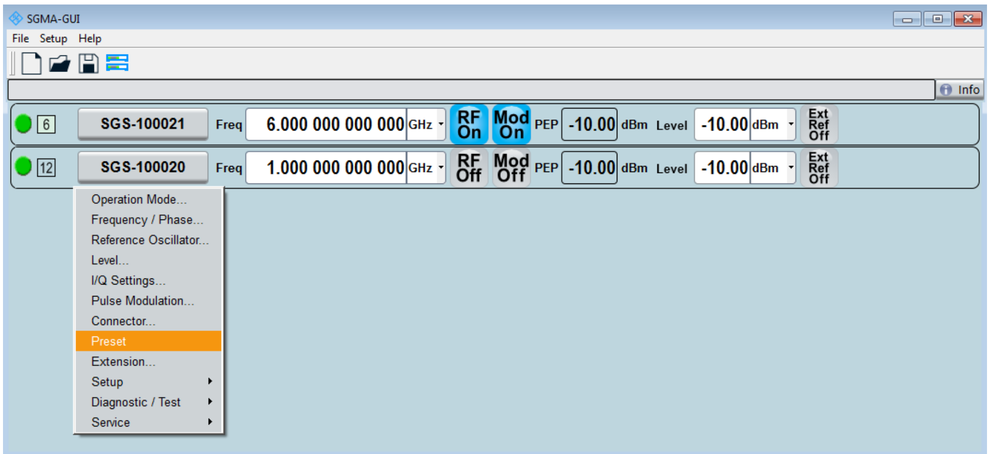
   The POWER ON/STANDBY and LAN key have to be **green**.

2. On the connected remote PC, start the R&S SGMA-GUI software application.

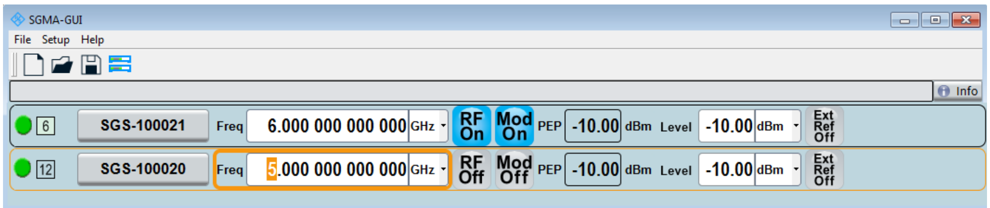
   The main panel of the application opens. The panel provides a quick access to the main settings of the configured and activated instruments. The display shows one row per instrument with the instrument-specific settings. The rows comprise the instrument, the connection state, the used frequency and power level, the state of the RF output and the modulator and the used reference frequency source.



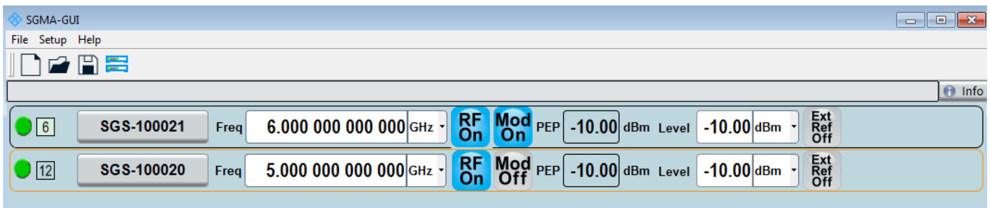
3. In the R&S SGMA-GUI main panel, the green indicator in front of the instrument's name confirms that there is a connection between the instrument and the remote PC and that the instrument is recognized by the software.
4. In the R&S SGMA-GUI main panel, select the row corresponding to the instrument to be configured and select "Instrument Name > Preset" to restore the predefined instrument's settings.



5. In the R&S SGMA-GUI main panel, select the row corresponding to the instrument to be configured and adjust the "Frequency" as required.



6. Select "SGMA-GUI > RF On" to enable the output of the CW signal.



The 5 GHz signal is output at the RF OUT connector at the rear panel of the R&S SGS.

Identifying a specific instrument

If several instruments are active in the R&S SGMA-GUI, use one of the device identification functions to identify a specific device:

- Select "SGMA-GUI > Instrument Name > Setup > Remote > Remote Channels > Device Identify". The green LAN LED on the front panel of the instrument blinks.
- Press the ID key on the instrument's front panel. The "Edit Instrument" dialog of the respective instrument opens.

4.2 Configuring a CW Signal with the R&S SGS100A Web-GUI

The R&S SGS100A Web-GUI is an alternative way to operate the R&S SGS. There is no installation needed. It can be used with all devices and operating systems, including tablets and smart phones, which have one of the following web browsers installed:

- Mozilla Firefox
- Google Chrome
- Microsoft Internet Explorer 9 or later

To connect to the R&S SGS from an external device, both of them must have access to the same network, i.e. use a shared network.

The feature set of the R&S SGS100A Web-GUI is limited to the most common settings, needed especially for modifying the output signal. For additional actions like firmware updates or adjustments, please use the R&S SGMA-GUI.

You can operate the R&S SGS100A Web-GUI and the R&S SGMA-GUI simultaneously. Furthermore you can enable the "Update" function (upper right corner) to allow an automatic update of the settings shown in the R&S SGS100A Web-GUI, if the settings were changed via other software.

As a prerequisite for this example, the R&S SGS has to be connected to the same network as the device used for controlling the instrument. Also one of the supported web browsers has to be available.

1. Check the front panel of the R&S SGS.

   The POWER ON /STAND BY and the LAN key have to be **green**.
2. Open a supported web browser.
3. Enter the instrument name or the IP address of the R&S SGS you want to connect to.

   Tip: The default hostname of the instrument is a non case-sensitive string built as follows:

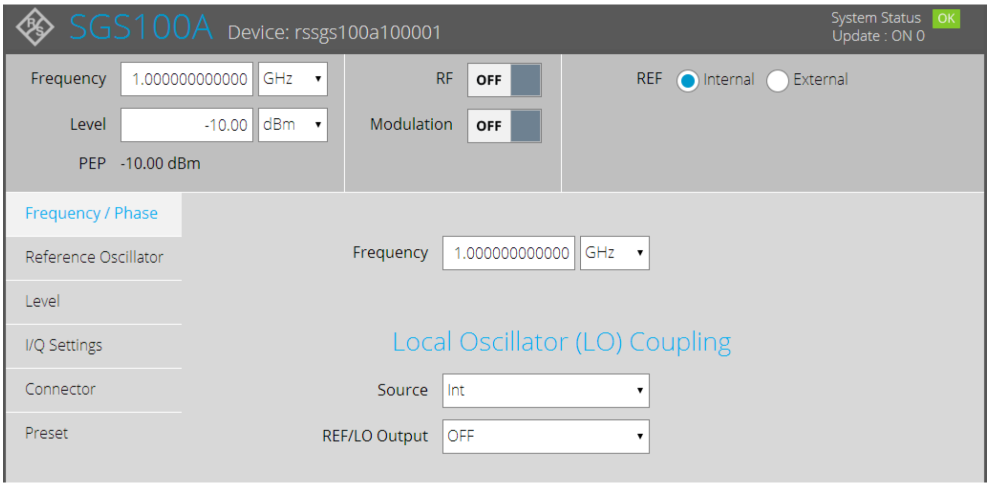
   `hostname = rssgs100a<serial number>`, where

   `<serial number>` is the individual serial number of the instrument.

The serial number is displayed at the rear side of the instrument. It is the third part of the device ID printed on the bar code sticker, see Figure 4-2.

Figure 4-2: Serial number of the R&S SGS100A

The main panel of the R&S SGS100A Web-GUI opens.



In the R&S SGS100A Web-GUI main panel, the green indicator "System Status > OK " confirms that there is a connection between the instrument and the remote PC and that the instrument is recognized by the software.
If you want to get additional information about the instrument, click on the "Device Name". For additional information on other settings, hold the mouse cursor over the specific setting.
Error messages are also displayed in the R&S SGS100A Web-GUI. If you want to hide an error message, click on it.

4. In the menu bar on the left side press "Preset" to restore the predefined instrument's settings.
5. Select "Frequency" and adjust the setting as required.
6. Select "RF On" to enable the output of the CW signal.

   A signal with the set frequency is output at the RF OUT connector at the rear panel of the R&S SGS.

5 System Overview

The R&S SGS RF Source is a signal generator intended either for the generation of IQ-modulated signals or as a pure local oscillator (LO) source in the frequency range of 1 MHz to 12.75 GHz.

Optimized for use in automated test equipment (ATE), the instrument offers very fast settling times in an exceptionally small formfactor and low power consumption. The R&S SGS can be equipped optionally with an active electronic step attenuator, a high stability reference oscillator and LO connectors for coupling multiple generators to a common LO source.

5.1 Setups for Instrument Control

The R&S SGS is an instrument designed for the automated test equipment (ATE) needs. To maintain the small size, the instrument is not equipped with a display and hence additional equipment is required to control the instrument.

This section provides an overview of the possible configuration setups for controlling the R&S SGS.

5.1.1 Manual Operation from the R&S SGMA-GUI

The following example represents a basic configuration of the R&S SGS, operated manually by the configuration software R&S SGMA-GUI. The configuration software is installed on a remote PC and controls several instruments. The instruments are connected to the remote PC over different remote control interfaces. Any combination of the used interfaces is possible.

Figure 5-1: Configuration example: manual control from R&S SGMA-GUI

For information about the manual control, refer to:
- Chapter 6, "Understanding the R&S SGMA-GUI Software", on page 48
- Chapter 7, "Signal Generator Settings", on page 75
- Chapter 8, "General Instrument Settings and Instrument Setup", on page 121

5.1.2 Remote Control from a Controller

The remote control provides access to the instrument's settings from a remote computer (external controller) by means of remote commands. To automate often repeating settings and settings sequences, these are grouped in the remote control programs, i.e. application programs.

An instrument may be connected to the controller via any of the supported interfaces LAN, USB or PCIe.

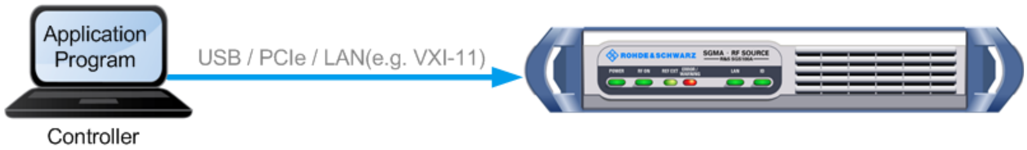


Figure 5-2: Configuration example: remote control from a controller

For information about remote control, refer to:
- Chapter 10, "Network and Remote Control Operation", on page 155
- Chapter A, "Remote Control Basics", on page 281

5.1.3 Control of an R&S SGS from an R&S Signal Generator

The R&S SGS can be used as an additional signal source to increase the number of available RF outputs of a R&S Signal Generator. In this setup, a controller does not need to access the R&S SGS directly. Instead, the signal generator acts as a controller to the R&S SGS and depending on the required output signal parameters performs all required settings automatically.

The Figure 5-3 shows a configuration example of the R&S SGS, directly controlled by a R&S SMW.

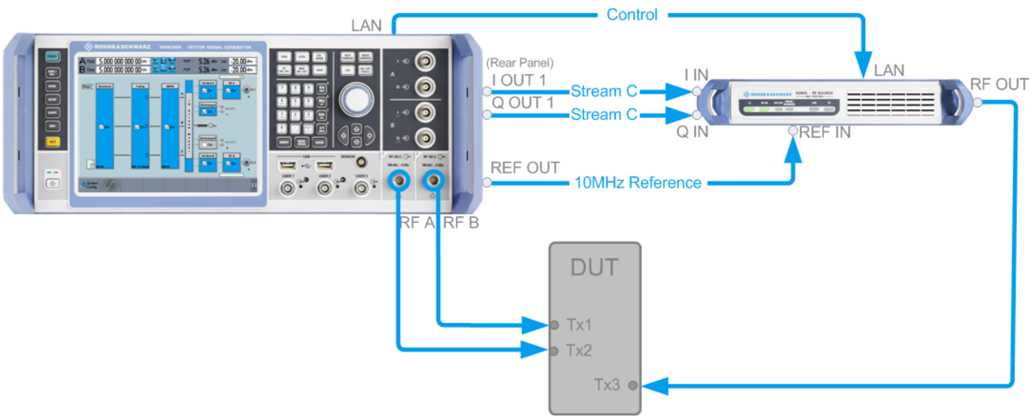


Figure 5-3: Configuration example: Control from a R&S SMW

5.2 Setups for Connecting an R&S SGS and an R&S SGU

If an R&S SGU is connected to an R&S SGS, the R&S SGU acts as an extension to the R&S SGS extending its frequency range. In this setup, a controller does not need to access the R&S SGU directly. Instead, the R&S SGS acts as a controller to the R&S SGU. The generator performs all required settings automatically depending on the required output signal parameters.

This chapter gives an overview of how to connect the instruments.

See:

- Chapter 5.2.1, "Direct Connection", on page 37
- Chapter 5.2.2, "Connection in a Company Network", on page 38
- Chapter 5.2.3, "Connection with a PCIe Switch", on page 41
- Chapter 5.2.4, "R&S SGU as an Extension to the R&S SGS", on page 42

5.2.1 Direct Connection

The R&S SGS and the R&S SGU can be connected through a direct connection as shown in Figure 5-4.

Direct connection of an R&S SGS and an R&S SGU

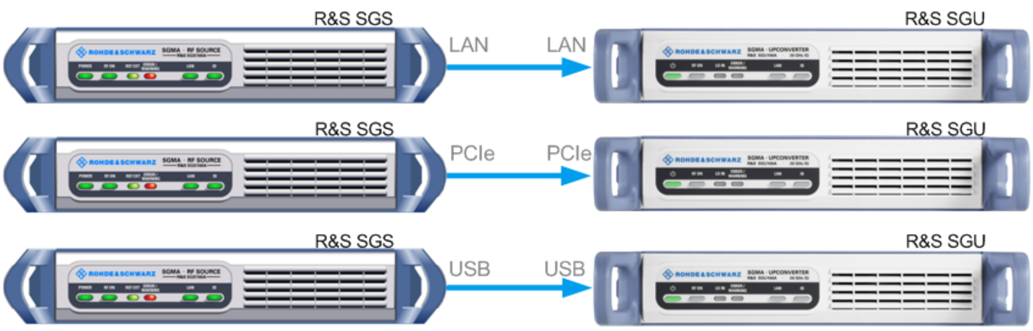


Figure 5-4: Direct connection of an R&S SGS and an R&S SGU

1. Connect the R&S SGS and the R&S SGU directly using one of the following options:
   a) USB cable. Use a Type Micro-A connector for R&S SGS and a Type Micro-B connector for R&S SGU. See also Chapter 2.3.4, "Connecting a Controller or a USB Device via USB", on page 24.
   b) LAN cable. No additional cable considerations are required.
   c) PCIe cable. Refer to Chapter 10.3.4, "Connecting the Controller and the Instrument", on page 169 for cable requirements and setup information.
2. Switch on the R&S SGS and the R&S SGU.

   The R&S SGS automatically identifies the connected R&S SGU as its extension and starts the extension mode.

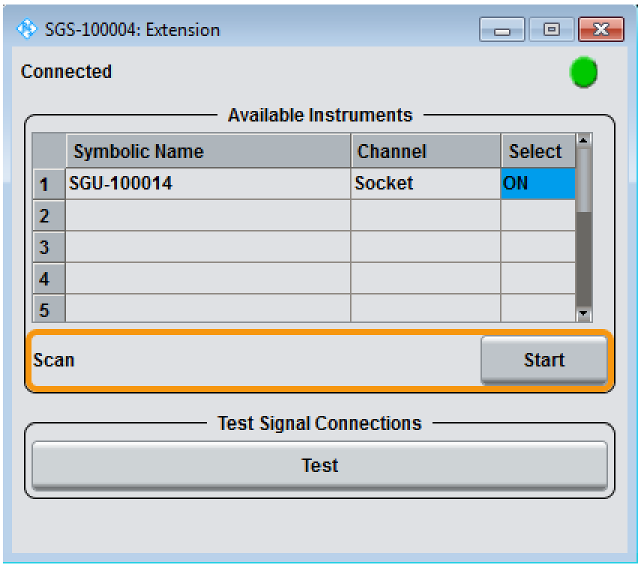
For a direct PCIe connection, an automatic identification of the R&S SGU as an extension is only available for an R&S SGS with a "Controller > Revision" 5 or higher. For a description on how to manually set the PCIe identification, see Chapter 9.14, "How to Manually Set a PCIe Direct Connection between an R&S SGS and an R&S SGU", on page 154.

You can check the "Controller > Revision" of your instrument in the "SGMA-GUI > Instrument Name > Hardware Config" dialog.

If instrument is not automatically added as an extension

If the R&S SGU is not automatically added as an extension you can do that manually in the "SGMA-GUI > R&S SGS Name > Extension" dialog.

If the R&S SGU is not listed in the list of "Available Instruments", you can press "Scan > Start" to find the instrument.



5.2.2 Connection in a Company Network

Connection of an R&S SGS and an R&S SGU in a Company Network

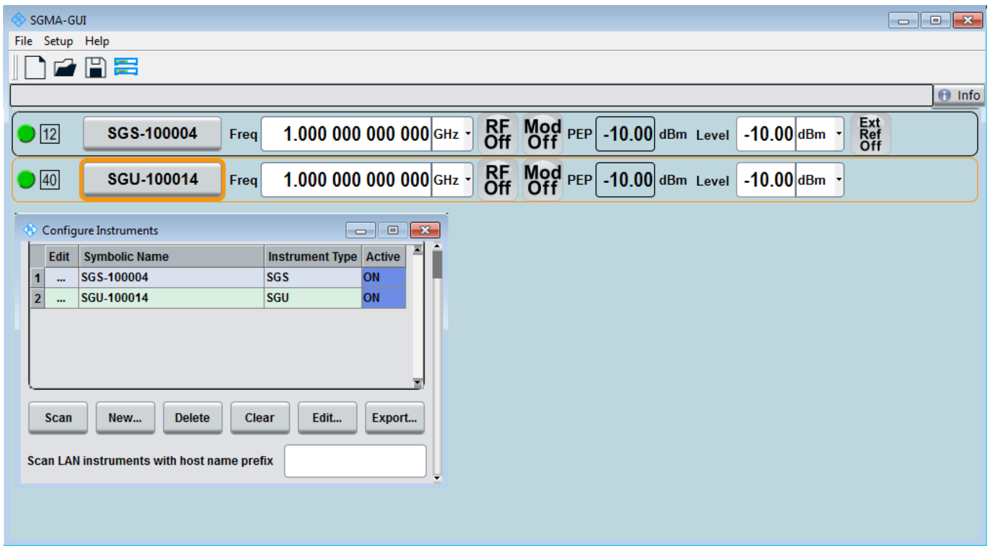
As a prerequisite for this example the R&S SGMA-GUI software has to be installed on a remote PC.

Figure 5-5: Connection of an R&S SGS and an R&S SGU in a company network

1. Connect the test equipment as shown in Figure 5-5:
   a) Connect the R&S SGS, the R&S SGU and the controller to the company network.
   b) Connect the RF OUT of the R&S SGS to the LO IN of the R&S SGU.
2. Switch on the R&S SGS and the R&S SGU.

   The POWER ON/STANDBY keys have to be **green** and not blinking.
3. Press the ID keys on the front panels of the R&S SGS and the R&S SGU.
4. On the connected remote PC, start the R&S SGMA-GUI software application.

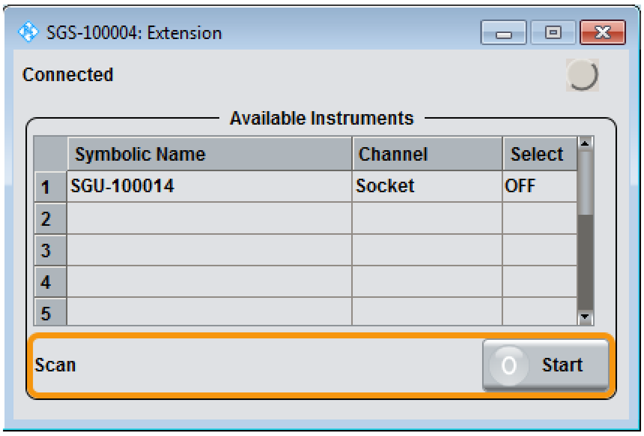
   The main panel of the application and the configure instruments dialog open. Both instruments are added automatically to the instruments list and to the main panel of the R&S SGMA-GUI software.



Note: If you connect the instruments to the company network for the first time this process may take several minutes.

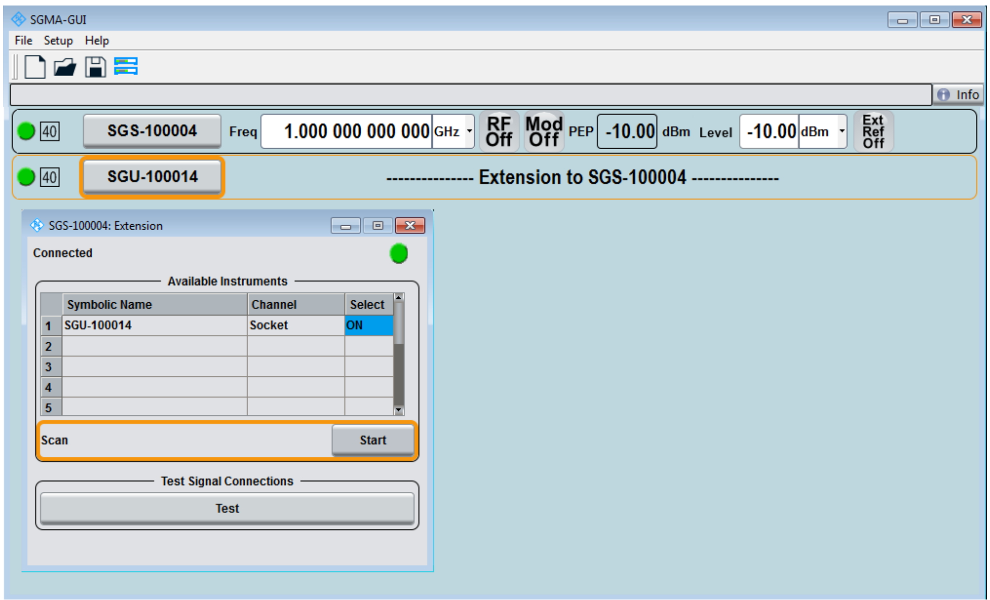
5. In the R&S SGMA-GUI main panel, the green indicator in front of the instrument's name confirms that there is a connection between the instrument and the remote PC and that the instrument is recognized by the software.
6. Select "SGMA-GUI main panel > R&S SGS > Extension".

   The "Extension" dialog opens.

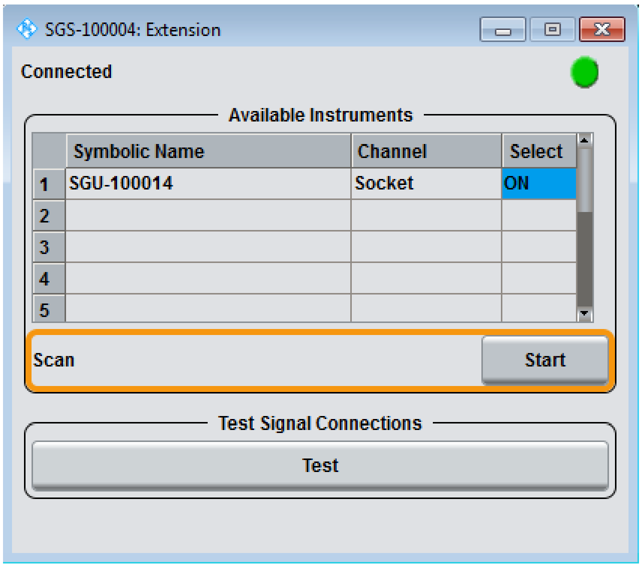


   Tip: Instrument doesn't appear in the extension dialog. If the R&S SGU is not automatically shown in this dialog press "Scan > Start" to find the instrument.
7. Select the R&S SGU from the list and set "Available Instruments > Select > On" to enable it as an extension.

   A green status indicator "Connected" indicates the successfully established remote connection between the R&S SGS ant the R&S SGU.
   The R&S SGMA-GUI indicates the extended frequency range of the R&S SGS and the activated extension mode.



8. Select "Test Signal Connections > Test" to trigger a check of all required signal connections.



The diagram displays the connection state of the tested signal connections. If the test connections are correct (shown by an uninterrupted blue line), you can start using the R&S SGS and the R&S SGU in extension mode.

Tip: If your connection is marked as faulty- a red line is crossing the blue connection line - check whether the cables are connected properly. Check also if the connection cables are functioning properly.

Figure 5-6: A faulty connection between an R&S SGU and an R&S SGS

5.2.3 Connection with a PCIe Switch

The R&S SGS and the R&S SGU can be connected through a PCIe switch as shown in Figure 5-7. This setup is recommended for achieving the highest setting/ measuring speeds.

PCIe switch connection of an R&S SGS and an R&S SGU

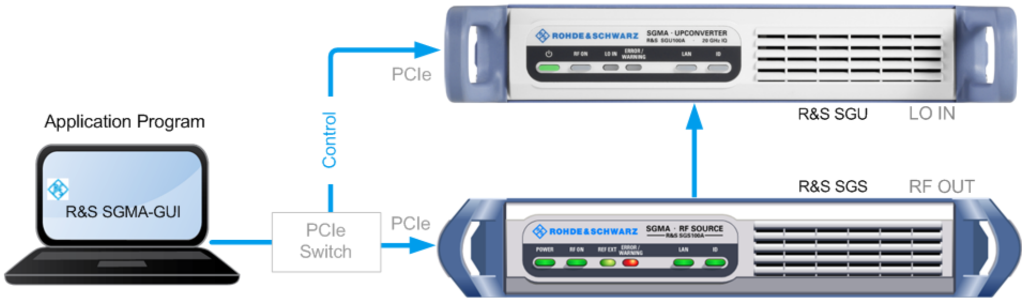


Figure 5-7: Connection of an R&S SGS and an R&S SGU through a PCIe switch

1. Connect the PCIe switch to a switched off computer with a single lane PCIe cable.
2. Connect the R&S SGS and the R&S SGU to the PCIe switch.
3. Switch on the R&S SGS and the R&S SGU.

   The POWER ON/STANDBY keys of both instruments have to be **green** and not blinking.
4. Switch on the computer.
5. On the computer start one of the following:
   a) The R&S SGMA-GUI
   b) An application program for remote control of the instruments
6. Manually (or remotely) activate the R&S SGU as an extension to the R&S SGS.

The logical connection between an R&S SGS and an R&S SGU is established by the driver layer of a program (e.g. the R&S SGMA-GUI) or the library PCIeController.dll (Linux: libpciecontroller.so) of a remote control program on the PC. Such a program has to be running on the PC so that an R&S SGS is able to communicate with an R&S SGU.

5.2.4 R&S SGU as an Extension to the R&S SGS

In case the R&S SGU is connected to a compatible R&S signal generator, a controller only needs to talk to the signal generator which in turn takes care of the proper settings for the R&S SGU.

In the following example, the instrument is manually operated via the R&S SGMA-GUI software. The R&S SGU in this example is a base unit equipped with the frequency option R&S SGU-B120.

Configuring the R&S SGU to upconvert a CW signal generated by the R&S SGS

As a prerequisite for this example the R&S SGMA-GUI software has to be installed on a remote PC.

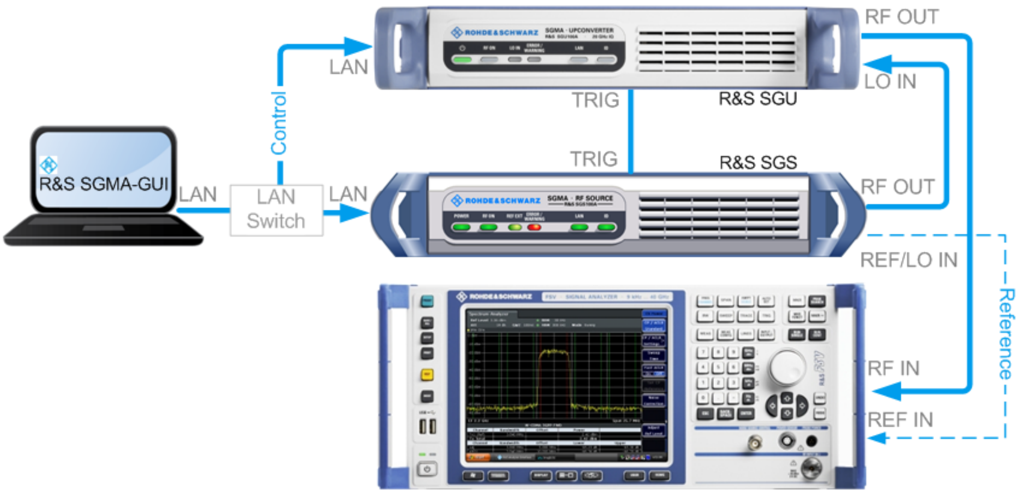


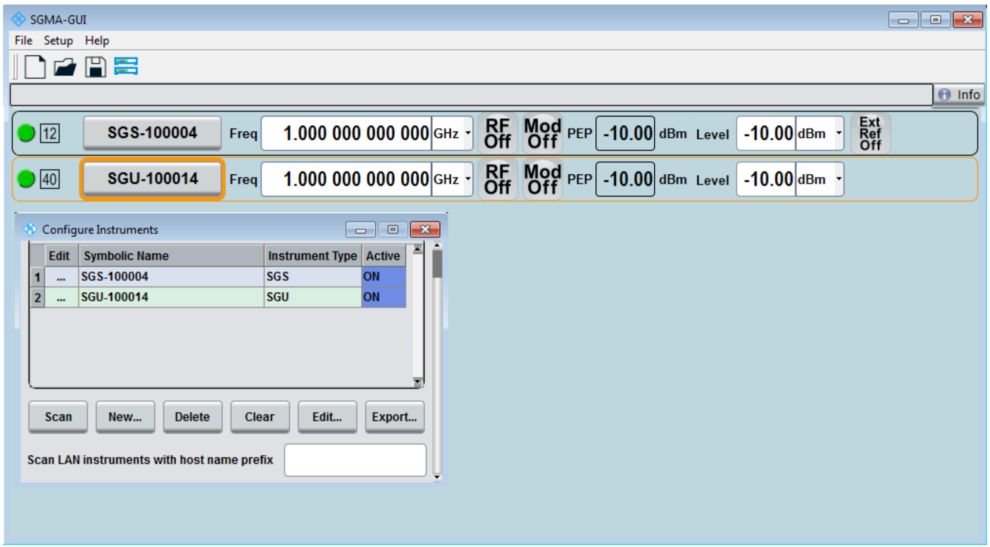
Figure 5-8: Example of a test setup for upconverting a CW signal generated by the R&S SGS

For higher setting/ measuring speeds, use a PCIe switch and PCIe connections.

1. Connect the test equipment as shown on Figure 5-8:
   a) Connect the R&S SGS, R&S SGU and the controller to a LAN switch.
   b) Connect the RF OUT of the R&S SGS to the LO IN of the R&S SGU.
   c) Connect the TRIG connectors of the R&S SGS and the R&S SGU.
   d) Connect the RF OUT of the R&S SGU to the RF IN of the signal analyzer.
2. Switch on the R&S SGS and the R&S SGU.

   The POWER ON/STANDBY keys have to be **green** and not blinking.
3. Press the ID keys on the front panels of the R&S SGS and the R&S SGU (only required if the components are connected via a company network).
4. On the connected remote PC, start the R&S SGMA-GUI software application.

   The main panel of the application and the configure instruments dialog open. Both instruments are added automatically to the instruments list and to the main panel of the R&S SGMA-GUI software.
   The main panel provides a quick access to the main settings of the configured and activated instruments. The display shows one row per instrument with the instrument specific settings. The rows comprise the instrument, the connection state, the used frequency and power level and the state of the RF output and the modulator.

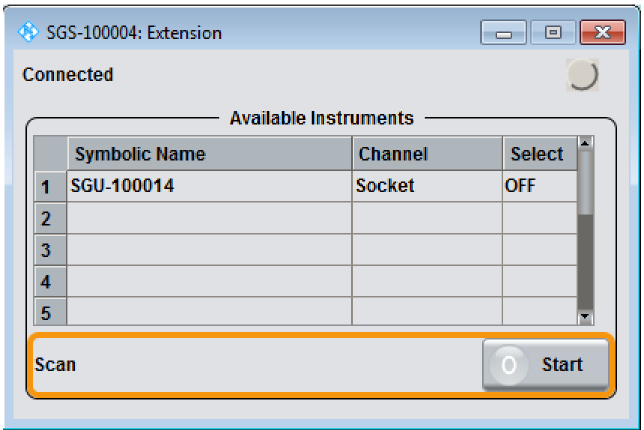


5. In the R&S SGMA-GUI main panel, the green indicator in front of the instrument's name confirms that there is a connection between the instrument and the remote PC and that the instrument is recognized by the software.

6. In the R&S SGMA-GUI main panel, select the rows corresponding to the corresponding instruments to be configured and select "Instrument Name > Preset" to restore their predefined settings.

7. Select "SGMA-GUI main panel > R&S SGS > Extension".

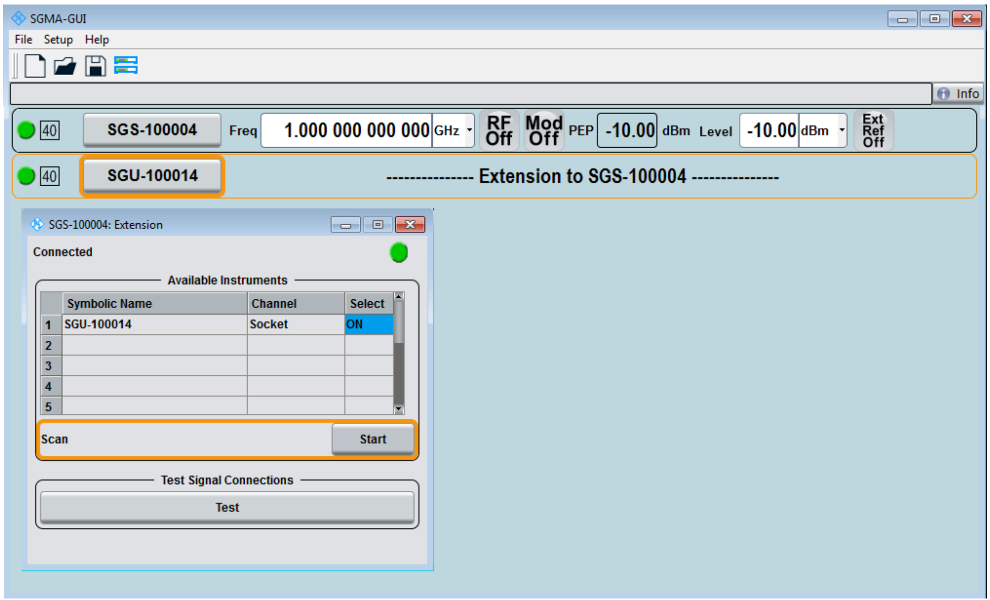
   The "Extension" dialog opens.



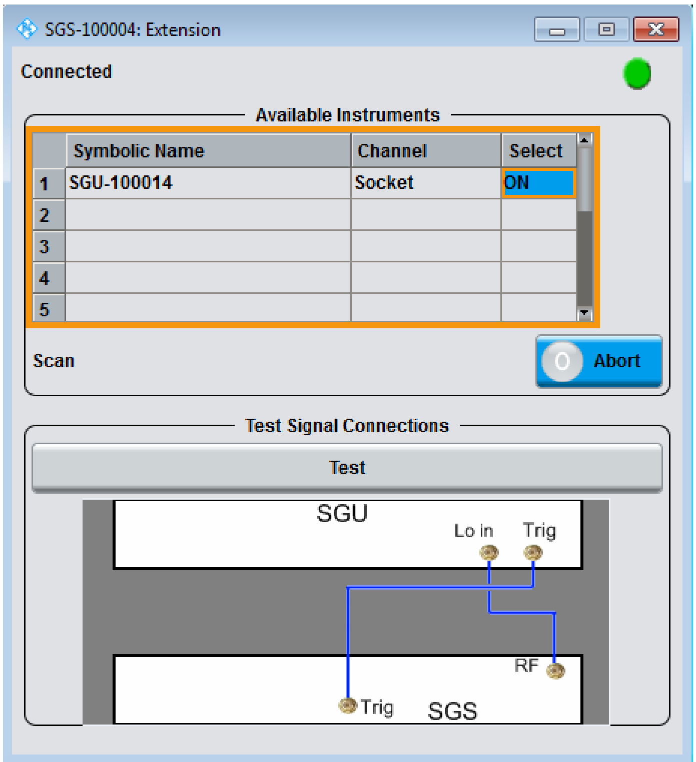
Tip: Instrument does not appear in the extension dialog. If the R&S SGU is not automatically shown in this dialog, press "Scan > Start" to find the instrument.

8. Select the R&S SGU from the list and set "Available Instruments > Select > On" to enable it as an extension.

   A green status indicator "Connected" indicates the successfully established remote connection between the R&S SGS ant the R&S SGU.
   The R&S SGMA-GUI indicates the extended frequency range of the R&S SGS and the activated extension mode.

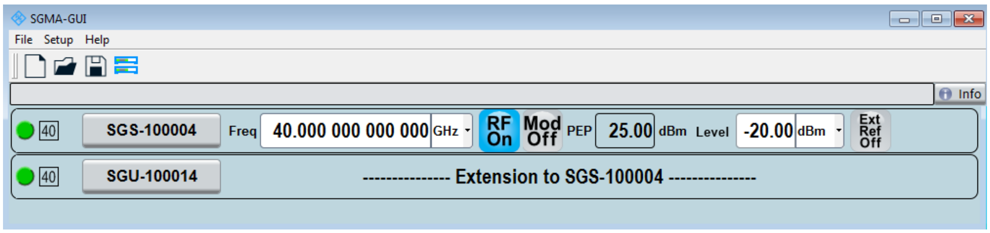


9. Select "Test Signal Connections > Test" to trigger a check of all required signal connections.



The diagram displays the connection state of the tested connections.

10. Select "SGMA-GUI > R&S SGS > Freq = 40 GHz", "Lev = -30 dBm".
11. Select "SGMA-GUI >SGS> RF > State > On" to enable the output of the CW signal.



The extension adopts these values and states automatically and generates a CW signal with RF = 40 GHz and Level = -20 dBm.

The signal is output at the RF OUT connector on the rear panel of the R&S SGU.

Identifying a specific instrument

If several instruments are active in the R&S SGMA-GUI use one of the device identification functions to identify a specific device:

- Select "SGMA-GUI > Instrument Name > Setup > Remote > Remote Channels > Device Identify". The green LAN LED on the front panel of the instrument blinks.
- Press the ID key on the instrument's front panel. The "Edit Instrument" dialog of the respective instrument opens.

5.3 Introduction to the Instrument Functions

This section is intended to give a brief introduction to the instrument's function. The description of the related user interface parameters is provided in the corresponding section in Chapter 7, "Signal Generator Settings", on page 75.

For detailed information on how to work with the instrument and to perform basic and advanced operating and configuration tasks, refer to Chapter 9, "Performing Configuration Tasks", on page 140.

The Figure 5-9 provides a simplified block diagram of the instrument.

For better understanding of the instrument functions and the signal flow, the block diagram shows the main blocks of the instrument together with the corresponding GUI parameters.

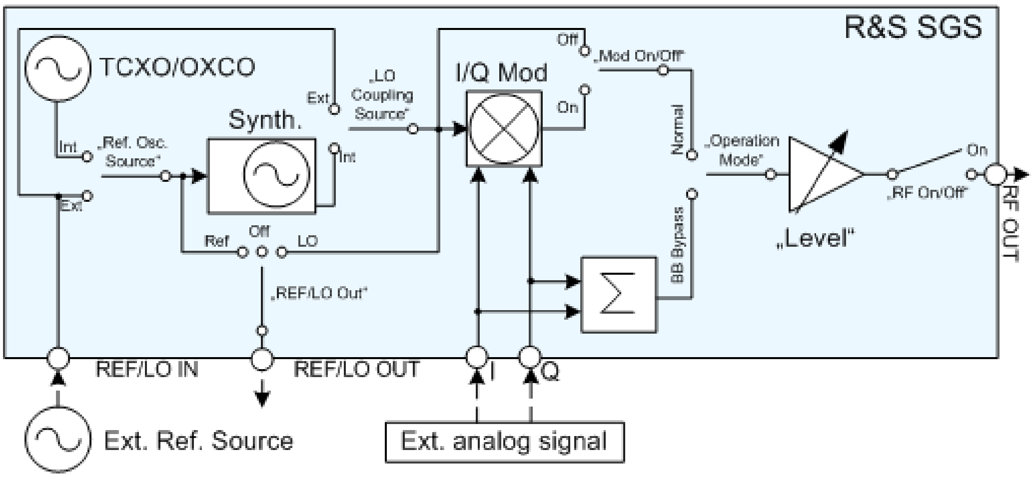


Figure 5-9: Simplified Block Diagram

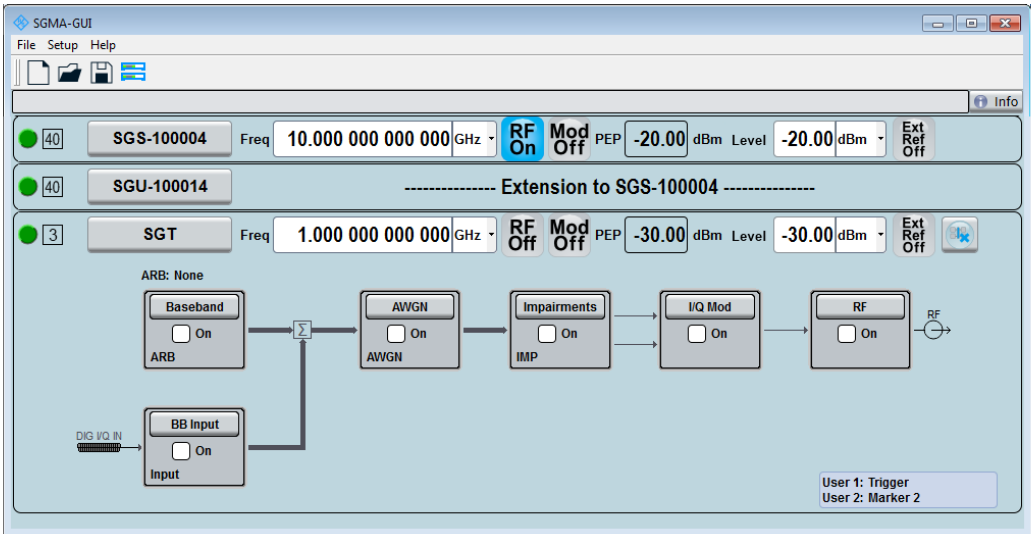
TCXO	= Built-in reference oscillator
OCXO	= Oven-controlled oscillator, requires hardware option R&S SGS-B1
Synth.	= Synthesizer
I/Q Mod	= I/Q Modulator
REF/LO IN, REF/LO OUT, I, Q, RF OUT	= Connector at the rear panel
"Ref. Osc. Source", "REF/LO Out", "LO Coupling Source", "Mod On/Off", RF On/Off", "Operation Mode"	= R&S SGMA-GUI equivalent parameter

The instrument can generate a CW or an I/Q modulated signal ("Mod On/Off"). The frequency and level settings are adjustable ("Level", "RF on/Off", "Frequency"). The instrument can use its internal reference frequency or a fed-in external one (REF/LO IN, "Ref. Osc. Source"). The reference frequency can also be output for synchronization purposes (REF/LO OUT, "REF/LO Out"). The local oscillator (LO) signal can be distributed in such a way, that two or more instruments are connected to generate phase coherent signals ("LO Coupling Source", REF/LO OUT, "REF/LO Out"). Whereas both possibilities, the input of the reference frequency and the input of a LO signal, exclude each other because they use the same connectors. The same applies for the output of the reference frequency and the LO signal. The instrument can also be configured to work in the special baseband bypass mode ("Operation Mode").

Refer to Chapter 9, "Performing Configuration Tasks", on page 140 for an overview of the general operating tasks. The Chapter 9.1, "How to Generate an I/Q Modulated Signal", on page 140 explains the basic operating concept by means of an example.

6 Understanding the R&S SGMA-GUI Software

This section gives a detailed description of the R&S SGMA-GUI user interface and information on how to work with it. The main panel with the overview of the configured instruments is the operating and control interface for the whole program. From here, all program functions are accessible. This panel is displayed after the start of R&S SGMA-GUI. The program always loads the previously used settings so you can continue your work in the next session.



6.1 Operating Menu and Toolbar

On the top of the main panel, there are the menu bar, the toolbar and the info bar with the corresponding "Info" button. Some of the functions are accessible via the toolbar with its icons below the menu selection line.

The dialogs are built using elements, e.g., selection lists, checkboxes, and entry fields. A blue frame indicates that the selected item is active. In a highlighted element, entries can be made.

Table 6-1: Content of the operating menu

File	Setup	Help
New	Instruments	About
Open	Software	Contents
Save	Reset SGMA-GUI	Index
Save as	Protection	

File	Setup	Help
Exit		
Shut down instruments and exit		

6.1.1 File Menu

The R&S SGMA-GUI employs the standard Save/Recall file management function and allows you to store and reload settings in/to a file with a user-defined name and location (see also Chapter 6.4.1, "Storing and Loading Settings", on page 62).

In the following, the "File" menu of the R&S SGMA-GUI is described in detail. It incorporates standard functions.

New
Resets R&S SGMA-GUI and all connected instruments to their preset settings.

Open
Opens the standard file open browser for loading a saved R&S SGMA-GUI file (`*.savrcl`). The file contains the user-specific settings of a session, such as instruments configured in the software, etc. The complete settings of a session can be saved and loaded.

Only files of this type are selectable.

Note: Instrument-specific settings, e.g. frequency and level settings, are stored locally on the particular instrument itself. These instruments settings are saved automatically in a predefined directory and loaded by default when starting the instrument again. The files with instrument settings are not accessible.

Save
Standard quick save of the settings of the current session if a filename previously has been applied. If not, the "Save As" dialog is opened.

Save as
Opens the standard file save browser for saving the settings of the current session. R&S SGMA-GUI files have the file extension `.savrcl` so the name typed in is equipped with this extension. The complete settings of a session are saved.

Exit
Quits the R&S SGMA-GUI. The current settings of the instrument's session are saved and loaded by default when starting the software again.

Note: The instruments configured in the R&S SGMA-GUI are not shut down.

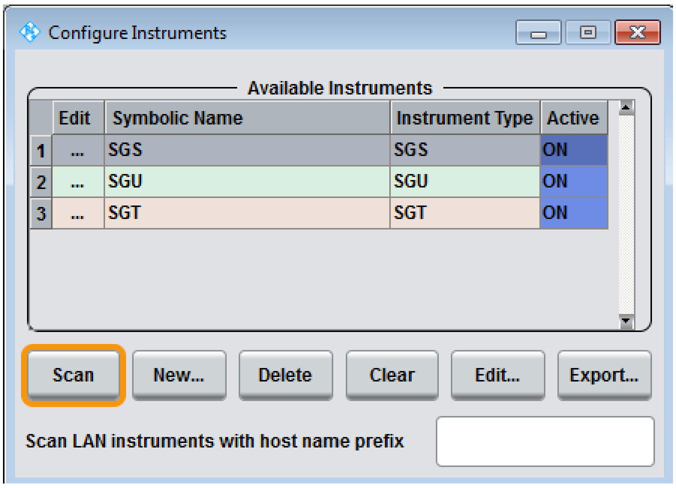
Shut down instruments and exit
Quits the R&S SGMA-GUI and switches the connected instruments to the standby state (see alsoChapter 9.9, "How to Switch between the Operating States", on page 149).

6.1.2 Setup Menu

The setup menu provides access to dialogs for setting the general settings of the software, like dialogs for managing the connected instruments or dialogs providing information about the installed options.

6.1.2.1 Configure Instruments

This dialog is the central point for managing the instrument that will be configured and operated via the R&S SGMA-GUI. New instruments can be created and appended to the list of available instruments, connection settings can be edited, instruments can be removed from the list or they can be deactivated, but kept in the list for further use.



Refer to Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 62 for information on how to configure and manage instruments in R&S SGMA-GUI.

Available Instruments

This section comprises a list of configured instruments. Each instrument is represented by a "Symbolic Name" which is also displayed in the main panel and an "Instrument Type". It is also displayed whether the instrument is activated in the R&S SGMA-GUI and hence displayed in the main panel or not.

Remote command:
`:INSTruments:COUNt?` on page 71
`:INSTruments:NAME` on page 71
`:INSTruments:TYPE` on page 73
`:INSTruments:ACTive[:STATe]` on page 70

Scan

Triggers a scan function and searches for instruments connected to the remote computer via all the available interfaces. During the scan process, a progress bar is displayed.

Tip: The first initialization of a newly connected instrument in a network and the instrument's request to the DHCP server for an IP address may take some time. During this time, the instrument does not respond to the query sent by the scan function. If the instrument does not appear in the list of "Available Instruments", trigger the scan function again after some minutes.

Remote command:
`:INSTruments:SCAN` on page 73

New Instrument
Calls the Add/Edit Instruments dialog.

Delete Instrument
Removes the selected instrument from the list of Available Instruments.

Edit Instrument
Calls the Add/Edit Instruments dialog.

Clear Instrument
Removes all instruments from the list of Available Instruments.

Export
Opens the standard file save browser for saving the list of the available instruments in a mapping file. The mapping files have the file extension `.map` so the filename typed in is automatically equipped with this extension.

A mapping file provides a cross-reference between the instruments' symbolic names and their respective remote control parameters. The information in the mapping file is grouped in rows, where one row corresponds to one configured instrument. The rows have the following structure:

<InstrumentType> <SymbolicName> <IP_Address/Hostname> <RemoteChannel> <SerialNumber>

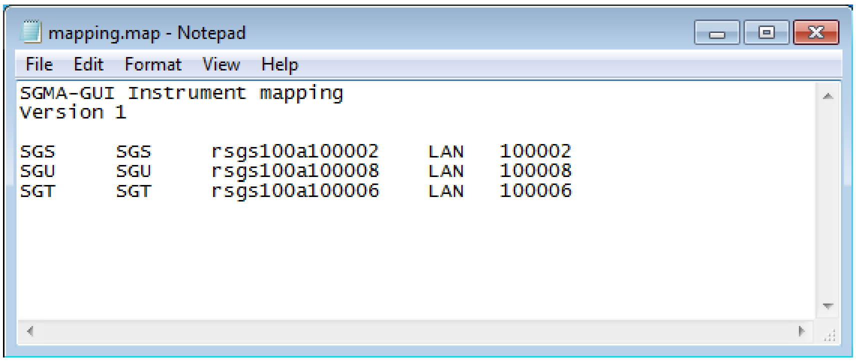


Figure 6-1: Mapping file example

Tip: In a remote control application program, address the instruments by their symbolic names and retrieve the remain required settings from the mapping file. This workflow is especially useful for frequent exchange of instruments.

Remote command:
`:INSTruments:MAPPing:FILE` on page 71

Scan LAN instruments with host name prefix
Sets the prefix the searched host names begin with. Use this function to limit the amount of the searched instruments and to speed up the scan process.

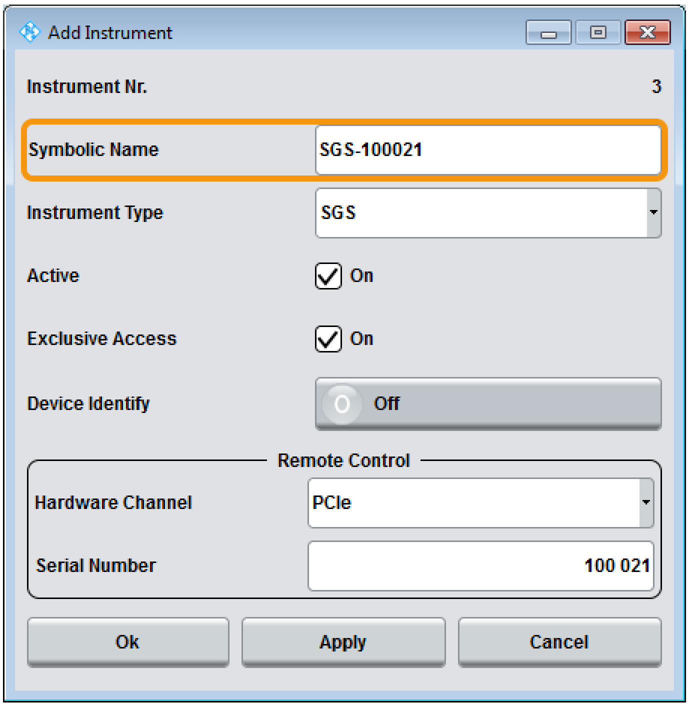
For example, set this field to "RsSGS, RsSGU, RsSGT", if you want to search for all available instruments.

Tip: If you start a scan for an instrument with a set IP address and it doesn't appear in the list of available instruments it may be due to the prefixes written in this field. You can perform another scan while leaving this field empty.

Remote command:
`:INSTruments:SCAN:HNPRefix` on page 73

6.1.2.2 Add/Edit Instruments

The dialog provides access to the main instrument's settings, such as "Symbolic Name", "Instrument Type" and connection settings.



Refer to Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 62 for information on how to configure and manage instruments in R&S SGMA-GUI.

Instrument Nr.
Automatically assigned number that indicates the instrument's index in the list of "Available Instruments".

Symbolic Name
Selects the alias name of the instrument.

Remote command:
:INSTruments:NAME on page 71

Instrument Type
Selects the instrument's family.

Remote command:
:INSTruments:TYPE on page 73

Active
Activates/deactivates the display of the instrument's settings in the main panel.

Note: Only instruments in an active state can be controlled from the R&S SGMA-GUI!

Remote command:
:INSTruments:ACTive[:STATe] on page 70

Exclusive Access
Checks whether the instrument is locked by another user and if not locks the instrument. When an instrument is locked, it is reserved and can be operated manually or remote **exclusively** from the remote PC on which the R&S SGMA-GUI is running or from which the SCPI command is sent.

For interfaces using VISA, i.e. for LAN and USB, enabling the "Exclusive Access" triggers the standard `viLock` request. For remote control over PCIe or Socket, the lock request is performed on a higher application level.

Note: It is recommended to lock the instrument prior to further configuration.
Locked instruments will not be found by the scan function.

The instrument has to be unlocked to allow operation from another remote PC.

Note: The two functions "Exclusive Access" and monitoring are mutually exclusive.
Disable "Exclusive Access" if the instrument is monitored by an external PC.

Remote command:
:INSTruments:EACCess[:STATe] on page 71
:LOCK? on page 197
:UNLock on page 197

Device Identity
Triggers the device identification function. The LAN LED on the front panel of the selected instrument blinks.

See also Chapter 6.4.4, "Bidirectional Instrument Identification ", on page 65.

Hardware Channel
Selects the hardware interface used by the remote channel.

Remote command:
:INSTruments:REMote:CHANnel on page 72

Instrument Name / IP Address
Enters the IP address or the host name of the connected instrument.

See also Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 65.

Remote command:
`:INSTruments:REMote:NAME` on page 72

GPIB Address
Enters the GPIB address of the connected instrument.

See also Chapter 10.1.5, "GPIB Interface (IEC/IEEE Bus Interface)", on page 163.

Remote command:
`:INSTruments:GPIB:ADDRess` on page 72

Board Number
Identifies the GPIB bus card of the controller to that the adapter is connected.

See also Chapter 10.1.5, "GPIB Interface (IEC/IEEE Bus Interface)", on page 163.

Remote command:
`:INSTruments:GPIB:BOARd` on page 72

Serial Number
Enters the serial number as instrument's identification while using the USB or PCIe interfaces for remote control.

Remote command:
`:INSTruments:SERial` on page 73

OK
Confirms the settings and closes the dialog.

Apply
Confirms the settings.

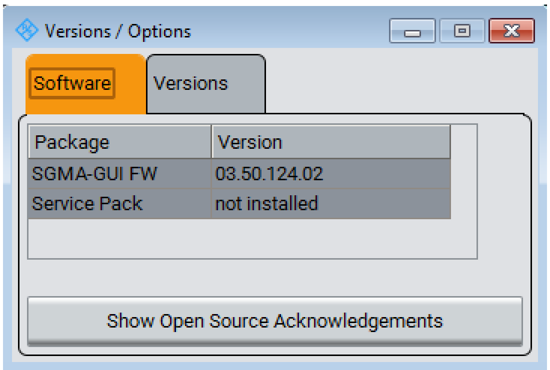
Cancel
Discards settings and closes the dialog.

6.1.2.3 Versions/Options Dialog

Querying information about the installed options and software version

► Select "Setup > Software".

An info dialog opens, showing program information.



Software

Displays information on:

"Package" Installed software packages.

"Version" Release of the software package.

Show Open Source Acknowledgments

Accesses the list of the used open source software packages and the corresponding verbatim license texts.

Versions

Shows the installed software platform and its version.

6.1.2.4 Protection

The "Protection" dialog provides access to the unlocking of protected service functions (authorized personnel of Rohde & Schwarz service departments only).

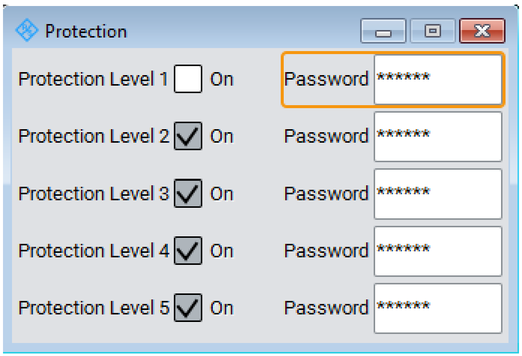
Unlocking of protected service functions

1. Select "SGMA-GUI > Setups > Protection".

   After the instrument has been switched on, the protection levels 1 to 4 are automatically activated.

2. To deactivate the protection, enter the correct password.
   Enter "Protection Level 1 > Password > 123456".

   Protection Level 1 is activated.



Protection Level / Password

"Protection Level 1" can be activated to expand the functionality of the internal adjustment. The password is *123456*.

The other protection levels 2 to 4 provide access to protected service functions. Only the authorized personnel of Rohde & Schwarz service departments can access these functions.

6.1.2.5 Reset SGMA-GUI

Resets R&S SGMA-GUI to its factory preset settings.

The connected instruments are not affected by this preset.

To preset one specific instrument to its factory preset settings, select "SGMA-GUI > Instrument Name > Setup > Factory Preset". Refer to Chapter 8.11, "Factory Preset", on page 135 for an overview of the settings affected by this function.

6.1.3 Help

The R&S SGMA-GUI is equipped with a context-sensitive help function. A help page can be called any time during software operation.

The context-sensitive page which is opened with the F1 button is part of a comprehensive help system.

It is possible to move from this context-sensitive page to any page of the help system. An overview of the contents of the online help can be reached via the menu "SGMA-GUI > Help > Contents".

A search for keywords within the help function is available via menu item "SGMA-GUI > Help > Index".

6.2 Info Dialog and Messages in the Info Bar

A few operating states and the current messages are displayed in the info line. For information on messages in greater detail and their management, an "Info" dialog can be opened.

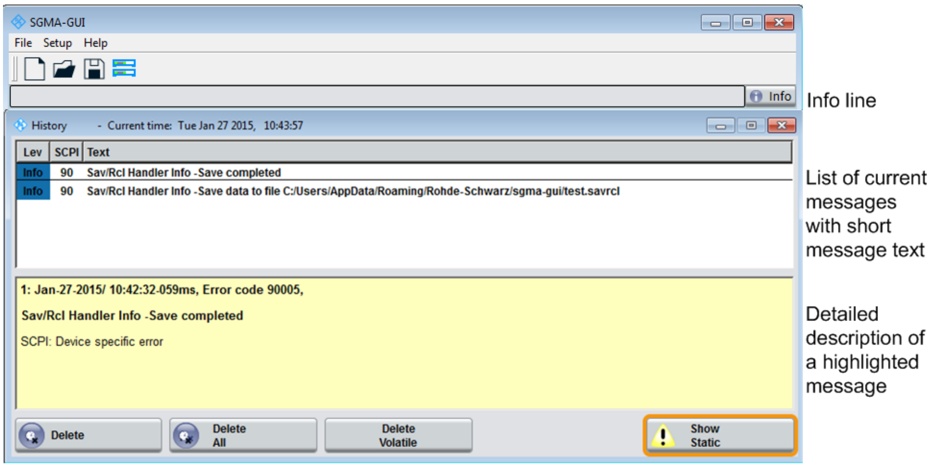
6.2.1 Info Dialog

The "Info" dialog provides a list of currently active permanent messages and a detailed description of each message. The messages are color-coded according to their level.

Accessing the info dialog

► In the "R&S SGMA-GUI main panel", select the "Info" button.

The "Info" dialog opens.



The upper part of the "Info" dialog lists the currently active permanent messages. See the following table for explanation of the displayed information.

Parameter	Description
"LEV"	Message level. Messages referring to a logical component of R&S SGMA-GUI, e.g., Unicode, are marked in red color, info messages are marked in black color. The following levels might occur: ● Err: Error message ● Info: Information message ● Sys: System message ● Crit: Critical message For detailed information on the message types, see Chapter 6.2.2, "Understanding the Messages in the Info Bar", on page 58.
"SCPI"	Indicates the SCPI error code.
Text	A list of all currently permanent messages in the order of their occurrence, i.e., the most recent message is displayed first.

The buttons in the lower part of the "Info" dialog provide quick access to some functions for managing these messages. For a detailed description on how to clear error messages or display a history of all messages, refer to Chapter 6.4.5, "Managing Messages in the Info Dialog", on page 67.

Function	Description
"Delete"	Clears the highlighted message. This button is available only if the history of the messages is displayed.
"Delete All"	Clears all messages. This button is available only if the history of the messages is displayed.
"Del. volatile"	Clears all brief messages. This button is available only if the history of the messages is displayed.
"Show History/Static"	Calls the list of all messages that have occurred since instrument switch-on. The most recent messages are displayed at the top of the list. When the button is pressed again, the list of current messages is displayed.

Refer to Chapter 6.4.5, "Managing Messages in the Info Dialog", on page 67 for information on how to manage messages.

6.2.2 Understanding the Messages in the Info Bar

Messages indicate information, warnings, and errors. They are displayed in the info line in different colors depending on their importance and display duration. The following messages are displayed:

- Error

  There are two options:

  – Critical errors are errors that prevent the instrument from working, e.g. an HW failure. Critical errors are displayed in red color.

  – System errors are errors that concern the operating system, e.g., wrong file path. System errors are displayed in black color.

- Information
  The information, e.g., file not found, is displayed in black color.

- Warning
  A warning indicates a less significant error and is displayed in black color.

- Brief message
  Brief messages report automatic settings in the program, e.g. switching on illegal entries that are not accepted by the program, 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.
  Brief messages usually do not demand user actions and disappear automatically after a short period of time. They are stored in the history, however.

- Permanent messages
  Permanent messages are displayed if an error occurs that impairs further program operation. The error signaled by a permanent message must be eliminated before correct software operation can be ensured.

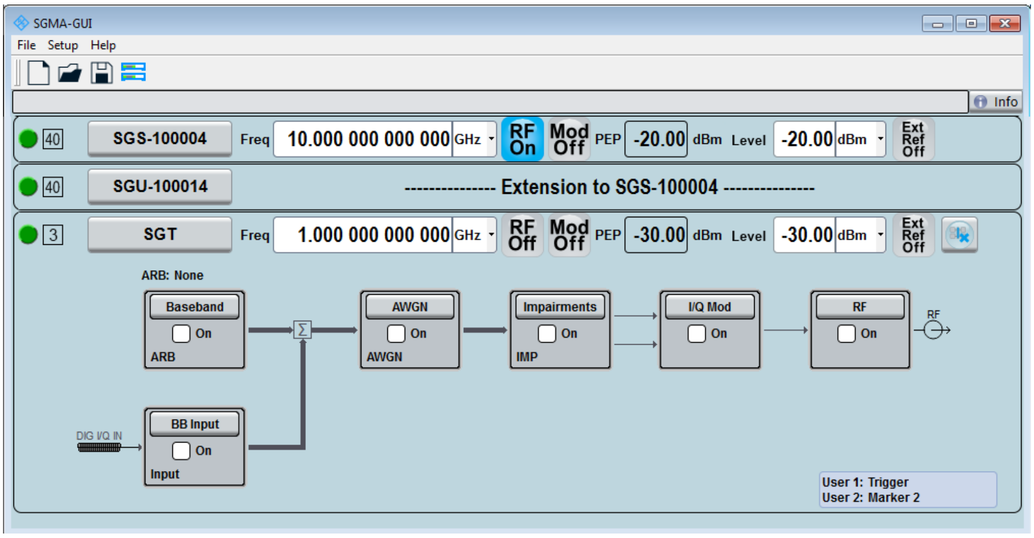
The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

6.3 Main Panel

The main panel of the R&S SGMA-GUI provides quick access to the main settings of the configured instruments. The display shows one row per instrument and comprises the instrument name and state, the used frequency and power level, the states of the RF output and modulator and the used reference source.

Click one of the buttons with an instrument name on it to access the menu tree with further settings for the corresponding instrument. For a detailed description of the provided settings, see:

- Chapter 8, "General Instrument Settings and Instrument Setup", on page 121 for general settings
- Chapter 7, "Signal Generator Settings", on page 75 for R&S SGS settings.



Instrument/Connection State

The three colors of the state indicator in front of the instrument's name distinguish between the following states:

- Gray: the instrument is configured and activated in the R&S SGMA-GUI but there is no connection to the instrument.
- Green: the instrument is active, the connection is working and the instrument can be manually and remotely operated.
- Red: the instrument is in one of the following states:
  – Standby state
    To operate the instrument manually, it has to be switched to ready state (see "To return the instrument from standby to ready state" on page 150).
  – Instrument locked

The red state indication together with the message "Instrument Locked" in the "Info" line indicates that the instrument is locked for Exclusive Access from another SGMA-GUI or controller.

– The instrument is performing a time consuming operation, e.g. a selftest.

Maximum Frequency

The numbers in the rectangular box 6 on the left of the instrument's name indicate the maximum frequency of the instrument.

When the Eco Mode is turned on then this rectangular is colored in green and the frequency shown in the rectangular corresponds to the maximum frequency available in this mode.

Pulse Modulation

A ⎍ sign on the left of the instrument's name indicates that the pulse modulation is switched on.

Instrument Name

Displays the alias name of the instrument, as selected by the parameter "SGMA-GUI > Setup > Instruments > Add/Edit Instruments > Symbolic Name".

Click the button to access a menu tree for configuring the available instrument's settings, e.g. "Level" settings.

Freq/Freq (Offs)

Sets the RF frequency, incl. enabled frequency offset.

The following apples:

"Freq" = Frequency + Offset

Where, the value set with the parameter "SGMA-GUI main panel > instrument name > Frequency/Phase > Frequency" is the RF frequency at the RF output, without the frequency offset.

The icon "Freq (Offs)" indicates that a frequency offset is applied.

Remote command:

`[:SOURce]:FREQuency[:CW|FIXed]` on page 227

RF On/Off

Activates and deactivates the RF output signal.

The current state of the RF output (activated and deactivated) is indicated in the main panel with the different block color (blue or gray) and the status "On/Off".

Remote command:

`:OUTPut[:STATe]` on page 216

Mod State

Switches the I/Q modulation on and off.

Remote command:

`[:SOURce]:IQ:STATe` on page 237

PEP

Displays the Peak Envelope Power (PEP) of the RF signal of the selected instrument. The value is calculated as follows:

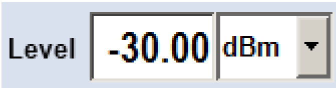
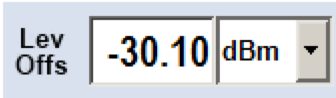
"PEP" = Level + Crest Factor

Remote command:
`[:SOURce]:POWer:PEP?` on page 243

Level/Level Offset

Sets the RF level at the RF output connector of the selected instrument.

If you set a level offset, it will be indicated in the R&S SGMA-GUI main panel by a change in the name of this parameter from "Level" to "Level Offset".

Note: The SCPI command `[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display, that means the level containing offset while `[:SOURce]:POWer:POWer` sets the level at the RF output connector.

Remote command:
`[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]` on page 242
`[:SOURce]:POWer:POWer` on page 241

Ref. Oscillator Source/Ext Ref On/Off

Determines whether the internal built-in oscillator (TXCO or OXCO) is used as a reference source or if an external reference is used. The internal reference oscillator OCXO requires the additional option R&S SGS-B1.

To feed in an external instrument reference, use the input connector REF/LO IN. To output the reference frequency at the output REF/LO OUT, select "SGMA-GUI > Instrument Name > Ref. Oscillator > REF/LO Output > REF".

See also Chapter 9.4, "How to Configure the Reference Oscillator Source", on page 145.

"Int"	The internal reference signal of 10 MHz is used.
"Ext"	An external reference signal is used. The frequency of the external reference signal must be selected with the parameter "SGMA-GUI > Instrument Name > Ref. Oscillator > Ex. Ref. Input Frequency".

Remote command:
`[:SOURce]:ROSCillator:SOURce` on page 251

LO Scr Ext

This icon indicates that the internal local oscillator is switched off.

See "Source" on page 78.

6.4 Working with R&S SGMA-GUI

This section explains how to work with the R&S SGMA-GUI software and perform configuration tasks for manual operation of the instruments.

6.4.1 Storing and Loading Settings

To proceed work with a particular configuration of the instruments in the R&S SGMA-GUI, it is useful to save the used settings and load them again later.

How to store and load settings

1. Select "SGMA-GUI main panel > File > Save As".
2. Navigate to the desired directory and enter the filename.
   The extension `*.savrcl` is applied automatically.

   The current settings of the software are saved to the selected file.
3. To load settings from a file, select "SGMA-GUI main panel > File > Open"
4. Navigate to the directory the file is stored in and select the setting file.

   The saved settings are loaded to the R&S SGMA-GUI and the main panel of the software displays the saved instrument's configuration.

6.4.2 Handling Instruments in the R&S SGMA-GUI

This section provides information on how to configure and manage instruments in the R&S SGMA-GUI.

For reference information about all provided settings in the user interface, refer to the corresponding sections:

- Chapter 6.1.2.1, "Configure Instruments", on page 50 and Chapter 6.1.2.2, "Add/Edit Instruments", on page 52
- Chapter 6.1.2.3, "Versions/Options Dialog", on page 54
  Chapter 6.1.2.5, "Reset SGMA-GUI", on page 56

6.4.2.1 How to Automatically Add New Instruments to the SGMA-GUI

1. For each new instrument perform the following steps:
   a) Connect the instrument to the network.
   b) Switch on the instrument.
   c) Press the ID key on the front panel of the instrument.
2. Start the SGMA-GUI on a computer connected to the same network.

   All instruments are added automatically to the main panel of the SGMA-GUI.

6.4.2.2 How to Manually Add New Instruments to the SGMA-GUI

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".

   The Configure Instruments dialog opens.
2. Select the "New" button.

   The Add Instrument dialog opens to register a new instrument.
3. In the "Symbolic Name" field, enter an alias name of your choice, e.g. SGS-100021.
4. In the "Instrument Type" field, select the device family to connect to.
5. Select "Remote Control > Hardware Channel" and select the hardware interface.
6. For LAN or Socket interfaces, select "Remote Control > Instrument Name / IP Address" and enter the IP Address or the hostname of the connected instrument, e.g. rssgs100a100021.

   Tip: See also Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 65 .
7. For USB or PCIe interfaces, select "Remote Control > Serial Number" and enter the serial number of the connected instrument , e.g. 100021.
8. Set "Active > On" to activate the instrument. Only active instruments are displayed in the R&S SGMA-GUI main panel.
9. Click "OK" to confirm the settings and to close the dialog or press the "Apply" button to confirm the settings.
10. Click the "Cancel" button to discard settings and to close the dialog.

6.4.2.3 How to Scan for New Instruments

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".

   The Configure Instruments dialog opens.
2. Click the "Scan" button to trigger the instrument to scan all remote channel interfaces for connected instruments.

   Tip: To limit the amount of the searched instruments and to speed up the scan process, select "Configure Instruments > Scan LAN instruments with hostname prefix" and enter the prefix the searched hostnames begin with.
   The scan function searches only for instruments whose hostnames begin with the selected prefix.

   All instruments which are connected to one of the available interfaces, are switched on and are not locked are displayed in the"Available Instruments" list.

The R&S SGMA-GUI obtains all information for connecting to the instrument, so further configuration is not necessary.

6.4.2.4 How to Activate Instruments for Control from the R&S SGMA-GUI

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".

   The "Available Instruments" in the Configure Instruments dialog lists all instruments configured in the software.
2. Select the newly configured/connected or deactivated instrument and set "Active > On" to activate it.

   Tip: Only active instruments are displayed in the R&S SGMA-GUI main panel!

6.4.2.5 How to Edit Instruments

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".

   The Configure Instruments dialog opens and lists the "Available Instruments".
2. Select the instrument to be edited and click the "Edit" button.

   The Edit Instrument dialog opens.
3. Change the settings and confirm with OK.

   The edited settings are applied.

6.4.2.6 How to Delete an Instrument

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".
   The Configure Instruments dialog opens.
2. Select the instrument to be deleted and click the "Delete" button.

   The selected instrument is deleted from the list of "Available Instruments".

6.4.2.7 How to Delete All Instruments

1. In the R&S SGMA-GUI main panel, select "Setup > Instruments".
   The Configure Instruments dialog opens.
2. Click the "Clear" button.

   All instruments are deleted from the list of "Available Instruments".

6.4.2.8 How to Reserve the Instrument for Control

1. Open the "SGMA-GUI > Setup > Instruments > Configure Instruments" dialog, select the instrument in the list of "Available Instruments" and select "Edit".
2. In the "Edit Instrument" dialog, enable "Exclusive Access".
3. Alternatively, send the SCPI command `:INSTruments:EACCess[:STATe]` from the external PC the R&S SGMA-GUI is installed on.

   The instrument is reserved for control from this external PC and cannot be accessed from any other controller. A scan function started from another controller finds the instrument but the instrument is indicated as locked.

The two functions "Exclusive Access" and monitoring are mutually exclusive!

The "Exclusive Access" must be disabled to remote control or monitor the instrument form another external PC (see Chapter 10.6, "Using the R&S SGMA-GUI to Monitor the Remote Control Operation", on page 180).

6.4.3 Finding Out the Default Hostname of the Instrument

The default hostname of the instrument is a non-case-sensitive string built as follows:

`hostname = <instrument name><serial number>`, where

`<serial number>` is the individual serial number of the instrument

`<instrument name>` is the complete name of the instrument, written without spaces.

How to query the hostname of the instrument

1. Find the individual serial number on rear of the instrument , e.g. 100021.
2. Build the default hostname.

   For the R&S SGS with serial number 100021, the default hostname is `rssgs100a100021`.

For instructions on how to change the default hostname, refer to Chapter 9.10, "How to Use Computer Names", on page 151.

6.4.4 Bidirectional Instrument Identification

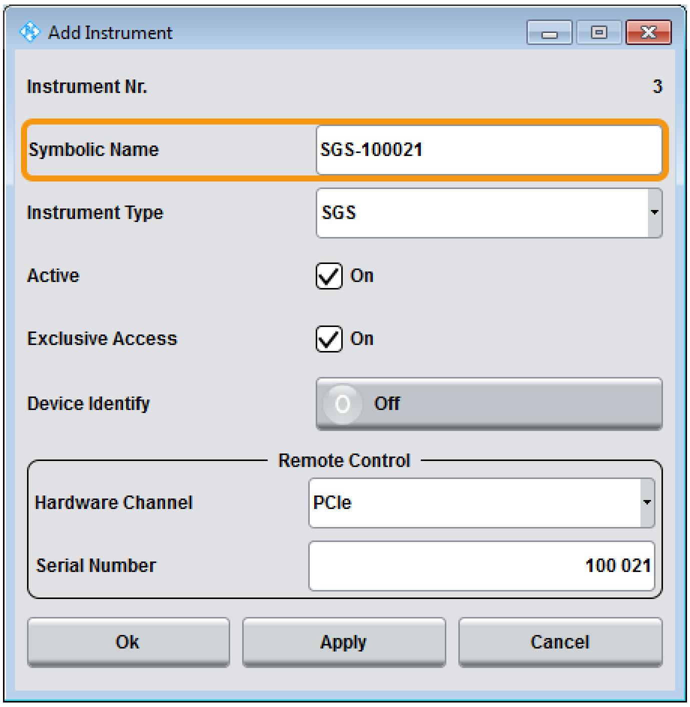
In practice, instruments are integrated into a large network or placed in racks together with several other instruments of the same kind. It might be difficult then to find out which of the instruments configured in the R&S SGMA-GUI corresponds to which physical instrument or to localize all instruments operated by the current controller.

The R&S SGMA-GUI and the instrument provide the "Device Identification" function for this purpose.

How to find an instrument in the R&S SGMA-GUI

► If several instruments have been configured and activated in the R&S SGMA-GUI, press the ID button on the instrument's front panel to trigger device identification.

The "Edit Instrument" dialog of this instrument opens.

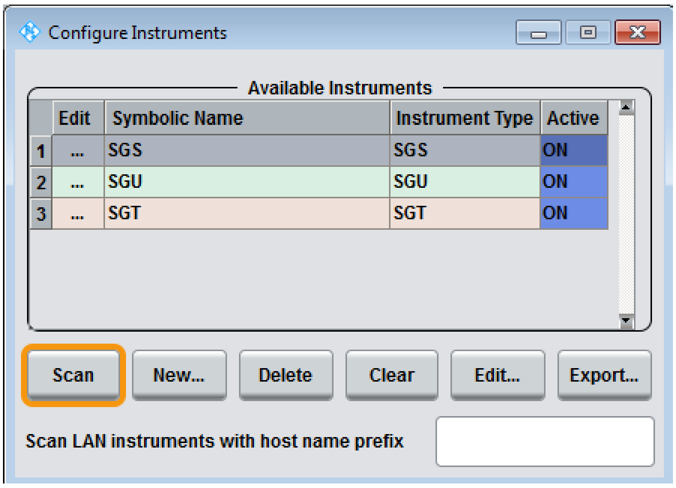


Field "Edit Instrument > Symbolic Name" displays the name of the instrument as shown in the R&S SGMA-GUI main panel.

Dialog "Edit Instrument" does not appear

If this dialog does not open, perform the following:

- Check whether the instrument is correctly connected to the external PC on which you work with the R&S SGMA-GUI.
- Check if the instrument is configured in the R&S SGMA-GUI and perform, if necessary, the steps described in Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 62.
- Select "SGMA-GUI > Setup > Instruments", check the state of the instrument in the "Configure Instruments > Available Instruments" table and activate it, if disabled.



How to identify an instrument in an instrument set

► To identify the instrument in an instrument set, use one of the device identification functions:

a) Select "SGMA-GUI > Setup > Instruments > Available Instruments > Instrument > Edit > Edit Instrument" and trigger "Device Identify"

b) Select "SGMA-GUI > Instrument Name > Setup > Remote > Remote Chanels" and trigger "Device Identify"

The green LAN LED on the front panel of the instrument blinks.

6.4.5 Managing Messages in the Info Dialog

How to get additional information on the message

► In the "Info" dialog, click a message to select it.

In the lower section of the dialog, additional information on the highlighted message is displayed.

How to display all messages

► In the "Info" dialog, click the "History" button.

A history of all messages that have occurred since the R&S SGMA-GUI software was started is listed in the upper dialog pane. The most recent message is displayed first.

How to delete an error message

► In the "Info" dialog, select the highlighted message and click the "Delete" button.

Tip: This button is available only when the history of the messages is displayed.

The highlighted message is cleared.

How to delete all error messages

► In the "Info" dialog, click the "Delete All" button.

Tip: This button is available only when the history of the messages is displayed.

All messages are cleared.

How to delete all brief messages

► In the "Info" dialog, click the "Del. volatile" button.

Tip: This button is available only when the history of the messages is displayed.

All brief messages are cleared.

How to call the history

1. In the "Info" dialog, click the "History" button.

   A list of all messages that have occurred since the instrument switch-on is displayed. The most recent messages are displayed at the top of the list.

2. Click the "History" button once more.
   A list of current messages is displayed.

6.5 Remote Control of the R&S SGMA-GUI

This section focuses on the remote control of the R&S SGMA-GUI software.

6.5.1 Configuring Instruments in the R&S SGMA-GUI

This section provides an example of the automation of the R&S SGMA-GUI.

In the following example we assume that a remote PC with installed R&S SGMA-GUI on it is connected to a LAN and that the remote PC and the instruments are switched on.

For more information, refer to Chapter 2.3, "Connecting an External PC and Devices", on page 20.

```
// ******************************************************************
// Trigger the scan function to search for instruments connected
// to the remote computer via all of the available interfaces.
// ******************************************************************

:INSTruments:SCAN:HNPRefix "rssg"
// scan returns only instruments with hostname beginning with "rssg"
:INSTruments:SCAN 1
*OPC?

// ******************************************************************
// Query the number of available instruments and the settings of each
// configured instrument: instrument type, symbolic name,
// remote channel used, serial number, hostname/IP address
// Adjust settings if required
// ******************************************************************

:INSTruments:COUNt?
// Response: 3

:INSTruments:TYPE?
// Response: SGU,SGS,SGT

:INSTruments:NAME?
// Response: SGU-100002,SGS-100006, SGT-100008

:INSTruments:SERial?
// Response: 100002,100006,100008

:INSTruments:REMote:CHANnel?
// Response: LAN,USB, PCIe

:INSTruments:REMote:NAME?
// Response: rssgu100a100002, rssgs100a100006, rssgt100a100008

// ******************************************************************
// Check the instrument state and activate instruments if required
// ******************************************************************

:INSTruments:ACTive:STATe?
// Response: 0,1,1
:INSTruments:ACTive:STATe ON,OFF,OFF
// Activates the first  instruments in the list,
// i.e. the instruments with symbolic names SGS-100006
```

```
// *******************************************************************
// Export the configuration into a mapping file
// *******************************************************************

:INSTruments:MAPPing:FILE 'd:\mapping_files\mapping.map'

// *******************************************************************
// Enable exclusive access for the selected instrument
// *******************************************************************

:INSTruments:EACCess:STATe?
// Response: 0,0,0
:INSTruments:EACCess:STATe ON,OFF, OFF
// Locks the first instrument
```

6.5.2 R&S SGMA-GUI Settings

This section comprises the SCPI commands provided to remote control the R&S SGMA-GUI.

:INSTruments:ACTive[:STATe] <State>

Enables/disables the instrument for the R&S SGMA-GUI. The main panel of this software displays only activated instruments.

Parameters:

<State>	List of BOOL-values <StateInstr#1>,<StateInstr#2>,... 0, 1, ON, OFF
Example:	See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.
Manual operation:	See "Available Instruments" on page 50

:INSTruments:COUNt?

Queries the number of the currently available instruments.

Return values:

<Count>	float Range: 0 to 12
Example:	See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.
Usage:	Query only
Manual operation:	See "Available Instruments" on page 50

:INSTruments:EACCess[:STATe] <State>

"Locks" the instruments, meaning the instrument is reserved and can be operated exclusively from the remote PC that sent this SCPI command.

Tip: It is recommended to lock the instrument prior to further configuration.

Parameters:

<State>	List of BOOL-values <LockInstr#1>,<LockInstr#2>,... 0,1,OFF,ON
Example:	See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.
Manual operation:	See "Exclusive Access" on page 53

:INSTruments:MAPPing:FILE <File>

Saves the list of the available instruments in a mapping file. Mapping files are stored with the predefined file extension `.map`; the file extension may be omitted.

The file is saved in the default directory. Use the command `MMEM:CDIRectory` to change the default directory or specify the complete path.

Parameters:

<File>	string
Example:	See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.
Manual operation:	See "Export" on page 51

:INSTruments:NAME <Name>

Selects the alias name of the instruments, i.e. sets the "Symbolic Name".

Parameters:

<Name>	<SymbolicNameInstr#1>,<SymbolicNameInstr#2>,...

Example: See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.

Manual operation: See "Available Instruments" on page 50

:INSTruments:REMote:CHANnel <Channel>

Sets the hardware interface used by the remote channel.

Parameters:

<Channel> List of CHAR-Data

<ChannelInstr#1>,<ChannelInstr#2>,...
The available interfaces are: `LAN`, `USB`, `SOCKET`, `PCIe`, `GPIB`, `HiSLIP`

Example: See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.

Manual operation: See "Hardware Channel" on page 53

:INSTruments:REMote:NAME <Name>

Enters the IP Address or the host name of the connected instrument.

Parameters:

<Name> <Hostname/IP-AddressInsr#1>,<Hostname/IP-AddressInsr#2>,...

Example: See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.

Manual operation: See "Instrument Name / IP Address" on page 53

:INSTruments:GPIB:ADDRess <Serial>

Sets the GPIB Address of the connected instrument.

Parameters:

<Serial> List of Numbers

Manual operation: See "GPIB Address" on page 54

:INSTruments:GPIB:BOARd <Board>

Identifies the GPIB bus card the controller uses.

Parameters:

<Board> List of Numbers

Manual operation: See "Board Number" on page 54

:INSTruments:SCAN <State>

Triggers a scan function and searches for instruments connected to the remote computer via all of the available interfaces.

Parameters:

<State> number

1 = triggers the scan function, 0 = aborts the running scan process
The query command returns 1 as long as scan is running; 0 indicates completed scan process.

Example: See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.

Manual operation: See "Scan" on page 50

:INSTruments:SCAN:HNPRefix <Prefix>

Sets the prefix the searched host names begin with.

Parameters:

<Prefix> string

Example: See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.

Manual operation: See "Scan LAN instruments with host name prefix" on page 52

:INSTruments:SERial <Serial>

Enters the serial number as instrument's identification while using the USB interface for remote control.

Parameters:

<Serial> <SerialNumberInstr#1>, <SerialNumberInstr#2>,...

Example: See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.

Manual operation: See "Serial Number" on page 54

:INSTruments:TYPE <Type>

Selects the instrument's family.

Parameters:

<Type> List of CHAR-Data

<TypeInstr#1>,<TypeInstr#2>,...

Example: See Chapter 6.5.1, "Configuring Instruments in the R&S SGMA-GUI", on page 68.

Manual operation: See "Available Instruments" on page 50

6.5.3 List of R&S SGMA-GUI Commands

7 Signal Generator Settings

This section summarizes the settings necessary to configure the instrument for signal generation. The description in this section follows the menu tree structure of the graphical user interface. Each of the discussed topics follows a common structure, providing basic background information, and reference to the user interface.

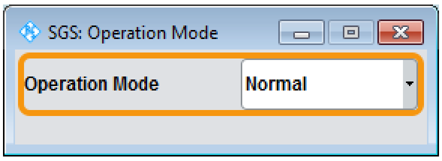
For step-by-step instructions for fulfilling typical tasks, refer to Chapter 9, "Performing Configuration Tasks", on page 140.

7.1 Operation Mode

You can operate the R&S SGS in two modes, normal mode and baseband bypass mode. In baseband bypass mode, an external IF signal fed in at the I or Q connectors is directly routed to the RF OUT connector. The level of the signal can be adjusted.

Refer to Figure 5-9 for visualization of the signal flow.

► To access the "Operation Mode" dialog, select "SGMA-GUI > Instrument Name > Operation Mode".



Operation Mode
Sets the operation mode.

"Normal" The complete signal processing chain is used.

"Baseband Bypass"
The IF signal fed in at the I or Q connectors is directly routed to the RF OUT connector.

Note: The "Baseband Bypass" is a special operation mode. See also Chapter 9.3, "How to Enable a Baseband Bypass Mode", on page 144.

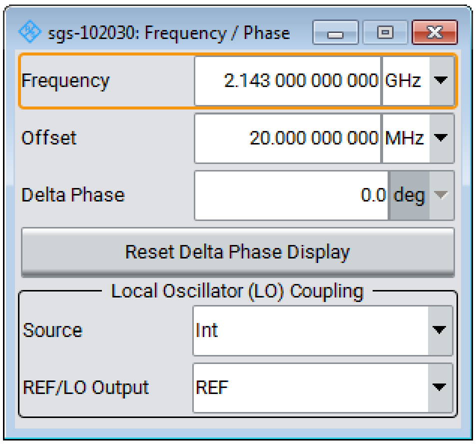
Remote command:
`[:SOURce]:OPMode` on page 227

7.2 Frequency/Phase Settings

Depending on the installed options, the instrument provides an adjustable output frequency in the frequency range of 1 MHz to 6 GHz or to 12.75 GHz.

Access:

▶ Select "SGMA-GUI > Instrument Name > Frequency/Phase".



The frequency and phase related settings are provided in this dialog.

Configuring the RF frequency

1. To change the RF frequency of the selected instrument, perform one of the following:
   a) Select "SGMA-GUI > Instrument Name > Frequency/Phase > Frequency" and set the frequency at the RF output.
   b) Select "SGMA-GUI main panel > Freq" and set the frequency.
   The value includes possible frequency offset.
2. To enable frequency offset for example to consider the frequency shift of a downstream instrument, set the parameter "Frequency/Phase > Offset".

   Changes of the RF frequency have an immediate effect on the output signal.

Frequency

Sets the RF frequency *at the RF output connector* of the selected instrument.

The displayed value does not consider an enabled frequency offset (Offset).

Remote command:
See `[:SOURce]:FREQuency[:CW|FIXed]` on page 227

Offset

Sets a frequency offset.

The frequency offset value represents the frequency shift of a downstream instrument, as for example an attenuator or an amplifier.

Enabled frequency offset does not change the frequency at the RF output (Frequency). It influences the value of the parameter "SGMA-GUI main panel > Freq".

The following applies:

"Freq" = Frequency + "Offset"

In the "SGMA-GUI main panel", enabled frequency offset is also indicated with the keyword "Freq (Offs)".

Remote command:
`[:SOURce]:FREQuency:OFFSet` on page 227

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

Remote command:
`[:SOURce]:PHASe` on page 239

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

Remote command:
`[:SOURce]:PHASe:REFerence` on page 239

7.3 Local Oscillator (LO) Coupling

The LO coupling function allows you to distribute the local oscillator signal in a way that multiple R&S SGSs or other R&S signal generators can be driven by the same LO signal. This is mandatory for phase coherent application, e.g. the generation of beamformed signals, and for phase coherent demodulation.

The LO coupling function is available only for instruments equipped with the option R&S SGS-K90 (Phase Coherence). This option enables phase coherent RF outputs of two or more RF signals. The local oscillator signal is provided at the REF/LO OUT connector. An external signal can be input at the REF/LO IN connector.

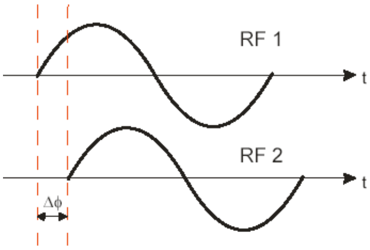
Refer to Figure 5-9 for visualization of the signal flow.

See also:

- Chapter 9.5, "How to Configure the Local Oscillator (LO) Coupling Source", on page 146
- Chapter 9.6, "How to Define the Signal at the REF/LO OUT Connector", on page 147
- Chapter 9.7, "How to Connect and Configure Instruments for Optimum Phase Coherence", on page 147

7.3.1 Phase Coherence

Phase coherence of RF signals designates a defined, constant delta phase between two or more RF carrier signals with the same frequency or a multiple of the frequency.



If two signal generators are coupled via their 10 MHz reference, they are generating exactly the same frequency but only in the long-term perspective. Having a closer look into the instantaneous differential phase (“delta phase”) of these two RF signals, this is unstable due to:

- Phase noise of the two synthesizers
- “weak” coupling at 10 MHz and a long synthesis chain up to the RF domain
- Temperature differences, which cause slightly different phase drift for the different synthesizers

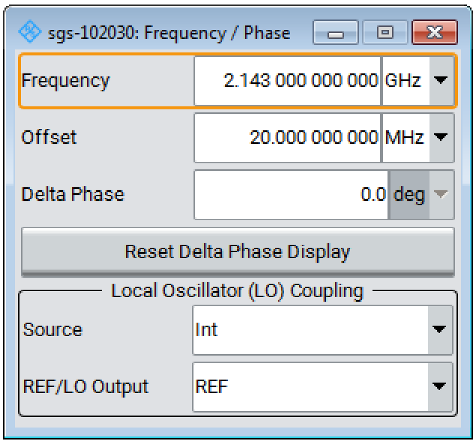
Most critical for a stable delta phase is the thermal RF phase fluctuation between multiple RF synthesizers. These fluctuations can be minimized by using a common synthesizer (common local oscillator (LO) signal) for all RF carriers.

See also Chapter 9.7, "How to Connect and Configure Instruments for Optimum Phase Coherence", on page 147.

7.3.2 Local Oscillator (LO) Coupling Settings

The LO coupling-related settings are provided in the "Frequency/Phase" dialog.

► To access this dialog, select "SGMA-GUI > Instrument Name > Frequency/Phase > Local Oscillator (LO) Coupling".



Source

Selects the source of the local oscillator signal.

"Int" The instrument uses the built-in local oscillator.

"Ext" The signal fed-in at the REF/LO IN input connector is used as signal source.

An icon in the block diagram indicates that an external LO source is used.

Note: The local oscillator input/output requires the additional software option R&S SGS-K90.

Remote command:
`[:SOURce]:LOSCillator:SOURce` on page 228

REF/LO Output

Determines the signal provided at the output connector REF/LO OUT.

See also Chapter 9.6, "How to Define the Signal at the REF/LO OUT Connector", on page 147.

"OFF" No signal is provided.

"LO" The signal of the local oscillator (LO) is available at the REF/LO OUT connector.

"REF" The signal of the reference oscillator is available at the REF/LO OUT connector.

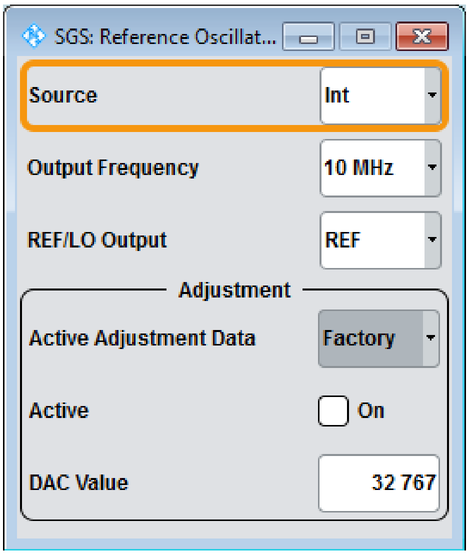
Remote command:
`:CONNector:REFLo:OUTPut` on page 201

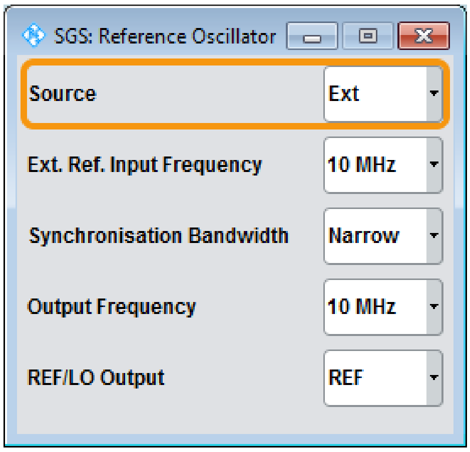
7.4 Reference Oscillator

The R&S SGS is equipped with an internal TXCO reference oscillator. If equipped with the additional HW option R&S SGS-B1, an OXCO can be used as an internal reference frequency source for the synthesizer. Moreover, an external reference signal source can be connected to the REF/LO IN connector of the instrument.

Refer to Figure 5-9 for visualization of the signal flow.

► To access this dialog, select "SGMA-GUI > Instrument Name > Reference Oscillator".





Ref. Oscillator Source/Ext Ref On/Off
Determines whether the internal built-in oscillator (TXCO or OXCO) is used as a reference source or if an external reference is used. The internal reference oscillator OCXO requires the additional option R&S SGS-B1.

To feed in an external instrument reference, use the input connector REF/LO IN. To output the reference frequency at the output REF/LO OUT, select "SGMA-GUI > Instrument Name > Ref. Oscillator > REF/LO Output > REF".

See also Chapter 9.4, "How to Configure the Reference Oscillator Source", on page 145.

"Int"	The internal reference signal of 10 MHz is used.
"Ext"	An external reference signal is used. The frequency of the external reference signal must be selected with the parameter "SGMA-GUI > Instrument Name > Ref. Oscillator > Ex. Ref. Input Frequency".

Remote command:
`[:SOURce]:ROSCillator:SOURce` on page 251

Ext. Ref. Input Frequency
Available only for "Source > Ext".

Selects the frequency of the external reference signal.

Remote command:
`[:SOURce]:ROSCillator:EXTernal:FREQuency` on page 250

Synchronization Bandwidth
Available only for "Source > Ext".

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

"Wide"	Synchronization bandwidth is app. 250 Hz.
"Narrow"	Synchronization bandwidth is app. 40 Hz.

Remote command:
[:SOURce]:ROSCillator:EXTernal:SBANdwidth on page 252

Output Frequency

Selects the output for the reference oscillator signal. The available values depend on the input frequency and the reference oscillator source.

Table 7-1: Output frequency

"Reference Oscillator Source"	Input frequency	Output frequency
"Internal"	10 MHz	10 MHz 1 GHz
"External"	10 MHz 13 MHz 100 MHz 1 GHz	10 MHz, 1 GHz 13 MHz, 1 GHz 100 MHz, 1 GHz 1 GHz

Support of 13 MHz reference frequency requires that the instrument is equipped with hardware module RF board with part number 1419.5308.02.

To find out the RF board installed in the instrument:

- Select "SGMA-GUI > instrument name > Setup > Hardware Config" > "RF Assembly"
- Observe the part number of the assembly "RfBoard".

Remote command:
[:SOURce]:ROSCillator:OUTPut:FREQuency on page 250

REF/LO Output

Determines the signal provided at the output connector REF/LO OUT.

See also Chapter 9.6, "How to Define the Signal at the REF/LO OUT Connector", on page 147.

"OFF"	No signal is provided.
"LO"	The signal of the local oscillator (LO) is available at the REF/LO OUT connector.
"REF"	The signal of the reference oscillator is available at the REF/LO OUT connector.

Remote command:
:CONNector:REFLo:OUTPut on page 201

Active Adjustment Data

Displays whether the factory or user defined (custom) calibration value is currently used for the external calibration of the reference oscillator.

Adjusting the calibration value for the OCXO adjustments is a protected service procedure, that requires a Protection Level 2 password. The exact test procedure is described in the service manual.

See also Chapter 8.15, "External Adjustments", on page 139.

Adjustment Active
Available only for "Source > Int".

Selects adjustment mode.

"OFF" Uses the calibrated internal reference frequency. This value is determined at one of the R&S service centers during calibration.

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

Remote command:
`[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe]` on page 251

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

"DAC Value = 0" indicates the calibrated state. The setting range depends on the reference oscillator type and its factory calibration value.

Remote command:
`[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue` on page 251

7.5 Level and Power-On Settings

This section explains the level settings of the R&S SGS. The instrument can be equipped optionally with an active electronic step attenuator (R&S SGS-B26).

Configuring RF level

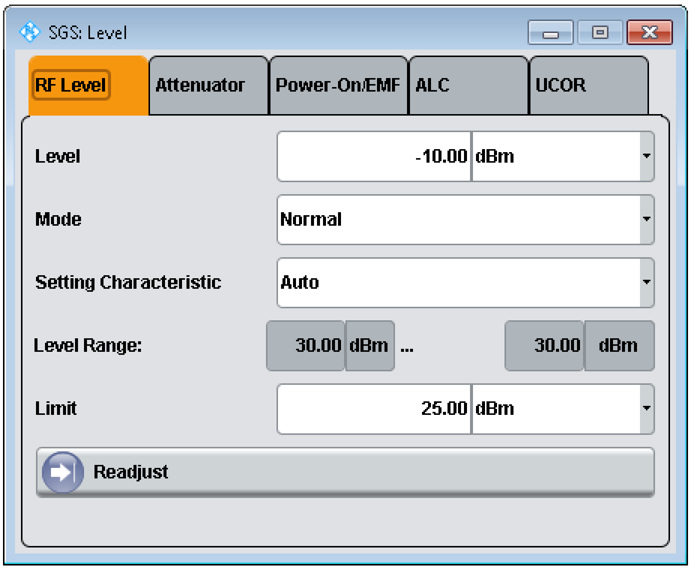
► To change the RF level of the selected instrument, perform one of the following:

a) Select "SGMA-GUI main panel > Level" and enter the desired value.
b) Select "SGMA-GUI > Instrument Name > Level > RF Level > Level" and enter the desired value.

Changes of the RF level have an immediate effect on the output signal.

7.5.1 RF Level

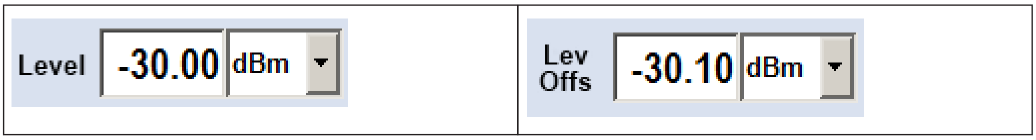
► To access the RF level settings, select "SGMA-GUI > Instrument Name > Level > RF Level".



This dialog comprises settings like the RF level and level limit.

Level/Level Offset
Sets the RF level at the RF output connector of the selected instrument.

If you set a level offset, it will be indicated in the R&S SGMA-GUI main panel by a change in the name of this parameter from "Level" to "Level Offset".



Note: The SCPI command `[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display, that means the level containing off-set while `[:SOURce]:POWer:POWer` sets the level at the RF output connector.

Remote command:
`[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]` on page 242
`[:SOURce]:POWer:POWer` on page 241

Offset
Sets a level offset.

This value represents the level shift of a downstream instrument, as for example an attenuator or an amplifier, and is indicated in the status bar of the display. It does not change the level at the RF output.

Remote command:
`[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet` on page 242

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

"Normal" In normal mode, the generator provides an RF output signal with high signal to noise ratio and low distortion, according to the data sheet.

"Low Noise" This setting forces the generator to optimize the signal to noise ratio.

"Low Distortion"
In this mode, the generator reduces distortions of the RF signal to a minimum.

Remote command:
`[:SOURce]:POWer:LMODe` on page 241

Setting Characteristic
Selects the characteristic for the level setting. For some general applications, the instrument operation can be optimized by selecting one of the predefined level setting characteristics.

"Auto" The instrument provides the highest dynamic range and the fastest setting times according to the data sheet.
The RF signal is shortly blanked during the moment the step attenuator is switched on.

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

"Strictly Monotone"
Provides level setting without discontinuities. All electronic switches in the RF path are clamped. The operation mode is useful for applications using level searching algorithms.
This mode further reduces the dynamic range of the instrument. The step attenuator is also fixed.

"Constant-VSWR"
Suppresses output impedance variations at the RF OUT connector due to changed level setting.
This mode reduces the dynamic range of the instrument. The step attenuator is fixed.

Remote command:
`[:SOURce]:POWer:SCHaracteristic` on page 242

Level Range
Displays the level range within which the level setting is expected to work properly. The range limits depend on several parameters like "Mode", "Setting Characteristic", the I/Q signal's crest factor etc.

Remote command:
`[:SOURce]:POWer:RANGe:LOWer?` on page 243
`[:SOURce]:POWer:RANGe:UPPer?` on page 243

Limit
Sets the level limit.

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

The value is not affected by an instrument preset function. This parameter is influenced only by the Factory Preset and its factory value is equal to the upper limit.

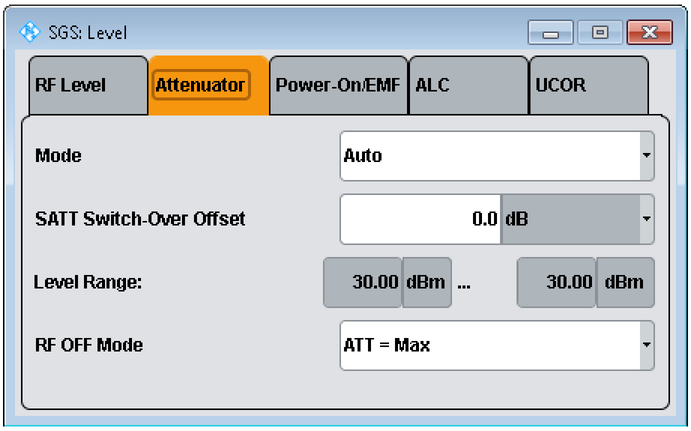
Remote command:
`[:SOURce]:POWer:LIMit[:AMPLitude]` on page 243

Readjust
Recalculates the instrument internal settings optimized for the current level. Not required for automatic modes.

Remote command:
`[:SOURce]:POWer:ALC:SONCe` on page 240

7.5.2 Attenuator

► To access the attenuator settings, select "SGMA-GUI > Instrument Name > Level >Attenuator".



This dialog comprises the settings for the power-on behavior of the instrument.

Mode
Sets the attenuator mode at the RF output.

"Auto"	Standard mode. The electronically switching attenuator switches with a ~ 6 dB step width at optimized switching points. The entire level range is available. The level setting is performed by continuous electronic level control combined with switching the step attenuator.

"Fixed" The level settings are made without switching the attenuator.
When this operating mode is switched on, the attenuator is fixed in the current position to provide level settings without interruption. The resulting variation range is defined and displayed with the parameters Level Range.

Note: The function is effective when automatic level control is activated ("ALC State = On").
If the normal variation range is overranged or underranged, level errors increase considerably. The warning "Level under/overrange" appears in the info line.

The spectral purity of the output signal decreases with high attenuation.

"Auto Passive" The attenuator is switched automatically.
The level settings are made only for the passive reference circuits.
The high-level ranges are not available.

Remote command:
`:OUTPut:AMODe` on page 215

SATT Switch-Over Offset
Sets the switch-over offset value of the attenuator.

Remote command:
`[:SOURce]:POWer:ATTenuation:SOVer[:OFFSet]` on page 241

Level Range
Displays the level range in which the level is set without interruption for the "Attenuator Mode Fixed" setting.

Remote command:
`:OUTPut:AFIXed:RANGe:LOWer?` on page 215
`:OUTPut:AFIXed:RANGe:UPPer?` on page 215

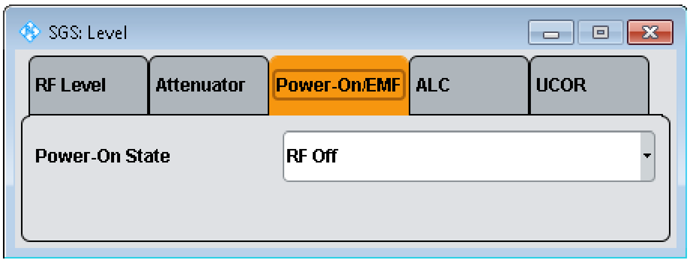
RF-Off-Mode
Determines the attenuator's state after the instrument is switched off.

In default setting, the electronic step attenuator switches to highest attenuation when RF is off. By setting the RF-Off mode, the electronic step attenuator can be fixed to keep the output impedance constant during RF off.

Remote command:
`[:SOURce]:POWer:ATTenuation:RFOFf:MODE` on page 240

7.5.3 Power-On/EMF

► To access the power- on/EMF settings, select "SGMA-GUI > Instrument Name > Level > Power-On/EMF".



This dialog comprises the settings for the power-on behavior of the instrument.

Power-On State
Selects the state which the RF output takes after the instrument is switched on.

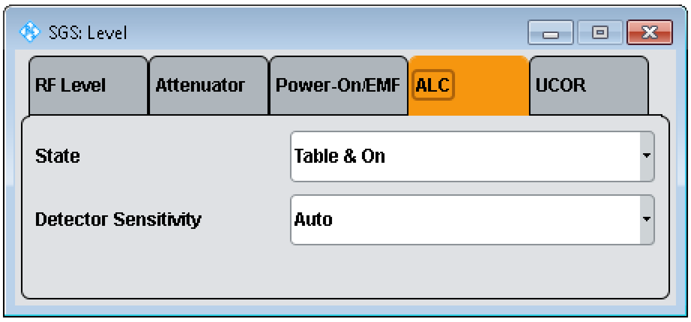
"RF Off" The output is deactivated when the instrument is switched on.

"Previous Setting"
When the instrument is switched on, the output takes the same state as it had when the instrument was switched off.

Remote command:
`:OUTPut[:STATe]:PON` on page 216

7.5.4 ALC

► To access the automatic level control (ALC) settings, select "SGMA-GUI > Instrument Name > Level > ALC".



Automatic level control can be used with almost all applications, especially I/Q modulation. It only has to be deactivated for certain settings in the baseband and when I/Q impairments ("Impairments State On") are activated. This is indicated under the respective function.

By default, the instrument operates in "Table & On" mode to provide the highest level accuracy and fastest setting time. Level control can be switched to "Off (Table)" or "On" for particular applications. The "Off (Table)" state (level control Off) is recommended if in CW mode the signal/intermodulation ratio is to be improved for multi-transmitter measurements.

State

Sets the internal level control.

"Table & On"	Default mode. First sets the level to the target value using the internal level table. Then activates the level control circuit to achieve maximum level accuracy.
"On"	Internal level control is permanently activated. If "On" and "Attenuator Mode Fixed" is selected, the level is recalibrated for every level and frequency setting.
"Off (Table)"	Internal level control is performed according to the ALC table.

Remote command:
`[:SOURce]:POWer:ALC[:STATe]` on page 240

Detector Sensitivity

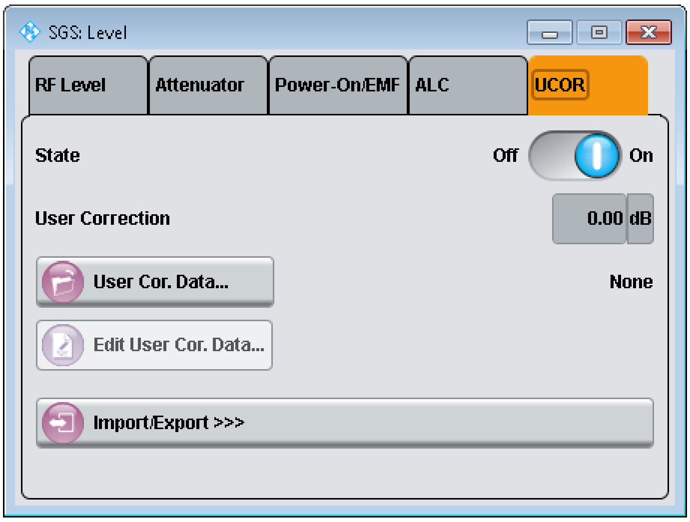
Allows you to fix the internal level detector. It is recommended to use the Auto mode (default).

"Auto"	Automatic detector selection. Recommended mode of operation.
"Low"	Low sensitivity detector selected. This setting is intended for signals with high internal electronic levels.
"Med"	Medium sensitivity detector selected. This setting corresponds to normal mode. It is intended for signals with medium internal electronic levels.
"High"	High sensitivity detector selected. Selects the detector path with high sensitivity, intended for signals with low internal electronic levels.
"Fix"	Fixes the last set sensitivity setting.

Remote command:
`[:SOURce]:POWer:ALC:DSENsitivity` on page 240

7.5.5 User Correction Settings

► To access the user correction level settings, select "SGMA-GUI > Instrument Name > Level > UCOR".



The "User Correction" function is used to create and activate lists in which level correction values predefined by the user are freely assigned to RF frequencies. Correction is performed by the user-defined table values being added to the output level for the respective RF frequency.

With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

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

If user correction is activated, the "UCOR" display ("User Correction") is shown in the header together with the "Level" display. The RF output level is the sum of both values.

"Level" + "UCOR" = Output level

If activated, user correction is effective in all operating modes.

State

Activates/deactivates user correction.

Remote command:
`[:SOURce<hw>]:CORRection[:STATe]` on page 236

User Correction

Indicates the current value for level correction.

Remote command:
`[:SOURce<hw>]:CORRection:VALue?` on page 236

User Cor. Data

Calls the "File Select" menu for selecting and creating a list or the "File Manager".

Remote command:

`[:SOURce]:CORRection:CSET:DELete` on page 231
`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 235

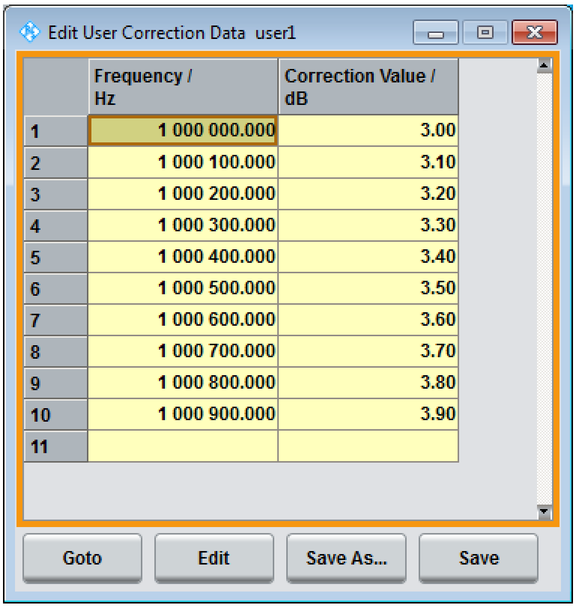
Edit User Cor. Data

Calls the editor for editing the selected user correction list.

A list consists of any number of frequency/level value pairs. The currently selected list is displayed.

Each list is saved as a separate file with extension `*.uco`. The file name and the directory to which the file is saved are user-selectable.

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



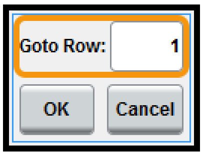
"Frequency /Hz"
: Enters the frequency to which the level correction value applies.

  Note: The "Fill..." function allows you to automatically enter any number of frequencies with freely selectable range and increment.

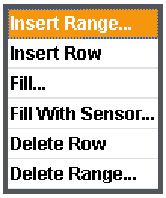
"Power/dB"
: Enters the level correction value to which the specified frequency applies.

"Goto" Selects row for editing.

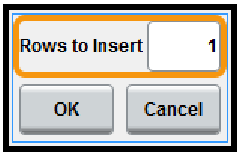
If "Goto Row" is selected, a window opens for entering the requested row.



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



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



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

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

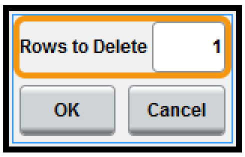
"Fill with sensor..."

Opens a dialog to configure the settings for automatic filling of user correction data with an R&S NRP power sensor, see Chapter 7.5.7, "Fill with Sensor", on page 94.

"Delete Row" Deletes the marked row.

"Delete Range..."

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



"Save as" Open the file menu to save the list under a new name.

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

Each list is saved to the R&S SGS hard disk as a separate file with the file prefix `*.uco`. The file name and the directory to which the file is saved are user-selectable.

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

Remote command:

`[:SOURce<hw>]:CORRection:CSET[:SELect]` on page 235

`[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency` on page 230

`[:SOURce<hw>]:CORRection:CSET:DATA:POWer` on page 230

Import/Export >>>

Expands the menu with the area for import and export of user correction files.

Externally edited Excel tables with any number of frequency/level value pairs can be imported as text or `*.csv` files and used for user correction.

Conversely, you can also export internally created user correction lists as text or `*.csv` files.

Mode

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

Remote command:

`[:SOURce<hw>]:CORRection:DEXChange:MODE` on page 234

Extension

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

Remote command:

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension` on page 232

Decimal Point

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

Remote command:

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal`
on page 233

Column Separator

Selects the separator between the frequency and level column of the ASCII table the user correction list is exported to or imported from.

Remote command:

`[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn`
on page 233

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

Remote command:
[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 233

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

Remote command:
[:SOURce<hw>]:CORRection:DEXChange:SELect on page 235

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

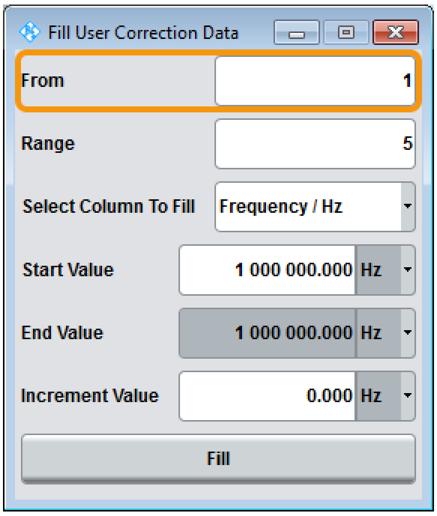
When import is selected, the ASCII file is imported as user correction list.

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

Remote command:
[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 234

7.5.6 Filling the Correction List Automatically

The "Fill Table" menu enables you to set the level correction values automatically.



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

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

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

From
Sets the start value of the index range.

Remote command:
n.a.

Range
Sets the range for filling the table.

Remote command:
n.a.

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

Remote command:
n.a.

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

Remote command:
n.a.

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

Remote command:
n.a.

Increment value
Sets the increment for the frequency or the level entries.

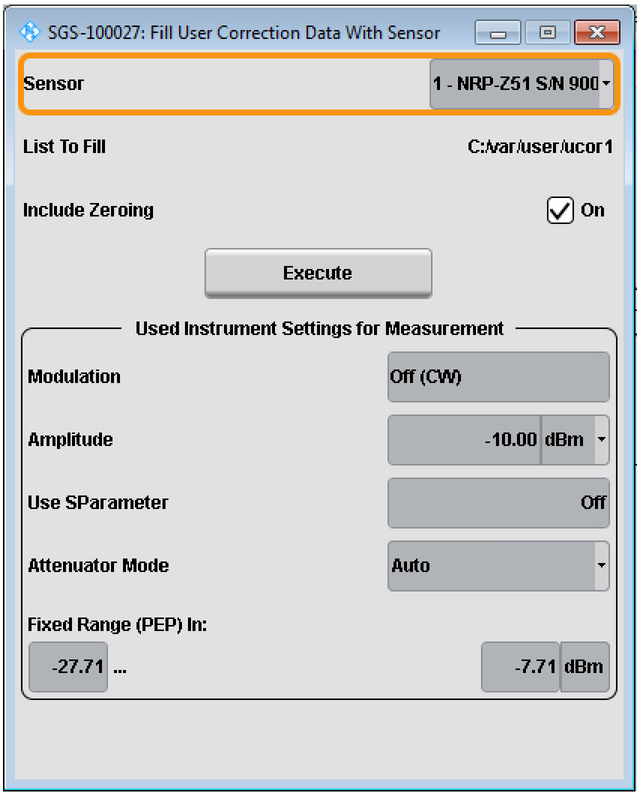
Remote command:
n.a.

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

Remote command:
n.a.

7.5.7 Fill with Sensor

► To access this dialog, select "SGMA-GUI > Instrument Name > Level > UCOR > Edit User Cor. Data> Fill With Sensor".



This dialog describes all parameters for filling a table automatically with sensor readings.

Since the settings are interdependent, the affected parameters change accordingly if you set a value.

To fill the table, press the "Execute" button.

To select the sensor and determine its parameters, refer to Chapter 7.7, "NRP Power Viewer", on page 98.

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. Since during zeroing no signal may be applied to the sensor, RF is temporarily switched off at the generator.
  When unchecked, the zeroing procedure is skipped. However, the RF signal level might be blanked shortly. This setting is recommended if blanking of RF is undesirable or the absence of power at the sensor 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 236
`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe` on page 231

Used Instrument Settings For Measurement
Displays the settings relevant for the measurement.

"Modulation" Indicates the modulation state

"Amplitude" Shows the currently set level.

"Use SParameter"
Indicates whether SParameter correction is used.

"Attenuator Mode"
Displays the selected mode of the attenuator.

"Fixed range (PEP) In"
Shows the level range.

Remote command:
n.a.

7.6 NRP Sensor Mapping

The "NRP Sensor Mapping" lists all R&S NRP sensors detected by the signal generator.

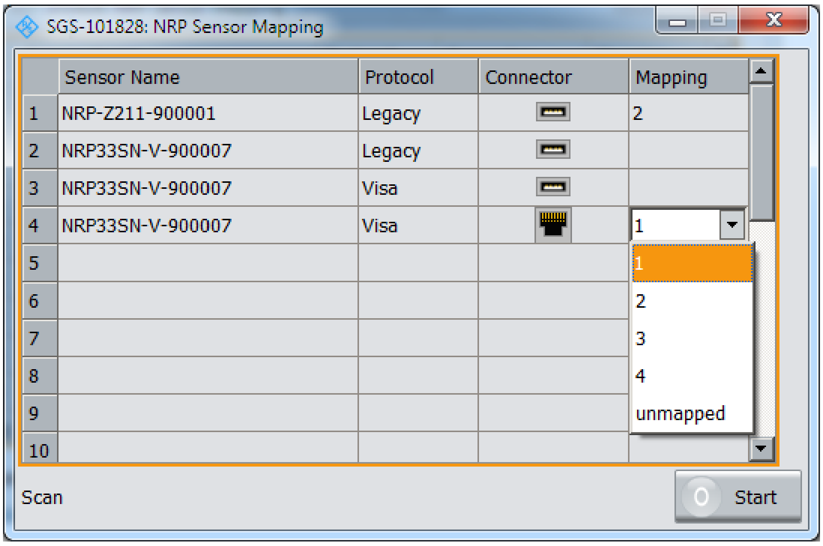
Any R&S NRP sensor that supports the USB legacy protocol and is connected to one of the USB interfaces, is detected automatically and added to the list. Vice versa, the R&S SGS removes a sensor from the list, when it is disconnected.

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.

7.6.1 NRP Sensor Mapping Settings

Access:

► Select "Instrument > RF > 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 SGS can only use up to four sensors simultaneously.

The remote commands required to define these settings are described in Chapter 11.12, "SENSe, READ, INITiate and SLISt Subsystems", on page 216.

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 225
`:SLISt:ELEMent<ch>:MAPPing` on page 226

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 226

7.7 NRP Power Viewer

The R&S SGS features the power viewer function for measuring or monitoring signals with R&S NRP power sensors.

The R&S SGS can perform up to four power measurements simultaneously. The measured signals can be the RF output power or other selected signal sources.

Connecting R&S NRP power sensors to the R&S SGS

R&S NRP sensors are connected to the R&S SGS in the following ways:

- Connection to the USB connector via adapter cable
  Required are the following cables:
  – Adapter cable: R&S NRP-Z3 or R&S NRP-Z4
  – USB Adapter Micro-A to A
- Connection via R&S NRP-Z5 sensor hub
  Additional cables are required, see Using the R&S NRP-Z5 sensor hub.
- Connection via USB hub with external power supply unit
  Additional cables are required, see Using USB hub.

Using the 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.

Figure 7-1 illustrates the connection as principle. For details, see the description R&S®NRP®Series Power Sensors getting started.

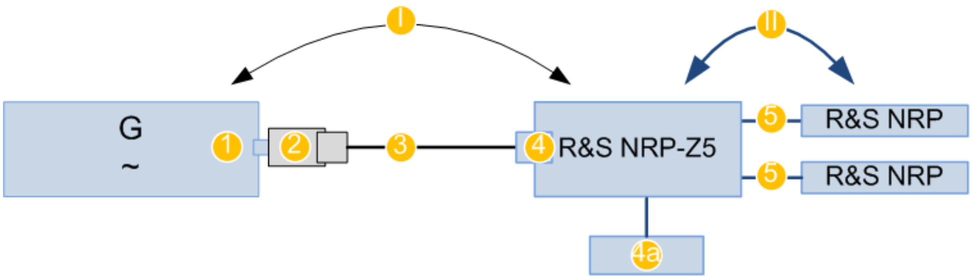


Figure 7-1: Connecting power sensors to the R&S SGS via R&S NRP-Z5 sensor hub

I, II = Connection order
G = Signal source (R&S SGS)
1 = USB type Micro-A connector
2 = USB Adapter Micro-A to A
3 = Standard USB cable with USB type A and USB type B connectors
4 = USB type B connector
4a = External power supply unit, incl. power cable (supplied with the R&S NRP-Z5)
5 = Cable R&S NRP-ZK6 per sensor

Using USB hub

Figure 7-2 illustrates the connection as principle. For details, see the description R&S®NRP®Series Power Sensors getting started.

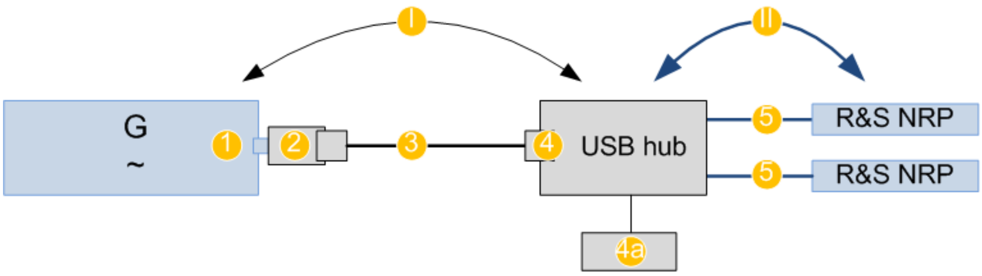


Figure 7-2: Connecting power sensors to the R&S SGS via USB hub

I, II = Connection order
G = Signal source (R&S SGS)
1 = USB type Micro-A connector
2 = USB Adapter Micro-A to A
3 = Standard USB cable with USB type A and USB type B connectors
4 = USB type B connector
4a = External power supply unit and extra power cable
5 = Adapter cable R&S NRP-Z3 or R&S NRP-Z4 per sensor

Connection order

Always connect the equipment in the following order:

1. Connect the R&S NRP-Z5 sensor hub or the USB hub to the power supply and to the R&S SGS
2. Switch on the R&S SGS
3. Connect/disconnect the R&S NRP sensors

Detection and mapping

The R&S SGS automatically detects a connected R&S NRP power sensor and indicates it in the "NRP Power Viewer" and "NRP Sensor Mapping" dialogs.

You can change the default mapping in the NRP Sensor Mapping dialog.

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: NRP Power Viewer Settings
- Sensor-specific information and sensor software update: Chapter 8.5, "NRP Info", on page 127
- Software version of the connected power sensor: `:SENSe<ch>[:POWer]:TYPE?` on page 224
- Acquisition of level correction data: Chapter 7.5.5, "User Correction Settings", on page 88.

Additional information

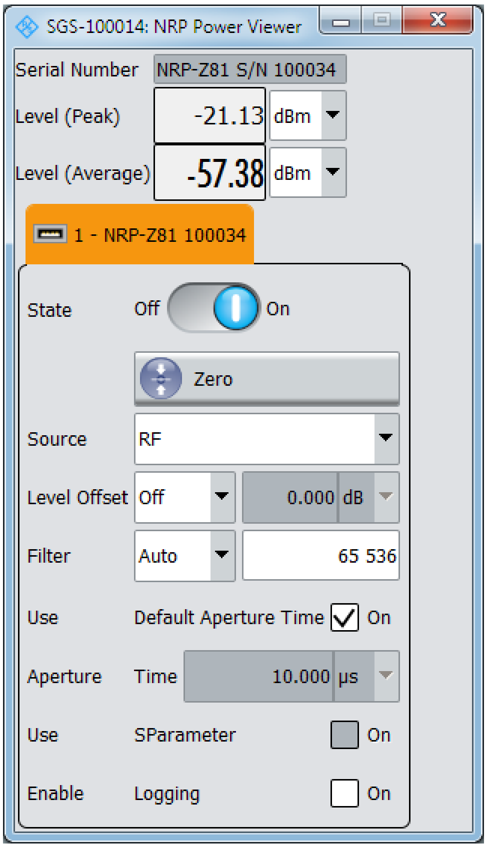
See Rohde & Schwarz website http://www.rohde-schwarz.com in section "Power Meters & Voltmeters" for:

- R&S NRP power sensor manual
- Information on the R&S NRP-Z5 sensor hub and the available accessories.

7.7.1 NRP Power Viewer Settings

Access:

► Select "Instrument > RF > 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, see NRP Power Viewer Settings.

The remote commands required to define these settings are described in Chapter 11.12, "SENSe, READ, INITiate and SLISt Subsystems", on page 216, including the triggering of the measurement and the retrieval of measurement results.

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 224
`:SENSe<ch>[:POWer]:SNUMber?` on page 223

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 218
:SENSe<ch>:UNIT[:POWer] on page 218

Sensor
Indicates the connector to that the sensor is connected.

State
Activates level measurement.

Remote command:
:INITiate<ch>[:POWer]:CONTinuous on page 217
To query the availability of a sensor at a given connector, use the command :SENSe<ch>[:POWer]:STATus[:DEVice]? on page 224.

Zero
Activates the auto zero function.

For details, see "About zeroing" on page 100

Remote command:
:SENSe<ch>[:POWer]:ZERO on page 225

Source
Selects the source for measurement.

"RF"	Assigns the signal to the RF path of the R&S SGS. 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 for measurement of amplifier gain with 2 sensors. Set the parameter Frequency to the measurement's frequency.

Remote command:
:SENSe<ch>[:POWer]:SOURce on page 224

Frequency
Defines the frequency value if "Source > User" is used.

Remote command:
:SENSe<ch>[:POWer]:FREQuency on page 222

Level Offset
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 223
:SENSe<ch>[:POWer]:OFFSet:STATe on page 223

Filter
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 99.

"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 Content.
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 221

Filter Length
For "Filter > Auto or User", indicates the used filter length.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?` on page 220
`:SENSe<ch>[:POWer]:FILTer:LENGth[:USER]` on page 220

Auto Once
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 99.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:SONCe` on page 221

Noise Content
For "Filter > Fixed Noise", sets the noise content.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio` on page 220

Timeout
For "Filter > Fixed Noise", sets a time limit for the averaging process.

Remote command:
`:SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe` on page 221

Use Default Aperture Time
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 219

Aperture Time
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 219

Use SParameter
Activates the use of the S-Parameter correction data of the connected power sensor. For sensors with attenuator, this checkbox is automatically checked.

Refer to the manual of the connected R&S NRP power sensor for a description of how to use the SParameter table.

Remote command:
`:SENSe<ch>[:POWer]:CORRection:SPDevice:STATe` on page 219

Enable Logging
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/sgs/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 222

7.8 Pulse Modulation

This section explains the pulse modulation settings of the R&S SGS. The equipment layout for generating the pulse modulation signal includes the option Pulse Modulator (R&S SGS-K22).

To configure and perform a pulse modulation, you need to select the modulation signal source and provide the corresponding settings.

Modulation signal sources

The R&S SGS provides the following signal sources for the signal modulation:

- **Internal**: A high-performance pulse generator, that allows you to generate either single or double pulse signals
- **Externally supplied signal:** the instrument expects the pulse modulation signals at the TRIG connector.

Pulse modulation signal waveforms

The high-performance pulse generator enables you to generate single or double pulse signals.

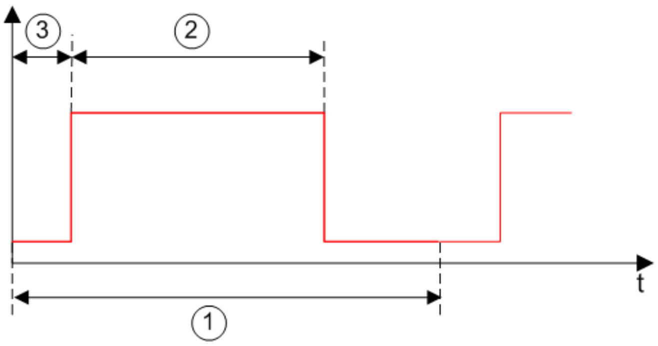


Figure 7-3: Pulse generator - single pulse mode

1 = Pulse period
2 = Pulse width
3 = Pulse delay

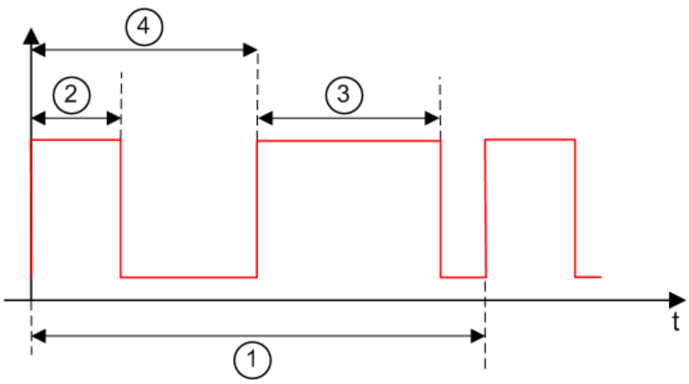
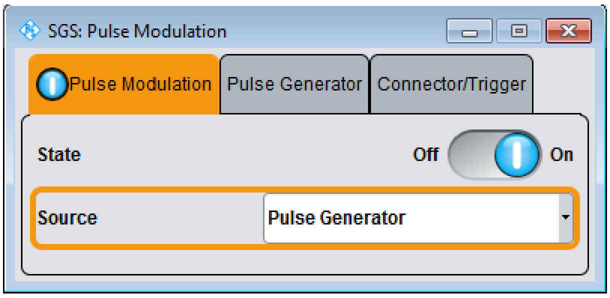


Figure 7-4: Pulse generator - double pulse mode

1 = Pulse period
2 = Pulse width
3 = Double pulse width
4 = Double pulse delay

7.8.1 Pulse Modulation Settings

► To access the pulse modulation settings, select "SGMA-GUI > Instrument Name > Pulse Modulation".

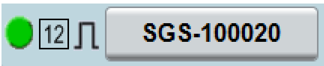


The "Pulse Modulation" dialog contains all parameters required to configure pulse modulation and pulse signal generation.

State

Activates pulse modulation.

The R&S SGMA-GUI indicates an activated pulse modulation as follows:



Remote command:

`[:SOURce<hw>]:PULM:STATe` on page 248

Source

Selects between the internal "Pulse Generator", or an "External" pulse signal for the modulation. In the later case, the instrument expects the pulse modulation signals at the TRIG connector.

Remote command:

`[:SOURce<hw>]:PULM:SOURce` on page 248

Polarity

Sets the polarity of the active slope of the modulation signal for "Source > External".

Remote command:

`[:SOURce<hw>]:PULM:POLarity` on page 247

External Impedance

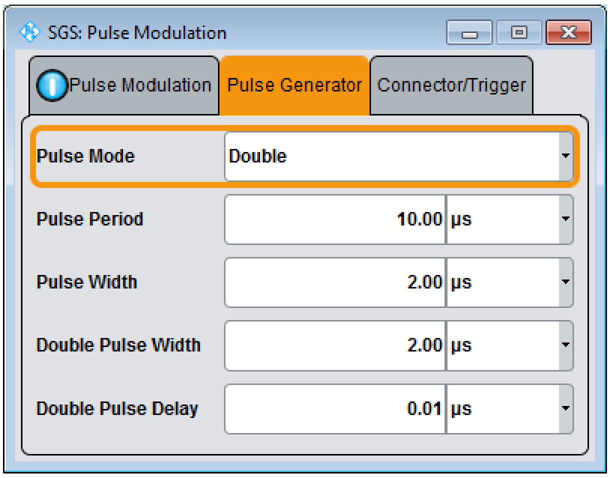
Selects the input impedance for an external pulse modulation signal.

Remote command:

`[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance` on page 249

7.8.2 Pulse Generator Settings

► To access the pulse connector/trigger settings, select "SGMA-GUI > Instrument Name > Pulse Modulation > Pulse Genrator".



Comprises the settings necessary to configure the internal pulse modulation signal.

Pulse Mode
Sets the operating mode of the pulse generator.

"Single" Generates a single pulse in one pulse period, see Figure 7-3.

"Double" Generates two pulses in one pulse period, see Figure 7-4.

Remote command:
`[:SOURce<hw>]:PULM:MODE` on page 247

Pulse Period
Sets the repetition rate of the generated pulse signal, see "Pulse modulation signal waveforms" on page 106.

Remote command:
`[:SOURce<hw>]:PULM:PERiod` on page 247

Pulse Width
Sets the pulse duration of the generated pulse signal, see "Pulse modulation signal waveforms" on page 106.

Remote command:
`[:SOURce<hw>]:PULM:WIDTh` on page 250

Double Pulse Width
Sets the width of the second pulse, see Figure 7-4.

Remote command:
`[:SOURce<hw>]:PULM:DOUBle:WIDTh` on page 247

Pulse Delay
Sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts, see Figure 7-3.

The pulse delay is not effective for double pulse generation.

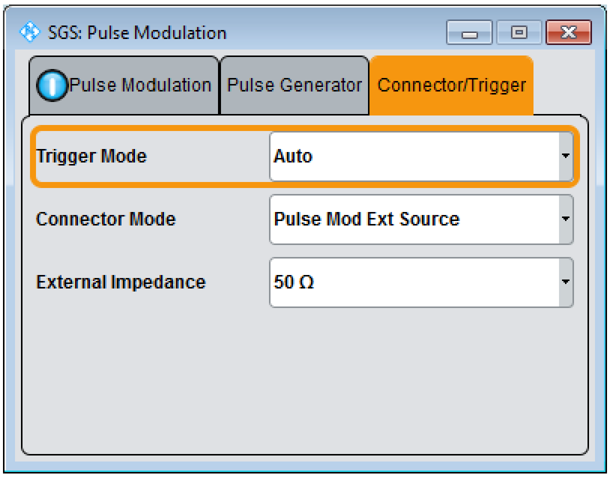
Remote command:
`[:SOURce<hw>]:PULM:DELay` on page 246

Double Pulse Delay
Sets the delay between the start of the first pulse and the start of the second pulse, see Figure 7-4.

Remote command:
`[:SOURce<hw>]:PULM:DOUBle:DELay` on page 246

7.8.3 Pulse Connector/Trigger Settings

► To access the pulse connector/trigger settings, select "SGMA-GUI > Instrument Name > Pulse Modulation > Connector/Trigger".



Comprises the settings necessary to configure the signal at the multi-purpose TRIG connector in the external trigger mode.

Trigger Connector Mode
Determines the signal at the input/output of the multi purpose TRIG connector.

"Signal Valid" Output of high signal to mark valid frequency and level settings.

"Not Signal Valid"
Output of high signal to mark the transition state when frequency and level change.

"Pulse Video Out"
Output of the internally generated pulse video (modulating) signal. The video signal level corresponds to the RF envelope.

"Pulse Mod Ext Trigger"
Input for an external trigger signal, used to trigger the pulse generator.

"Pulse Mod Ext Source"
Input for an externally provided pulse modulation signal.
Used when an external pulse modulator source is provided at the connector.

Remote command:
`:CONNector:TRIGger:OMODe` on page 201

Trigger Mode
Selects between continuous pulse modulation or pulse modulation triggered by an external signal.

"Auto" Generates the modulation signal continuously.

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

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

Remote command:
`[:SOURce<hw>]:PULM:TRIGger:MODE` on page 249

Ext. Trigger Input Slope
Available only for "Trigger Mode > Ext Triggered "

Sets the polarity of the active slope of an applied external trigger signal.

Remote command:
`[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe` on page 249

Gate Input Polarity
Available only for "Trigger Mode > Ext Gated "

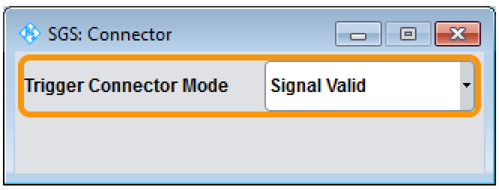
Sets the polarity of the active slope of an applied gate signal.

Remote command:
`[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity` on page 248

7.9 Trigger Connector Settings

The dialog provides settings to determine the signal at the input/output of the multi-purpose TRIG connector.

► To access the pulse connector/trigger settings, select "SGMA-GUI > Instrument Name > Connector".



Comprises the settings necessary to configure the signal at the input/output of the multi-purpose TRIG connector.

Trigger Connector Mode
Determines the signal at the input/output of the multi purpose TRIG connector.

"Signal Valid" Output of high signal to mark valid frequency and level settings.

"Not Signal Valid"
Output of high signal to mark the transition state when frequency and level change.

"Pulse Video Out"
Output of the internally generated pulse video (modulating) signal.
The video signal level corresponds to the RF envelope.

"Pulse Mod Ext Trigger"
Input for an external trigger signal, used to trigger the pulse generator.

"Pulse Mod Ext Source"
Input for an externally provided pulse modulation signal.
Used when an external pulse modulator source is provided at the connector.

Remote command:
`:CONNector:TRIGger:OMODe` on page 201

7.10 I/Q Modulation and Signal Impairment

The R&S SGS offers I/Q modulation with external analog I/Q signals. I/Q modulation with an external analog I/Q signal is possible for the instrument equipped with frequency options R&S SGS-B106V/-B112V. The external signal is input via the I and Q connectors and transferred to the I/Q modulator.

Before the signal is fed into the I/Q modulator, the signal can be impaired. Impairment at this point along the signal flow is provided for error correction of the supplied signal or for enabling dedicated impairments. Impairments caused by the I/Q modulator are automatically corrected by the "Internal Adjustments" function.

System error correction of the I/Q modulator permits precise and repeatable measurements. The correction routine should be called in the case of temperature fluctuations of several degrees. To call the routine, select "SGMA-GUI > Instrument Name > Setup > Internal Adjustment" and execute the desired adjustment procedure.

7.10.1 I/Q Impairments

Signal impairments are well-defined arithmetic modifications of the data. Every data sample is modified in the same way. The purpose of adding impairments to the data stream is to simulate frequent sources of distortions in a real signal-processing chain to generate a test signal with dirty transmitter conditions.

7.10.1.1 Gain and Gain Imbalance

An I/Q gain is a multiplication of all I/Q amplitudes by a common factor. The effect is equivalent to two identical I and Q gain factors. The effect of an increased gain factor in the I/Q constellation diagram is shown below.

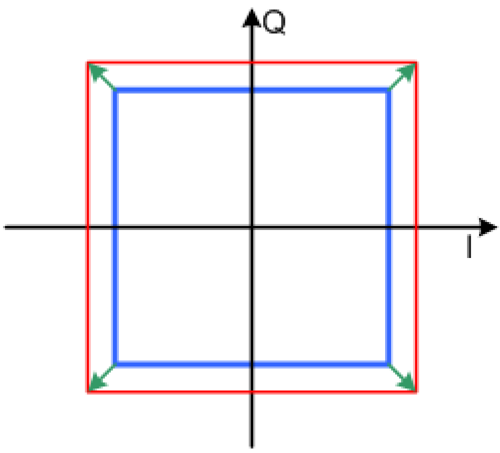


Figure 7-5: Effect of an increased amplitude in the I/Q constellation diagram

An I gain multiplies the I amplitudes by a factor, leaving the Q amplitudes unchanged. A Q gain has the opposite effect. Different I and Q gain factors result in an I/Q imbalance. This is usually due to different gains of the amplifiers in the I and Q channels of the I/Q modulator. The effect of a positive and negative gain imbalance is shown below.

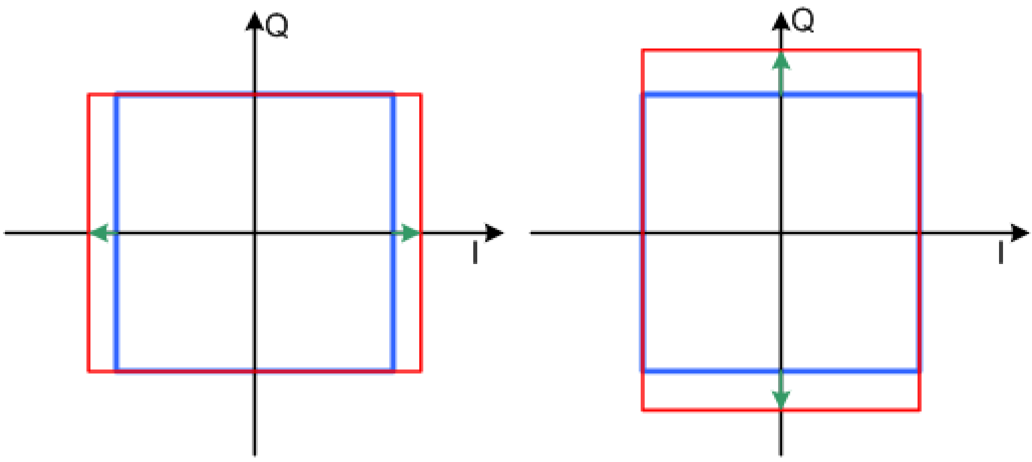


Figure 7-6: Negative gain imbalance (left) and positive (right) gain imbalance in the I/Q constellation diagram

7.10.1.2 I and Q Offset

An I offset adds a constant value to all I amplitudes, leaving the Q amplitudes unchanged. A Q offset has the opposite effect. A combination of I and Q values results in an I/Q offset, which is usually due to carrier feedthrough in the I/Q modulator. Possible reasons are interfering signals at the RF carrier frequency, e.g. an unsuppressed RF carrier subchannel. The effect of a positive I and Q offset in the I/Q constellation diagram is shown below.

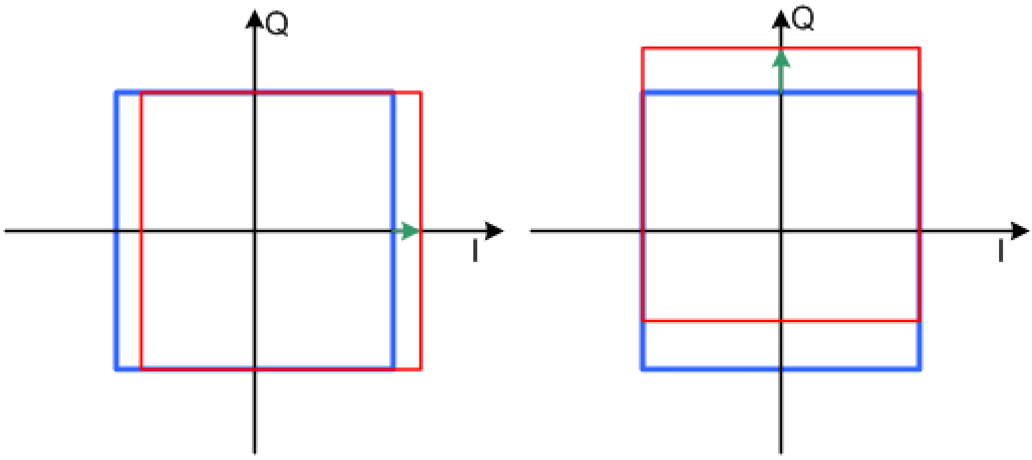


Figure 7-7: I offset (left) and Q offset (right) in the I/Q constellation diagram

7.10.1.3 Quadrature Offset

Changes the phase angle between the I and Q vectors from the ideal 90 degrees, while the amplitudes are maintained. A positive quadrature offset results in a phase angle greater than 90 degrees. The effect of a positive quadrature offset in the I/Q constellation diagram is shown below.

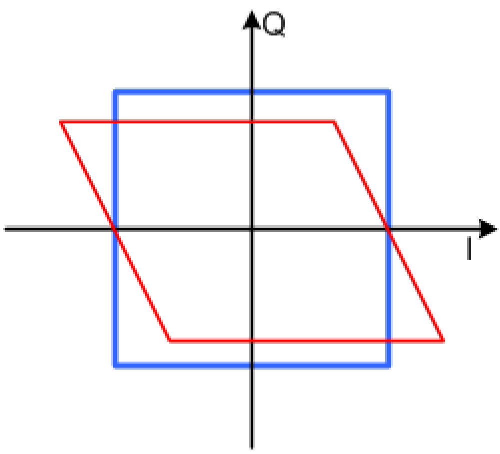
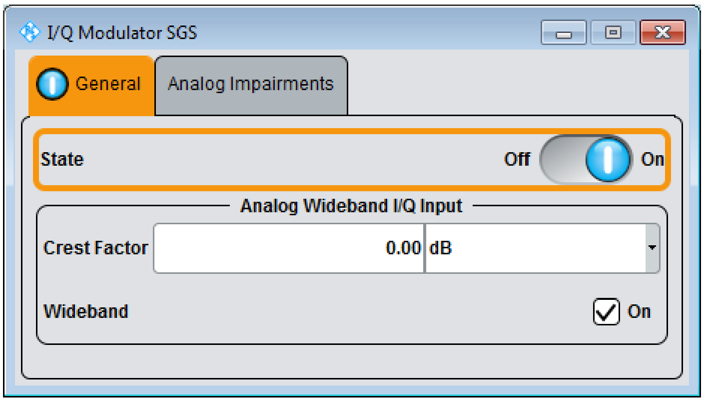


Figure 7-8: Positive quadrature offset in the I/Q constellation diagram

7.10.2 General I/Q Settings

► To access the settings of the I/Q modulator, select "SGMA-GUI > Instrument Name > I/Q Settings > General".



Comprises the settings for setting the state and the analog wideband I/Q input.

Mod State
Switches the I/Q modulation on and off.

Remote command:
`[:SOURce]:IQ:STATe` on page 237

I/Q Wideband
Setting mode for wideband modulation signals (higher I/Q modulation bandwidth).

The modulation frequency response of the R&S SGS in the useful bandwidth is improved at the expense of poorer harmonic suppression. This is achieved by shifting the switching frequencies of the low pass filters in the output section.

Remote command:
`[:SOURce]:IQ:WBSTate` on page 239

Crest Factor
Sets the crest factor of the I/Q modulation signal.

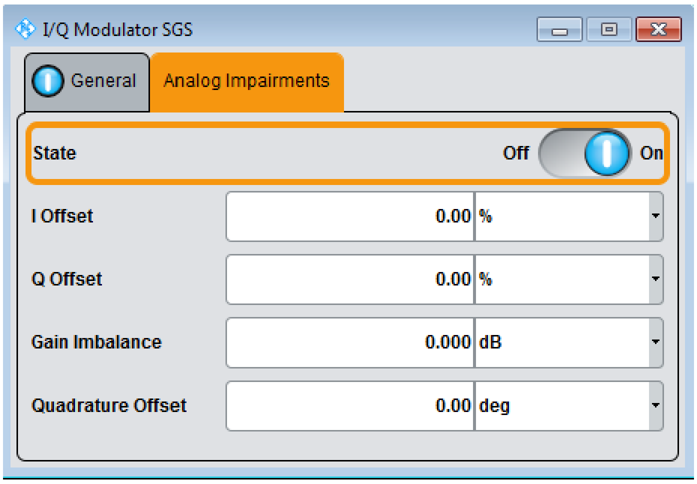
The crest factor gives the difference in level between the peak envelope power (PEP) and average power value (RMS) in dB. This value is necessary for the generation of the correct output power at the RF output, i.e. the instrument uses the crest factor value to compensate the average power.

In vector modulation mode, the output level setting is correlated to the nominal full scale voltage at the I/Q input. If the baseband signal exhibits no constant envelope, the instrument internal level setting can be corrected by use of the crest factor value.

Remote command:
`[:SOURce]:IQ:CREStfactor` on page 238

7.10.3 Analog Impairment Settings

► To access the settings of the I/Q modulator, select "SGMA-GUI > Instrument Name > I/Q Settings > Analog Impairments".



Comprises the settings like I/Q offset and quadrature offset.

State
Activates/deactivates I/Q impairments.

If activated, the settings for offset, gain imbalance and quadrature offset become effective.

It is indicated in the function block, if the I/Q impairment is activated.

Remote command:
`[:SOURce]:IQ:IMPairment[:STATe]` on page 238

Offset
Sets the carrier offset (in percent) of the amplitudes (scaled to the peak envelope power (PEP) for the I and/or Q signal component. An ideal I/Q modulator suppresses the carrier offset completely (offset = 0 percent).

For more information, see Chapter 7.10.1.2, "I and Q Offset", on page 113.

Remote command:
`[:SOURce]:IQ:IMPairment:LEAKage:I` on page 237
`[:SOURce]:IQ:IMPairment:LEAKage:Q` on page 237

Gain Imbalance
Sets the imbalance of the I and Q vector (see Chapter 7.10.1.1, "Gain and Gain Imbalance", on page 112).

The entry is made in dB (default) or %, where 1 dB offset is roughly 12 % according to the following:

Imbalance [dB] = 20log (| GainQ | / | GainI |)

Positive values mean that the Q vector is amplified more than the I vector by the corresponding percentage. Negative values have the opposite effect.

Remote command:
[:SOURce]:IQ:IMPairment:IQRatio[:MAGNitude] on page 237

Quadrature Offset

Sets the quadrature offset (see Chapter 7.10.1.3, "Quadrature Offset", on page 113).

Remote command:
[:SOURce]:IQ:IMPairment:QUADrature[:ANGLe] on page 238

7.11 Preset

Calls up a defined instrument setup. All parameters and switching states are preset (also those of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings. However, functions that concern the integration of the instrument into a measurement setup are not changed, e.g. reference oscillator settings.

Overview of the most important preset states

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

- "RF frequency" = 1 GHz
- "Reference frequency" = "Internal"; adjustment off
- "RF output" switched off
- "Modulator State" = Off

Settings that are **not affected** by the "SGMA-GUI > Instrument Name > Preset" function:

- Reference frequency settings ("Ref Oscillator" dialog)
- Power on settings ("Level" dialog)
- Network settings ("Setup" dialog)
- Password and settings protected by passwords ("Setup" dialog)
- "Eco Mode" state ("Setup > Eco Mode" dialog)

To preset the R&S SGMA-GUI itself and all configured instruments to their predefined state, use the "SGMA-GUI > File > New" function.

SCPI command:

:SYSTem:PRESet on page 198

7.12 Extension

Depending on the installed option, your R&S SGS generates an RF signal with frequency range up to 12.75 GHz. Some test cases, however, require even higher frequencies. A general setup would thus include an upconverter connected to the signal generator and you would have to control both the signal generator and the upconverter.

The R&S SGS equipped with one of the options R&S SGS-B112/B112V provides the build-in extension mode for controlling the R&S SGU upconverter. If you connect an R&S SGU to the R&S SGS, this upconverter acts as an extension to your instrument extending its frequency range to 20 GHz for instance. Refer to Chapter 5.2, "Setups for Connecting an R&S SGS and an R&S SGU", on page 37 for a description of the possible setups.

The extension mode provides the following advantages:

- Simplified calibration of the R&S SGU and single point of control
  In this setup, a controller does not need to access the extension, i.e. the R&S SGU, directly. Instead, the R&S SGS acts as a controller to it and depending on the required output signal parameters performs all required settings automatically. The signal generator settings of the extension are disabled for direct configuration in the R&S SGMA-GUI. However, you can still remotely control the extension using the corresponding SCPI commands.
- Extended value ranges and functionality
  The main application field of the extension mode is the extended frequency range but you can also benefit from the I/Q modulation and pulse modulation functions of the extension. For frequencies greater than 12.75 GHz, the combination of R&S SGS and R&S SGU can generate vector modulated signals even if the R&S SGS is not equipped with the required options R&S SGS-B106V/B112V.

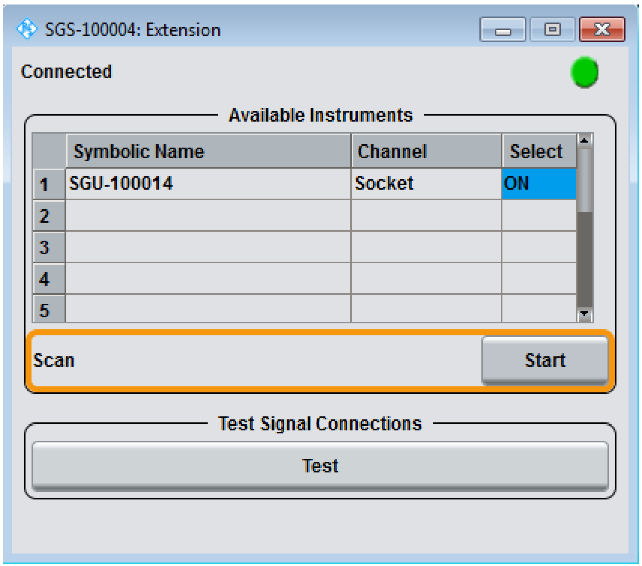
Prerequisites and required physical connections for operation in extension mode:

- The R&S SGS is equipped with one of the options R&S SGS-B112/B112V.
- A remote PC is connected to the master instrument, the remote PC and the instrument are switched on and a connection between them is established.
  The instrument and the extension are connected via a direct remote connection or over network/switch. All interfaces (LAN, PCIe, or USB) can be used for controlling the SGU.
- The R&S SGMA-GUI or an application program is running on the remote PC.
- Signal connections between the R&S SGS and the R&S SGU are established, i.e. the connections between:
  – The RF OUT of the R&S SGS and the LO IN of the R&S SGU
  – For vector modulated signals, the I OUT/Q OUT of the R&S SGU and the I IN/Q IN of the R&S SGS
  – The TRIG connectors of both instruments

This section describes the manual operation via the R&S SGMA-GUI software. The remote commands required to define these settings are described in Chapter 11.8, "EXTension Subsystem", on page 203.

To access the extension mode settings and enable the extension mode

1. Select "SGMA-GUI > Instrument Name > Extension".



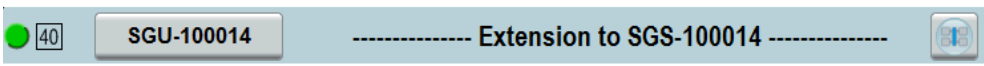
Tip: Steps 2 and 3 can be omitted if the R&S SGS and a single R&S SGU are connected using PCIe or USB or by a direct LAN connection. In this case, R&S SGS automatically activates the R&S SGU.

2. Trigger "Scan" to find all available instruments that can serve as an extension to the particular instrument.
3. Select an instrument from the list and set "Available Instruments > Select > On" to enable it as an extension.

   A green status indicator "Connected" indicates the successfully established remote connection to the extension.
4. Select "Test Signal Connections > Test" to trigger a check of all required signal connections.

   The diagram displays the connection state of the tested connections.

   The R&S SGMA-GUI indicates the extended frequency range of the master instrument and the activated extension mode.



You cannot access the signal generation settings of an instrument working in extension mode. The extension is controlled via the master instrument.
To display the R&S SGU settings, click on the button next to the instrument's name.
Select for example "SGMA-GUI > Master Instrument Name > Freq = 20 GHz", "Lev = -30 dBm" and enable "RF > State > On". The extension adopts these values and states automatically. To confirm, disable the "Extension > Available Instruments > Extension Name > Select > Off" and compare the values of the parameters "SGMA-GUI > Extension Instrument Name > Freq/Lev".

Connected
The connection state indicator visualizes the state of selected extension:
- Grey - the connection to the extension is not activated ("Extension > Available Instruments > Instrument# > Select > Off")
- Green - the extension is connected to the master instrument and can be manually and remotely operated
- Red - the extension is in standby or locked state, or is performing a time consuming operation

Available Instruments
Lists all available instruments that may serve as an extension to the R&S SGS.

Each instrument is represented by:

"Symbolic Name"
Alias name of the instrument as it is defined in the main panel of R&S SGMA-GUI.

"Channel" Hardware channel, "Socket", "LAN", "USB" or "PCIe", used by the extension as remote control channel

"Select" State of the remote connection to the extension.
The R&S SGMA-GUI indicates an activated extension mode as follows:

Remote command:
:EXTension:BUSY[:STATe]? on page 205
:EXTension:INSTruments:NAME? on page 203
:EXTension:INSTruments:REMote:CHANnel? on page 204
:EXTension:INSTruments:REMote:LAN:NAME? on page 204
:EXTension:INSTruments:REMote:SERial? on page 204
:EXTension:INSTruments:SCAN[:STATe] on page 203
:EXTension:REMote:STATe? on page 203

Scan
Triggers a scan function and searches for instruments connected to the instrument via all the available interfaces.

Remote command:
:EXTension:INSTruments:SCAN[:STATe] on page 203

Test Signal Connections
The "Test" function triggers a test of all signal connections between the instrument and the extension. The schematic diagram displays the required physical signal connection for the current test setup and the connection state.

A faulty connection is marked with a red line crossing the drawn blue connection line as shown in Figure 7-9. If your connection is marked as faulty check whether the cables are connected properly and if the connection cables are functioning properly.

Figure 7-9: A faulty connection between an R&S SGU and an R&S SGS

Note: If your connection is marked as faulty check whether the cables are connected properly. Check also if the connection cables are functioning properly.

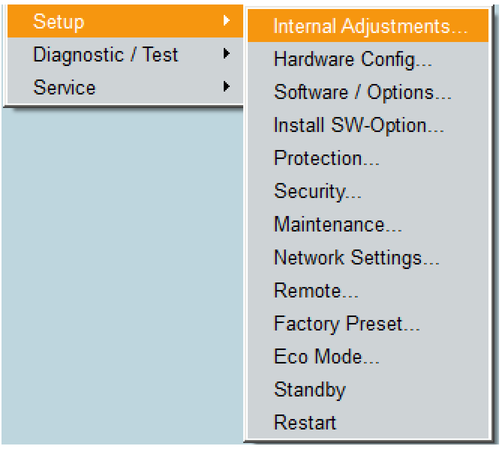
Remote command:
n.a.

8 General Instrument Settings and Instrument Setup

This section describes the settings which do not directly affect signal generation.

Access:

► Select "SGMA-GUI > Instrument Name > Setup" and select the required dialog.



8.1 Internal Adjustments

The R&S SGS is accurate due to the integrated procedures for adjustments.

All internal adjustments for which no external measuring equipment is needed can be started in the "Internal Adjustments" dialog. The adjustments with external measuring equipment are described in the service manual.

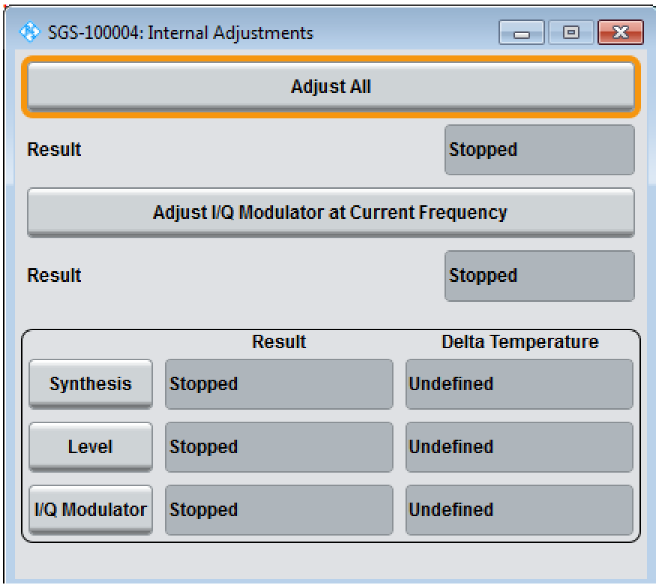
Adjustment is recommended if the temperature range in which the instrument is operated changes, before all applications which require maximum level and frequency accuracy, or after enabling/disabling of the "Eco Mode" (see Chapter 8.12, "Eco Mode", on page 136).

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

NOTICE

Risk of invalid adjustment

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



Adjust All

Starts all internal adjustments for which no external measuring equipment is needed. The adjustments with external measuring equipment are described in the service manual.

Remote command:
`:CALibration:ALL[:MEASure]?` on page 199

Adjust I/Q Modulator at Current Frequency

Starts the adjustment for the I/Q modulator for the currently set frequency. The I/Q modulator is adjusted regarding carrier leakage, I/Q imbalance and quadrature.

The adjustment is only possible when "RF > On" and "I/Q Mod > State > On".

Adjustment for only the set frequency is considerably faster than adjustment across the entire frequency range. An adjustment of the entire range is possible with the I/Q Modulator button of this dialog.

Remote command:
`:CALibration:IQModulator:LOCal?` on page 199

Synthesis

Performs all adjustments which affect the frequency.

Remote command:
`:CALibration:FREQuency[:MEASure]?` on page 199

Level

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

Remote command:
`:CALibration:LEVel[:MEASure]?` on page 200

I/Q Modulator
Starts the adjustment for the I/Q modulator for the entire frequency range. The I/Q modulator is adjusted regarding carrier leakage, I/Q imbalance and quadrature.

Remote command:
`:CALibration:IQModulator:FULL?` on page 199

Delta Temperature
Displays the difference between the current temperature and the temperature by the last performed adjustment.

Note: Adjustment is recommended if the temperature range in which the instrument is operated changes, before all applications which require maximum level and frequency accuracy, or after enabling/disabling of the "Eco Mode" (see Chapter 8.12, "Eco Mode", on page 136).

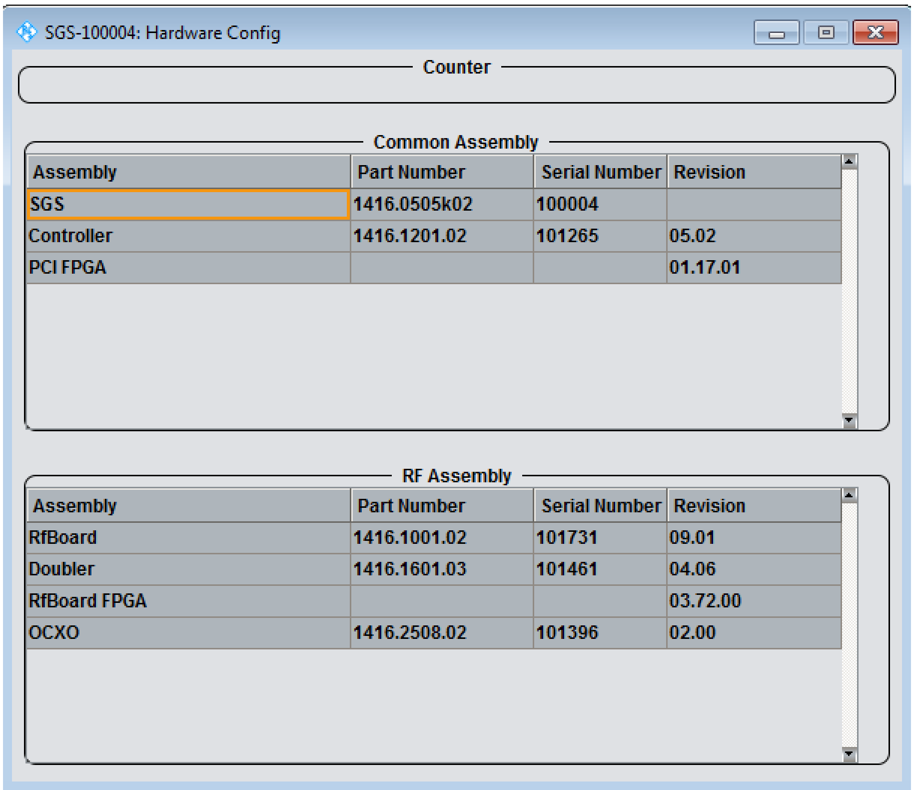
Remote command:
`:CALibration:LEVel:TEMPerature?` on page 200
`:CALibration:FREQuency:TEMPerature?` on page 200
`:CALibration:IQModulator:TEMPerature?` on page 200

8.2 Hardware Configuration

Querying information about the installed assemblies

► Select "SGMA-GUI > Instrument Name > Setup > Hardware Config".

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



The dialog is a table that lists the installed assemblies. It is divided into the sections:

- "Common Assembly"
- "RF Assembly"

Assembly

The tables list the installed assemblies.

"Assembly" Name of the assembly

"Part Number" Part Number of the assembly

"Serial Number"
Serial number of the assembly

"Revision" Revision state of assembly

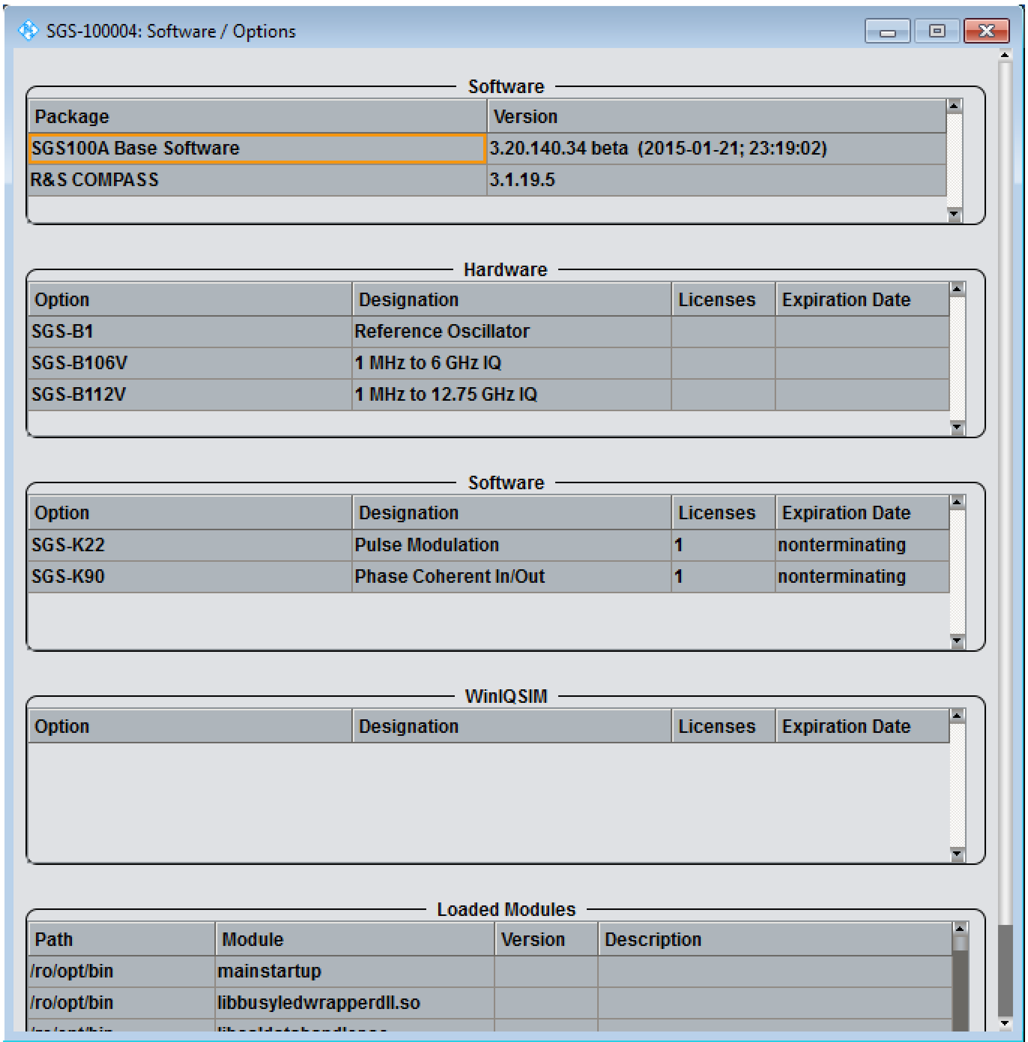
Remote command:
`:SYSTem:HARDware:ASSembly<dir>:NAME?` on page 265
`:SYSTem:HARDware:ASSembly<dir>:PNUMber?` on page 265
`:SYSTem:HARDware:ASSembly<dir>:SNUMber?` on page 266
`:SYSTem:HARDware:ASSembly<dir>:REVision?` on page 265

8.3 Software / Options

Querying information about the installed options and software version

► Select "SGMA-GUI > Instrument Name > Setup > Software/Options".

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



The dialog is divided into the following sections:

- "Firmware"
- "Hardware"
- "Software"
- "Loaded Modules"

Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. An instruction on how to install options is described in the service manual. Most hardware options need to be installed at an authorized Rohde & Schwarz service center.

Software
Shows the software/firmware version and the version of the software platform.

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

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

"Option" Short name of the option

"Designation" Name of the option

"Licenses" Number of licenses

"Expiration Date"
For regular options, "Permanent" is indicated in this column. Some options are available as trial versions. This column shows their expiration date. After this date, the option is no longer available on the instrument.

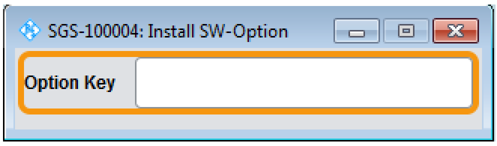
Remote command:
`:SYSTem:SOFTware:OPTion<dir>:NAME?` on page 267
`:SYSTem:SOFTware:OPTion<dir>:DESignation?` on page 266
`:SYSTem:SOFTware:OPTion<dir>:LICenses?` on page 267
`:SYSTem:SOFTware:OPTion<dir>:EXPiration?` on page 266

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

Show Open Source Acknowledgments
Accesses the list of the used open source software packages and the corresponding verbatim license texts.

8.4 Install SW-Options

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



Only if the instrument is equipped with an older firmware version, a firmware update before enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option.

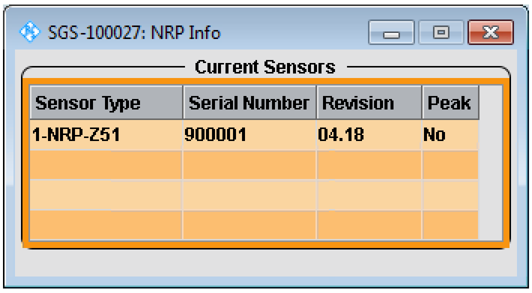
See:

- Chapter 9.12, "How to Install a New Firmware Version on the Instrument", on page 152 for information on how to perform firmware update
- Chapter 9.13, "How to Activate Options", on page 154 for instruction on how to install new options

The firmware update is also described in the service manual.

8.5 NRP Info

► To access this dialog, select "SGMA-GUI > Instrument Name > Setup > NRP Info"



Current Sensors
Shows the sensors that are connected to the generator with information on serial number, the revision state, and some characteristic features.

8.6 Protection

The "Protection" dialog provides access to the unlocking of protected service functions (authorized personnel of R&S Service Departments only).

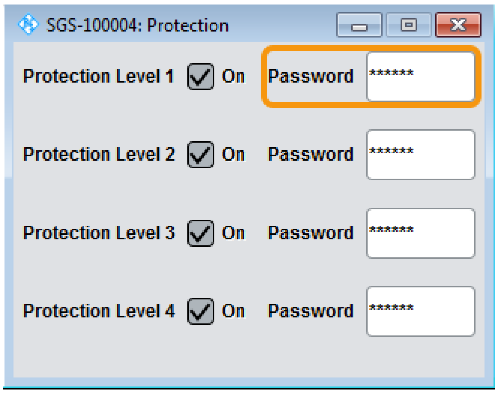
Unlocking of protected service functions

1. Select "SGMA-GUI main panel > Instrument Name > Setup > Protection".

   The "Protection" dialog provides access to the unlocking of protected service functions (authorized personnel of R&S Service Departments only).

2. To deactivate the protection, the correct password has to be entered. After the instrument has been switched on, the protection levels 1 to 4 are automatically activated.
   Enter "Protection Level 1 > Password > 123456".

   Protection Level 1 is activated.



Protection Level / Password
"Protection Level 1" can be activated to expand the functionality of the internal adjustment. The password is 123456.

The other protection levels 2 to 4 provide access to protected service functions. Only the authorized personnel of R&S Service Departments can access these functions.

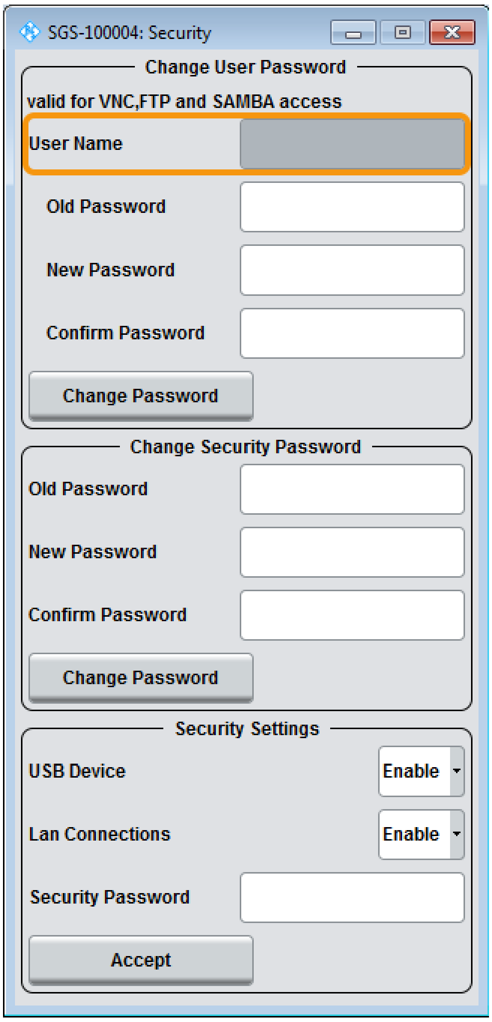
8.7 Security Setting

The R&S SGS employs a security concept based on user and security password. The security password is required for changing several critical settings, like performing firmware updates. Access to the passwords and mass storage security settings is provided in the "Security" dialog.

► To access the "Security" dialog, select "SGMA-GUI > Instrument Name > Setup > Security"

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

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



The settings of this dialog are not accessible over remote control (e.g. SCPI commands).

Change User Password

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

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

User Name ← Change User Password

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

Old Password ← Change User Password

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

New Password ← Change User Password
Enter the new user password.

Confirm Password ← Change User Password
Enter the new password for conformation.

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

Change Password ← Change User Password
Changes the password accordingly.

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

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

Old Password ← Change Security Password
Enter the currently used security password. The default password is '123456'.

New Password ← Change Security Password
Enter the new security password. The security password may contain decimal characters only.

Confirm Password ← Change Security Password
Enter the new password for conformation.

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

Change Password ← Change Security Password
Changes the password accordingly.

Security Settings
Comprises the settings for enabling and disabling the USB and LAN interfaces. The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

USB Device ← Security Settings
Enable/disable the USB interface.

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

LAN Connection ← Security Settings
Enable/disable the LAN interface.

Note: It is not possible to access the instrument via LAN while the LAN connection is disabled.
An enabled LAN connection is a prerequisite for the remote control of the instrument via VNC, FTP or SAMBA.

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

Note: It is highly recommended to change the default security password before connecting the instrument to the network. To change the security password, select "SGMA-GUI > Instrument Name > Setup > Security > Change Security Password".

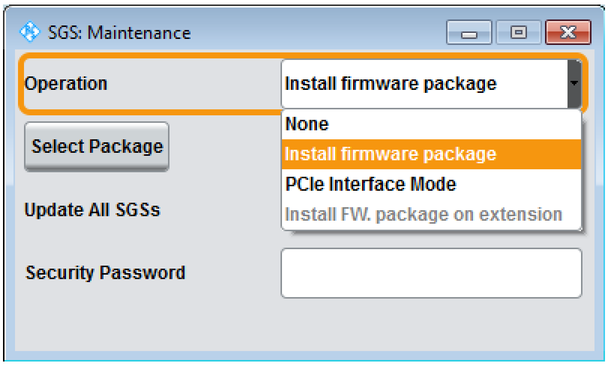
The settings are only accepted after the "Accept" button is pressed.

Accept ← Security Settings
Accept a new entry or selection and change the settings accordingly.

8.8 Maintenance

The R&S SGS provides a special dialog for performing some maintenance procedures, like installing firmware packages.

► To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Maintenance".



Operation
Selects the desired maintenance operation.

Select Package
Available only for "Operation > Install Firmware Package".

Selects the firmware package to be installed, see also Chapter 9.12, "How to Install a New Firmware Version on the Instrument", on page 152.

Update All
Available only for "Operation > Install Firmware Package".

Enable this function to perform a simultaneous firmware update on all instruments, that are in active state and are connected to this controller.

Note: A firmware update and the required subsequent restart and the automatically initiated internal adjustment process of the controller may be a time consuming operation.

This feature accelerates the update process and the required restart of the external PC can be executed once after the update operation of all instruments is completed.

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

Note: It is highly recommended to change the default security password before connecting the instrument to the network. To change the security password, select "SGMA-GUI > Instrument Name > Setup > Security > Change Security Password".

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

Accept
Accept the selected operation and perform the required procedure.

PCIe Interface Mode
Sets the PCIe interface mode for the R&S SGS.

"Endpoint"	Standard mode.
"Root Complex"	The mode needed for a direct PCIe connection of an R&S SGS and an R&S SGU.

8.9 Network Settings

The instrument is equipped with a network interface and can be connected to an Ethernet LAN (local area network). The "Network Settings" dialog provides access to the network settings.

NOTICE

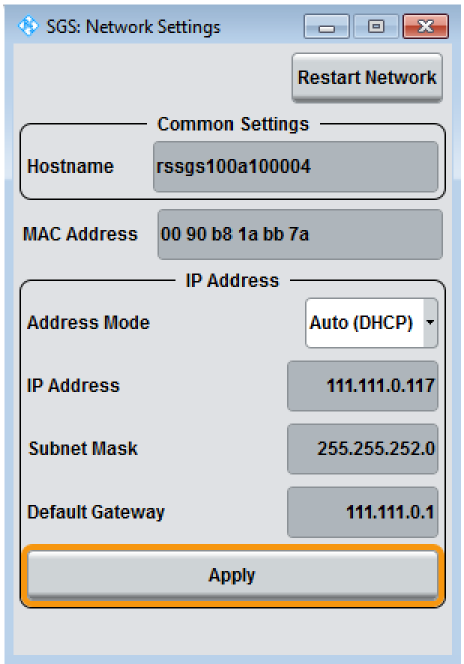
Risk of network errors!

Connection errors can affect the entire network.

If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN.

Contact your network administrator to obtain a valid IP address.

► To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Network Settings".



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

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

This function can be used to resolve network problems.

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

Hostname
Displays the individual computer name of the instrument.

A predefined name is indicated and can be used for network connections, see Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 65.

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command:
`:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 261

MAC Address
Indicates the MAC address of the network adapter.

Address Mode
Selects if the IP address is assigned automatically or manually.

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Note: Lost LAN connection to an instrument.
If the connection to an instrument configured to use static IP addresses is lost, press the LAN LED on the instrument front panel for 3 seconds.

This resets the "Address Mode" to its default value ("Auto (DHCP)").

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

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress:MODE` on page 260

IP Address

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

In case of manual input of the IP address, it is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command:
`:SYSTem:COMMunicate:NETWork:IPADdress` on page 260

Subnet Mask

Displays the subnet mask. To enter the subnet mask manually, select "Address Mode > Static".

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

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK` on page 261

Default Gateway

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

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

It is recommended that a connection of the instrument to the network is coordinated with the network administrator. Connection errors may affect the entire network.

Remote command:
`:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway` on page 261

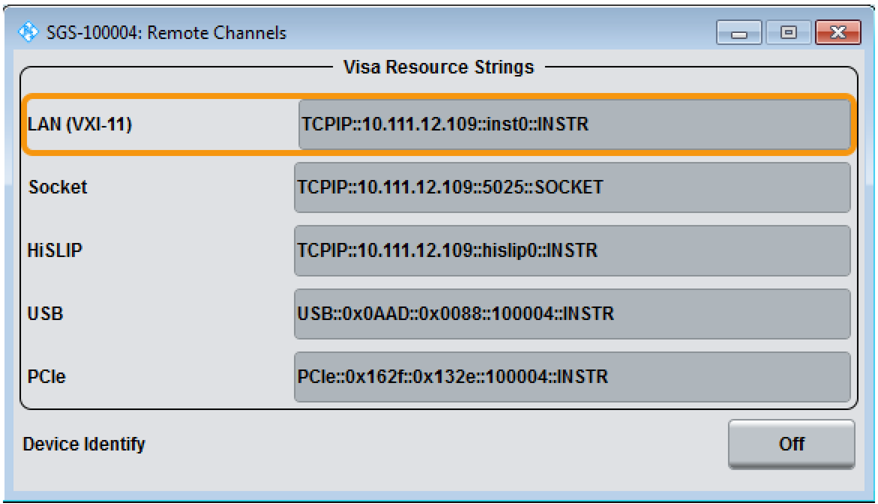
Apply

Applies the network settings to the instrument.

8.10 Remote Channels

The "Remote" dialog provides access to the settings for remote control.

► To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Remote".



Visa Resource Strings

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

Note: For background information and description of the syntax of the VISA resource strings, refer to the description of the corresponding interface in Chapter 10.1, "Remote Control Interfaces and Protocols", on page 155.

Remote command:
`:SYSTem:COMMunicate:HISLip:RESource?` on page 263
`:SYSTem:COMMunicate:NETWork:RESource?` on page 262
`:SYSTem:COMMunicate:SOCKet:RESource?` on page 263
`:SYSTem:COMMunicate:USB:RESource?` on page 264
`:SYSTem:COMMunicate:PCIexpress:RESource?` on page 263

Device Identity

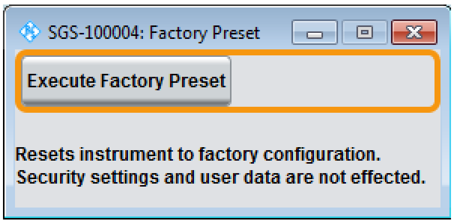
Triggers the device identification function. The LAN LED on the front panel of the selected instrument blinks.

See also Chapter 6.4.4, "Bidirectional Instrument Identification ", on page 65.

8.11 Factory Preset

The "Factory Preset" dialog provides a function to reset the instrument's settings to their factory states

1. To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Factory Preset".



2. Select "Execute Factory Preset".

   The instrument's settings are reset to their factory states. Security settings and user data are not effected.

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

Note: Because "Factory Preset" resets the "Remote Channel Settings" and "Network Settings" to the default values, executing factory preset via remote control may terminate the connection to the instrument, if these settings had been configured to values different to the default ones!

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

- Power on settings ("Level" dialog)
- Network settings including hostname ("Setup > Network Setting" dialog)
- Remote Channel settings ("Setup > Remote Channel" dialog)
- Eco Mode state ("Setup > Eco Mode" dialog)

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

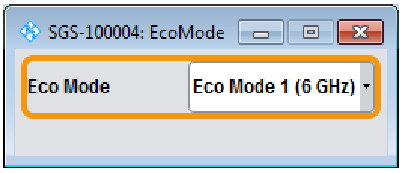
Not affected by the "Factory Preset" are also user data, lists or instrument settings files, created for example with the "File Save As" function.

Remote command:
`:SYSTem:FPReset` on page 198

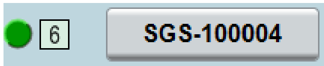
8.12 Eco Mode

This energy saving mode is available only for instruments equipped with optionR&S SGS-B112/B112V.

► To access this dialog, select "SGMA-GUI > Instrument Name > Setup > Eco Mode".



With enabled "Eco Mode 1" the doubler stage in a 12.75 GHz instrument is permanently switched off to reduce power consumption and the maximum frequency is limited to 6 GHZ. An enabled "Eco Mode" is indicated by a green coloring of the frequency range in the R&S SGMA-GUI.



NOTICE

Risk of invalid adjustment after changing the Eco Mode

The switching off and on of the doubler stage changes the thermal conditions in the instrument.

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

Performing adjustment in eco mode

The instrument performs the internal adjustment within the currently active frequency range, i.e. up to 6 GHz for enabled mode "Eco Mode 1". The correct alignment of the parameters outside of the current active frequency range is not guaranteed. A subsequent readjustment for the total frequency range of the instrument is recommended.

The state of this parameter is not affected by an instrument "Preset". This parameter is influenced only by the Factory Preset.

SCPI command:

`:SYSTem:EMODe` on page 257

8.13 Standby and Restart

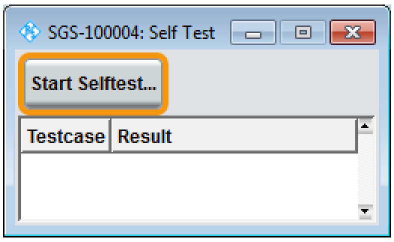
See Chapter 9.9, "How to Switch between the Operating States", on page 149.

8.14 Diagnostic and Tests

This section describes the settings provided for diagnostic and test purposes.

8.14.1 Self-test

1. To access this dialog, select "SGMA-GUI > Instrument Name > Diagnostic Tests > Self-test".



2. To trigger a self-test, select "Self-test".

   Performs a self-test on all installed hardware options.

   The result of the self-test, succeeded or failed, is displayed. The list of the numeric results of the performed test cases is protected by protection level 2.

SCPI command:

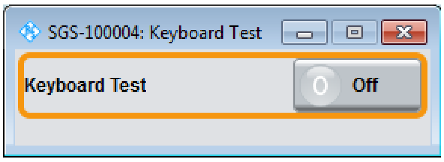
`:TEST:ALL:STARt` on page 268

`:TEST:ALL:RESult?` on page 268

8.14.2 Keyboard Tests

Access:

► Select "SGMA-GUI > Instrument Name > Diagnostic Tests > Keyboard Test".



Use this function to check the proper operation of all front panel elements.

If "Keyboard Test" is enabled, all front panel LEDs except the POWER ON are orange.

The exact test procedure is described in the service manual.

SCPI command:

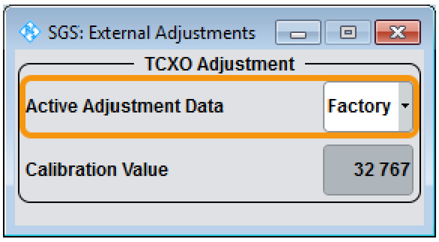
`:TEST:KEYBoard[:STATe]` on page 268

8.15 External Adjustments

The external adjustment is a protected service procedure, that requires a Protection Level 2 password. The exact test procedure is described in the service manual.

Access:

1. Select "SGMA-GUI > Instrument Name > Protection" and enter the Protection Level 2 password.
   (See "Unlocking of protected service functions" on page 127)
2. Select "SGMA-GUI > Instrument Name > Service > External Adjustments".



Depending on the installed options, the R&S SGS is equipped with a TCXO or OCXO reference oscillator. The reference oscillator is factory calibrated to a specific calibration value. In the external adjustment dialog, you can select a different (custom) calibration value.

Active Adjustment Data
Selects whether the factory provided or a custom defined calibration value is used to adjust the reference oscillator.

Remote command:
:CALibration<hw>:ROSCillator:DATA:MODE on page 200

Calibration Value
Sets a user definable calibration value.

The permanent storage of this value in the instrument's memory is a password protected function. The exact test procedure is described in the service manual.

This parameter is restored to its permanently stored value by "Preset" and instrument restart.

Remote command:
:CALibration<hw>:ROSCillator[:DATA] on page 201

9 Performing Configuration Tasks

This section provides a general explanation on how to operate the instrument manually via the R&S SGMA-GUI software.

We assume, that the R&S SGS is connected to a remote PC. The R&S SGMA-GUI software has to be installed on this remote PC and the instrument has to be added to the list of "Available Instruments".

For information on how to fulfill these requirements, refer to:

- Chapter 2.3.2.1, "Connecting the Instrument to the Network", on page 22
- Chapter 2.3.1, "Installing the R&S SGMA-GUI Software on an External PC", on page 21
- Chapter 2.3.2.3, "Automatically Adding Instruments to the SGMA-GUI ", on page 23

General workflow

The general workflow for generating a signal with the R&S SGS comprises the following main steps:

1. Decide whether you want to generate a CW or an I/Q modulated signal.
   See Chapter 9.1, "How to Generate an I/Q Modulated Signal", on page 140.
2. Select the operating mode.
   See Chapter 9.3, "How to Enable a Baseband Bypass Mode", on page 144.
3. Configure the reference and local oscillator settings.
   See Chapter 9.4, "How to Configure the Reference Oscillator Source", on page 145 and Chapter 9.5, "How to Configure the Local Oscillator (LO) Coupling Source", on page 146.
4. Adjust the frequency, level and I/Q settings, for example, to optimize performance or to add impairments to the generated signal (see Chapter 9.11, "How to Optimize Performance", on page 151).

9.1 How to Generate an I/Q Modulated Signal

The instrument is manually operated via the R&S SGMA-GUI software.

The I/Q Modulator requires the hardware option R&S SGS-B106V and for operation up to 12.75 GHz also the hardware option R&S SGS-B112V.

An example of how to configure the instrument to generate a continuous wave (CW) signal is provided in Chapter 4, "First Steps with the Instrument", on page 31.

To generate an I/Q modulated signal

1. Connect the test equipment. Provide the external analog signal to be modulated at the I and Q connectors of the instrument.
   The Figure 9-1 shows an example of the test setup. A signal generator, e.g. R&S AFQ100B is used as a source of the external analog signal. The R&S signal generator provides its internal reference signal to the R&S SGS and the connected signal analyzer, e.g. the R&S FSW.

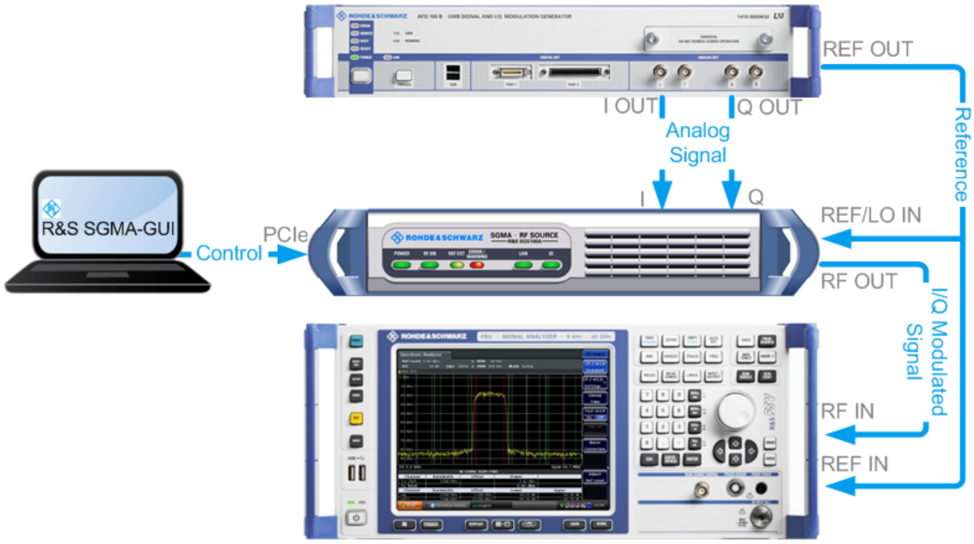


Figure 9-1: Example of the setup

   Tip: Refer to the user manual of the R&S signal generator and the R&S signal analyzer for information on how to configure the corresponding instrument.

2. Select "SGMA-GUI main panel > Instrument Name > Reference Oscillator > Ext" and adjust the settings as required.
3. Select "SGMA-GUI main panel > Instrument Name > Frequency/Phase > LO Coupling Source > Int".
   Tip:
   For detailed description on how to select the reference frequency source and the LO coupling source, refer to:
   - Chapter 9.4, "How to Configure the Reference Oscillator Source", on page 145 and
   - Chapter 9.5, "How to Configure the Local Oscillator (LO) Coupling Source", on page 146.
4. In the "Frequency/Phase" dialog, configure the frequency settings.
5. Select the "SGMA-GUI > Instrument Name > Level > RF Level > Level" and set the"RF Level".
   In the same dialog, configure the further "Level" and "Power-On" settings.
6. Select the "SGMA-GUI main panel > Instrument Name > I/Q settings > Analog Impairments" and enable I/Q impairments.

In the "I/Q settings >General" dialog, set "State > On" to enable the I/Q modulator.

7. Select "SGMA-GUI main panel > RF > On" or press the RF ON key on the front panel of the instrument.

   The RF ON key is green.

   The I/Q modulated signal is output at the RF connector of the instrument.

How to generate an I/Q modulated signal with higher RF?

If the R&S SGS is equipped with one of the options R&S SGS-B112/B112V, you can connect an extension, an R&S SGU, to it and thus extend the frequency range of the generated I/Q signal up to 40 GHz.

Refer to Chapter 9.2, "How to Generate I/Q Signals with an R&S SGS and an R&S SGU Upconverter", on page 142 for more information.

9.2 How to Generate I/Q Signals with an R&S SGS and an R&S SGU Upconverter

Options R&S SGS-B112V and R&S SGU-B120V/-B140V are required for the I/Q modulation.

To generate an I/Q modulated signal with higher frequency

In this example, the R&S SGU acts as an extension to the R&S SGS extending its frequency range to 40 GHz.

The Figure 9-2 shows an example of the test setup.

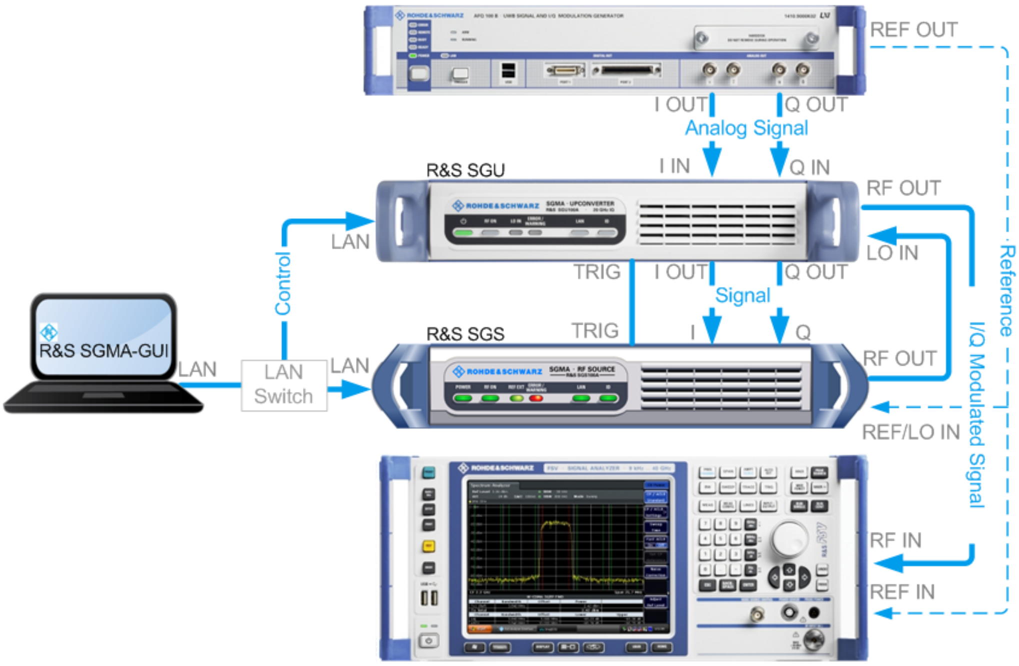


Figure 9-2: Example of the test setup

For higher setting/ measuring speeds, use a PCIe switch and PCIe connections.

If a common reference frequency is required, use the internal reference signal of the signal generator and provide it to the R&S SGS and the connected signal analyzer, e.g. the R&S FSW.

1. Connect the test equipment as shown on Figure 9-2:
   a) Connect the R&S SGS, the R&S SGU and the controller to a LAN switch.
   b) Connect the I/Q OUT of the base band signal source to the I/Q IN of the R&S SGU.
   c) Connect the I/Q OUT of the R&S SGS to the I and Q connectors of the R&S SGS.
   d) Connect the RF OUT of the R&S SGS to the LO IN of the R&S SGU.
   e) Connect the TRIG connectors of the R&S SGS and the R&S SGU.
   f) Connect the RF OUT of the R&S SGU to the RF IN of the signal analyzer.
2. Select "SGMA-GUI main panel > R&S SGS > Extension".

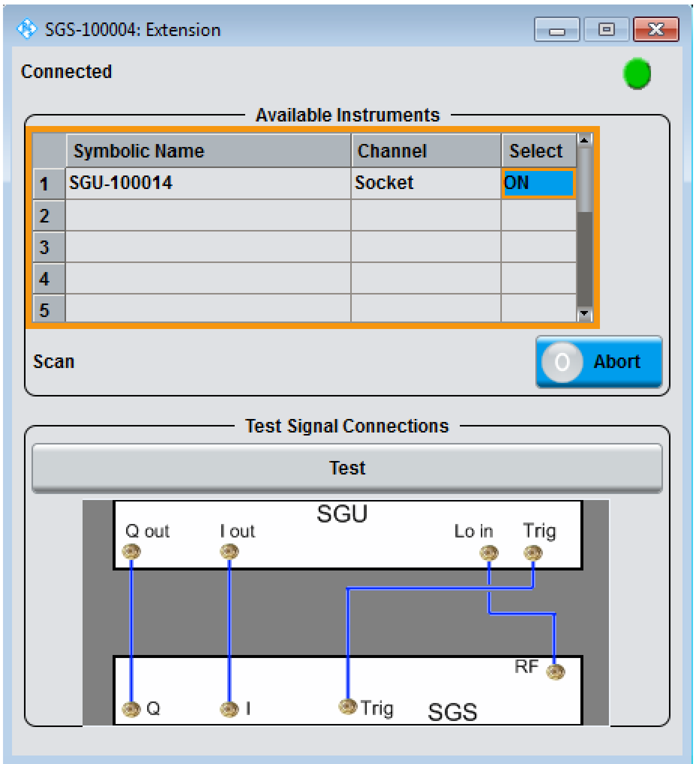
   Tip: Steps 3 to 5 can be omitted if the R&S SGS and a single R&S SGU are connected using PCIe or USB or by a direct LAN connection. In this case, the R&S SGS automatically activates the R&S SGU.
3. Press the ID key on the front panel of the R&S SGU (only required if the components are connected via a company network).
4. In the "Extension" dialog, trigger "Scan".

The scan function finds out the connected R&S SGU.

5. Select the R&S SGU from the list and set "Available Instruments > Select > On" to enable it as an extension.

   A green status indicator "Connected" indicates the successfully established remote connection to the extension.

6. Select "Test Signal Connections > Test" to trigger a check of all required signal connections.



   The diagram displays the connection state of the tested connections.

7. Select "SGMA-GUI > R&S SGS > Freq = 20 GHz", "Lev = -30 dBm" and enable "RF > State > On".

   The extension adopts these values and states automatically. Generated is an I/Q signal with "RF = 20 GHz" and "Level = -30 dBm".

9.3 How to Enable a Baseband Bypass Mode

1. Provide an external analog signal at the I or Q connector or on both at the rear of the instrument.
   Refer to Figure 5-9 for visualization of the signal flow.

2. Select "SGMA-GUI > Instrument Name > Operation Mode > Baseband Bypass".

Some instrument's functions like "Frequency" and I/Q settings are disabled.

3. Select "SGMA-GUI > Instrument Name > Level > RF Level" and adjust the level of the output signal.
4. Set "SGMA-GUI > RF > On" or press the RF ON key on the front panel of the instrument to enable the output of the generated signal at the RF connector.

   The RF ON key is green.

   The fed signal is amplified with the selected value and output at the RF connector of the instrument.

9.4 How to Configure the Reference Oscillator Source

To use the internal reference frequency source

1. To enable the instrument to use its internal reference frequency source, perform one of the following:
   a) Select "SGMA-GUI main panel > Ext Ref Off ".
   b) Select "SGMA-GUI > Instrument Name > Reference Oscillator > Source > Int".
2. In the "Reference Oscillator" dialog, set the "REF/LO Out > REF".

   The "Output Frequency" can be configured to either 10 MHz or 1 GHz.

   The instrument uses the internal reference signal. The REF EXT LED at the front panel of the instrument is off.

To output the reference frequency (internal or external) at the REF/LO OUT connector of the instrument, select "Reference Oscillator > REF/LO Output > REF".

To use an external reference frequency source

To improve measurement accuracy, it is advisable to provide an external reference frequency to all the instruments in the test setup or to distribute the internal reference signal of the signal generator to the remaining instruments.

1. Provide the signal of an external reference frequency source to the REF/LO IN connector of the instrument.
2. To enable the instrument to use the external reference frequency source, perform one of the following:
   a) Select "SGMA-GUI main panel > REF > Ext Ref On ".
   b) Select "SGMA-GUI > Instrument Name > Reference Oscillator > Source > Ext".

3. In the "Reference Oscillator" dialog, set the parameter "Ext. Ref. Input Frequency" to the value of the fed external reference frequency.

   Now, the instrument uses an external reference signal. The green REF EXT LED at the front panel of the instrument indicates that the instrument is synchronized to the external reference signal.

If the instrument is configured to use an external reference signal but no signal is fed in at the REF/LO IN connector, the REF EXT LED on the front panel of the instrument is red and an error message is displayed in the "Info" line.

9.5 How to Configure the Local Oscillator (LO) Coupling Source

The R&S SGS can use two frequency sources for the carrier frequency (LO signal) of the I/Q modulator, an internal and an external one. The first possibility is to use the output signal of the internal synthesizer. If an external LO signal is provided at the REF/LO IN connector, this signal can alternatively be directly routed to the LO input of the I/Q modulator.

To use an external LO source

1. Provide the signal of an external LO source to the REF/LO IN connector of the instrument.

   Note: The local oscillator input/output requires the additional software option R&S SGS-K90.

2. Select "SGMA-GUI > Instrument Name > Frequency/Phase > LO Coupling Source > Ext".

   Tip: When you select "Source > Ext", the icon LO Scr Ext appears in the R&S SGMA-GUI.

   The signal provided by the external frequency source is directly routed to the input of the I/Q modulator and used as carrier frequency.

To use the internal LO source

► Select "SGMA-GUI > Instrument Name > Frequency/Phase > LO Coupling Source > Int".

   The output signal of the internal synthesizer is used.

9.6 How to Define the Signal at the REF/LO OUT Connector

The reference oscillator and the LO use the same REF/LO IN connector. Hence, it is not possible to use both an external reference source and an external LO source signal at the same time.

The signal at the REF/LO OUT connector also depends on the selected reference oscillator and LO sources. The following table gives an overview of this dependency.

Table 9-1: Selection available at the REF/LO OUT connector depending on the LO and reference oscillator sources

	LO coupling source	
Ref. oscillator source	**Int**	**"Ext"**
"Int"	"OFF/REF/LO"	"OFF/LO"
"Ext"	"OFF/REF/LO"	Combination not possible

To define the signal at the REF/LO OUT connector

1. In the "Frequency / Phase > Local Oscillator (LO) Coupling" dialog, select the "LO Source" as required.
2. In the "Reference Oscillator" dialog, select the "Ref. Oscillator Source" as required.
3. In the "Frequency / Phase > Local Oscillator (LO) Coupling" dialog, set the "REF/LO Output".
   Consider the dependencies, see Table 9-1.

9.7 How to Connect and Configure Instruments for Optimum Phase Coherence

Using the LO input/output connectors, two or more instruments can be coupled to achieve optimum phase coherence between their RF output signals. The first instrument in the chain delivers the LO signal at the REF/LO OUT connector to the REF/LO IN connector of second instrument. If necessary, more instruments can be connected in the same way. The first instrument is set such that the internal synthesizer generates the system LO frequency. In all following instruments, the internal synthesizer is switched off and the LO signal from the REF/LO IN connector drives the I/Q modulator or the CW path.

To connect the instruments

1. Connect the instruments as a daisy chain (see Figure 9-3), i.e. connect the REF/LO IN connector of each further instrument to the REF/LO OUT connector of the previous one.
2. Optionally, provide an external reference signal for the first instrument.

3. Avoid unnecessary cable lengths and branching points.

Refer to Figure 9-3 for an example of how to connect two instruments for achieving phase coherence. The configuration can be extended by further instruments.

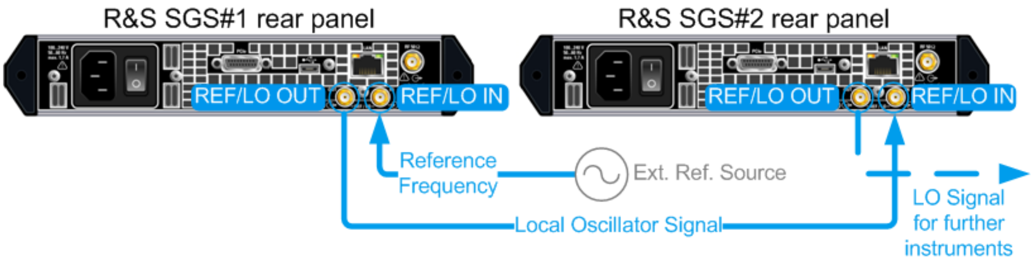


Figure 9-3: Example of a setup: LO coupling

To configure the first instrument in the chain

1. In the "Frequency / Phase > Local Oscillator (LO) Coupling" dialog, select "LO Source > Internal".
2. In the "Frequency / Phase > Local Oscillator (LO) Coupling" dialog, select "REF/LO Output > LO".
3. If an external reference frequency is used, select "SGMA-GUI > Instrument Name > Reference Oscillator > Source > External".

To configure next instruments

1. In the "Frequency / Phase > Local Oscillator (LO) Coupling" dialog, select "LO Source > External".
2. In the "Frequency / Phase > Local Oscillator (LO) Coupling" dialog, select "REF/LO Output > LO".

9.8 How to Restore the LAN Connection to an Instrument

► If the LAN connection to an instrument configured to use a static IP address is lost, press the LAN LED on the instrument's front panel for more than 3 seconds to reset the LAN settings and to set the "Address Mode" on page 133 to DHCP.

Provided the network supports automatic assignment of IP address, new IP address is automatically assigned to the instrument.

9.9 How to Switch between the Operating States

The Figure 9-4 gives an overview of the operating states of the instruments and how to trigger the switch-over between them.

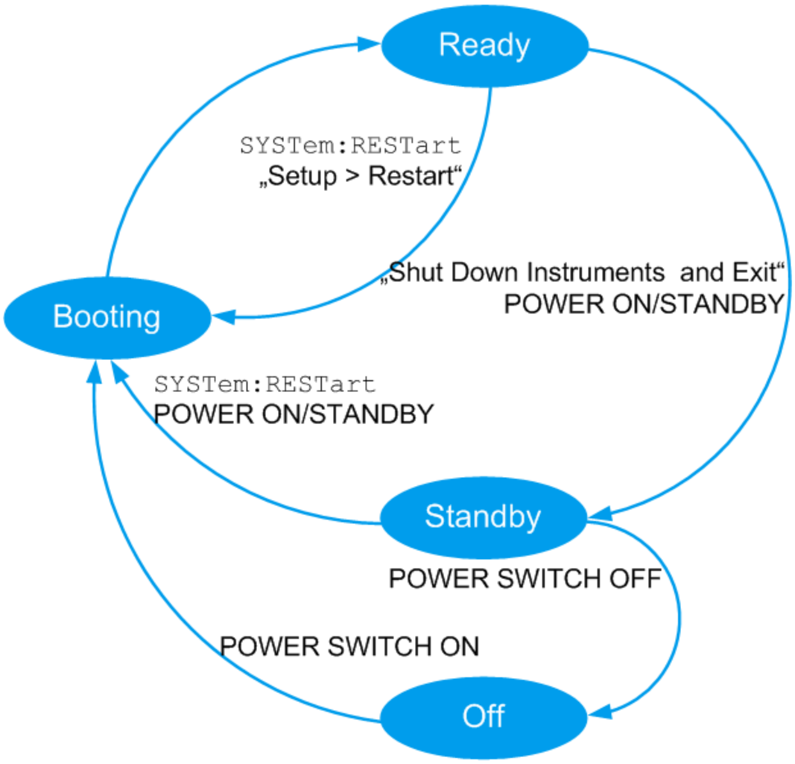


Figure 9-4: Operating states

:RESTart, :STANdby	= SCPI commands
"Setup > Standby", "Setup > Restart", "Shut Down Instruments and Exit"	= R&S SGMA-GUI controls
POWER ON/STANDBY, POWER SWITCH ON/OFF	= Hardkey controls on the front/rear panel of the instrument

The Table 9-2 provides a short description of the operating states and their indication.

Table 9-2: Indication of the operating states

Operating state	Description	Indication
Off	The instrument is shut down.	All LEDs on the front panel of the instrument are off.
Booting	The instrument boots the operating system and starts the instrument firmware. If the previous session was terminated regularly, the instrument uses the last setup with the relevant instrument settings.	The green POWER ON /STAND BY key blinks.

Operating state	Description	Indication
Standby	The standby power mode keeps the power switch circuits and the remote control system active. In this state, it is safe to switch off the AC power and disconnect the instrument from the power supply.	In the R&S SGMA-GUI, the status indicator in front of the instrument name is red. The orange POWER ON /STAND BY key is on.
Ready (normal operation)	The instrument is ready for operation. All modules are power-supplied.	In the R&S SGMA-GUI, the status indicator in front of the instrument name is green. The green POWER ON /STAND BY key is on.

To switch the instrument to standby state

► Use one of the following:

a) On the remote PC, select "SGMA-GUI > Instrument Name > Setup > Standby".
b) Press the POWER ON/STANDBY key on the front panel of the instrument.
c) Send the SCPI command:
`:STANdby`.

The current instruments settings are automatically stored. The instrument switches to a power-saving mode.
In the R&S SGMA-GUI, the standby state is indicated by the red state symbol in front of the corresponding instrument's name, on the front panel, by the orange POWER ON/STANDBY button.
The instrument can still be remote controlled.

To return the instrument from standby to ready state

► Use one of the following:

a) On the remote PC, select "SGMA-GUI > Instrument Name > Setup > Restart".
b) Press the orange POWER ON/STANDBY key on the front panel of the instrument.
c) Send the SCPI command:
`:RESTart`.

The instrument loads the last setup with all instrument settings, switches to ready state and is ready for normal operation.
In the R&S SGMA-GUI, the ready state is indicated by the green state symbol in front of the instrument's name.
On the front panel, the ready state is indicated by the green POWER ON /STAND BY button.

To switch all connected instruments to standby state and close the R&S SGMA-GUI

► In the R&S SGMA-GUI main panel, select "File > Shut down instruments and exit".

The R&S SGMA-GUI quits and switches the connected instruments to standby state.

For description on how to terminate work and shut down the instrument regularly, refer to Chapter 2.1.5, "Switching the Instrument On and Off", on page 17.

9.10 How to Use Computer Names

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

For instruction on how to find out the default computer name, refer to Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 65.

To query and change a computer name

To avoid violations and to make use of the easy identification provided by the computer name, it is recommended to keep the default hostname unchanged.

1. Open "SGMA-GUI > Instrument Name > Setup > Network Settings" dialog.

   The computer name is displayed under "Hostname".

2. Select "SGMA-GUI > Instrument Name > Setup > Protection" and enable the "Protection Level 1".

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

3. Change the "Hostname".

4. Press the POWER ON /STAND BY key to restart the instrument.

   Note: The "Factory Preset" function restores the factory value of the parameter "Hostname".

9.11 How to Optimize Performance

In its (factory) preset state, the instrument uses predefined frequency and level setting designed for best performance. The predefined settings, e.g. the"Level modes" "Auto" and "Normal", ensure that the instrument automatically selects the optimal settings according to the configured RF frequency and level.

However, in some special application cases it might be necessary to choose different settings or to optimize the signal for the particular application. This section describes instructions on how to achieve that.

Restoring the default settings

Use the "R&S SGMA-GUI main panel > Instrument name > Preset" or the "R&S SGMA-GUI main panel > Instrument name > Setup > Factory Preset" function to return the instrument to its predefined state.

For information on how to adjust the quality characteristics of the RF output signal, i.e. to optimize the quality characteristics of RF output signal, refer to Chapter 7.5, "Level and Power-On Settings", on page 82.

For information on how to adjust the reference oscillator, e.g. to allow the frequency of the internal reference oscillator to be impaired, refer to Chapter 7.4, "Reference Oscillator", on page 79.

9.12 How to Install a New Firmware Version on the Instrument

You can update the firmware of the R&S SGS .

Firmware installation through the R&S SGMA-GUI

If an update to a new firmware version is required for both the R&S SGMA-GUI and the instrument, it is mandatory that the new instrument's firmware is installed before the update of the R&S SGMA-GUI to the new version.

1. Select "SGMA-GUI main panel > Instrument Name > Setup > Maintenance > Operation > Install firmware package".
2. Press "Select Package" and navigate to the directory the new firmware is stored in.
3. If several instruments have to be updated to new firmware version, enable the feature "Update All " to accelerate the update process.

   All instruments that are in active state and are connected to this controller are updated simultaneously.
4. Enter the "Security Password".
5. Confirm the update with "Accept".

   The software transfers the firmware file and automatically starts the update procedure. During the update, the message "Updating Firmware" is displayed in the "Info" line. The update process is indicated by an LED running light.

   Note: The update procedure requires a restart of the instrument. The restart is performed automatically. The instrument is not accessible during that time.
6. Wait until the message "Updating Firmware" disappears and the update is completed.

   The green POWER ON /STAND BY LED is on.

Tip: Calibration error. If the "Info" line shows the message "Calibration Error", select "SGMA-GUI main panel > Instrument Name > Setup > Internal Adjustments > Adjust All" to trigger internal adjustment.

7. If necessary, install the new R&S SGMA-GUI.
   For detailed description, refer to Chapter 2.3.1, "Installing the R&S SGMA-GUI Software on an External PC", on page 21
8. If the instrument and the controller/PC are connected over the PCIe interface and the external PC does not support hot-plugging, restart the external PC.

Firmware update through a session control protocol (SCP)

If an update to a new firmware version is required for both the R&S SGMA-GUI and the instrument, it is mandatory that the new instrument's firmware is installed before the update of the R&S SGMA-GUI to the new version.

1. Connect the R&S SGS and a Windows PC to the same network.
2. On the PC, open a windows explorer window.
3. To connect to the R&S SGS, enter the name of the instrument or its IP address in the windows taskbar.
4. Enter the user name and password to connect to the R&S SGS. The default user name is *instrument* and the password is *instrument*.
   A folder opens, containing the `share` and the `update` folder.
5. Open the `update` folder and copy the new firmware update file in it.
   The update starts automatically.

Unsuccessful or erroneous firmware update

An erroneous or unsuccessful installation of firmware update package is indicated by a combination of one orange and red LEDs on the front panel.

Refer to the service manual for a description of the displayed error code or contact the customer support center.

9.13 How to Activate Options

A firmware update before the activation of the SW option may be required.

Refer to the description of the SW option for the required firmware version.

See also Chapter 9.12, "How to Install a New Firmware Version on the Instrument", on page 152 for instruction on how to update the firmware version.

1. Select "SGMA-GUI main panel > Instrument Name > Setup > Install SW-Options".
2. Select "Option Key" and enter the key code delivered with the new option.

   The new option is now enabled and ready for operation.

9.14 How to Manually Set a PCIe Direct Connection between an R&S SGS and an R&S SGU

To build a direct PCIe connection between an R&S SGU and an R&S SGS, which has a "Controller > Revision" < 5, first you have to set the correct PCIe interface mode manually. If your R&S SGS has a "Controller > Revision" 5 or higher, these settings are done automatically.

You can check the "Controller > Revision" of your instrument in the "SGMA-GUI > Instrument Name > Hardware Config" dialog.

Toset a PCIe direct connection between an R&S SGS and an R&S SGU manually

1. Connect the R&S SGS and the R&S SGU directly using a PCIe cable. Refer to Chapter 10.3.4, "Connecting the Controller and the Instrument", on page 169 for cable requirements and setup information.
2. Switch on the R&S SGS and the R&S SGU.
3. Select "SGMA-GUI main panel > Instrument Name > Setup > Maintainance".
4. Select "Operation > PCIe Interface Mode".
5. Select "PCIe Interface Mode > Root Complex".
6. Restart your instrument for the changes to take place.

   The PCIe connection between the R&S SGS and the R&S SGU is established and the instruments can be used.

10 Network and Remote Control Operation

As an alternative to operating the R&S SGS interactively via the R&S SGMA-GUI, one can also control the R&S SGS using programmed commands from a remote PC.

The description in this section requires basic knowledge of the remote control operation. Definitions specified in the SCPI standard are not provided.

Nevertheless, you can find some basic information to the SCPI syntax, command lists, and general programming recommendations in Chapter A, "Remote Control Basics", on page 281. In addition, this chapter provides information on the status reporting system of the instrument.

10.1 Remote Control Interfaces and Protocols

The instrument supports several interfaces for remote control. The following table gives an overview.

Table 10-1: 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]`
	• **VXI-11**
	`TCPIP::host address::inst0[::INSTR]`
	Library: VISA
	• **socket communication** (Raw Ethernet, simple Telnet)
	`TCPIP::host address[::LAN device name]::<port>::SOCKET`
	Library: VISA or socket controller
		A LAN connector is located on the rear panel of the instrument.
		The interface is based on TCP/IP and supports various protocols.
		For details, see Chapter 10.1.2, "LAN Interface", on page 158

USB	**USBTMC** `USB::<vendor ID>::<product ID>::<serial number>[::INSTR]` Library: VISA	A USB connector is located on the rear panel of the instrument. For details, see Chapter 10.1.3, "USB Interface", on page 161
PCIe	**Proprietary** `PCIe::<vendor ID>::<product ID>::<serial number>[::INSTR]` Library: pcie controller	A PCIe connector is located on the rear panel of the instrument. For details, see Chapter 10.1.4, "PCI Express Interface", on page 162
GPIB (IEC/IEEE Bus Interface)	– • `GPIB::<address>[::INSTR]` (no secondary address) VISA	The instrument is not equipped with GPIB bus interfaces. Use a GPIB-to-LAN or GPIB-to-USB adapter instead. For details, see Chapter 10.1.5, "GPIB Interface (IEC/IEEE Bus Interface)", on page 163

*) VISA is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is a prerequisite

for remote control over LAN (when using VXI-11 or HiSLIP protocol) or USB. However, no VISA installation is necessary for remote control while using socket communication. For more information about VISA, refer to the user documentation.

Rohde & Schwarz provides the standardized I/O software library R&S VISA for communication via TCP/IP (LAN: HiSLIP, VXI-11 and raw socket) or USB (USBTMC) interfaces.

R&S VISA is available for download at the Rohde & Schwarz website http://www.rohde-schwarz.com/rsvisa.

SCPI (Standard Commands for Programmable Instruments)

SCPI commands are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

10.1.1 Remote Control Programs and Libraries

The Figure 10-1 provides a schematic illustration of the remote control capabilities of the instrument.

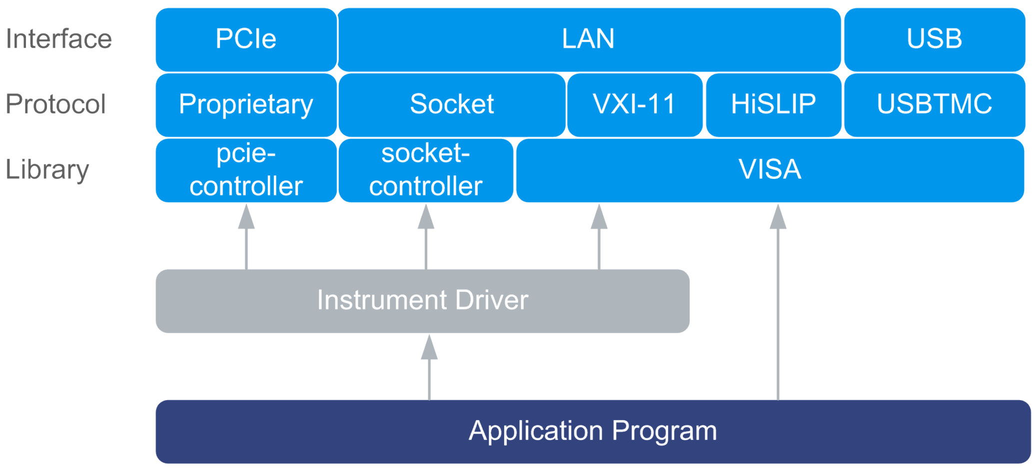


Figure 10-1: Remote control interfaces, protocols and libraries

The following examples give an overview of the dependencies between the available libraries, the possible interfaces and protocols, and whether an instrument driver is provided. The involved parts are **highlighted**.

- Remote control program using VISA

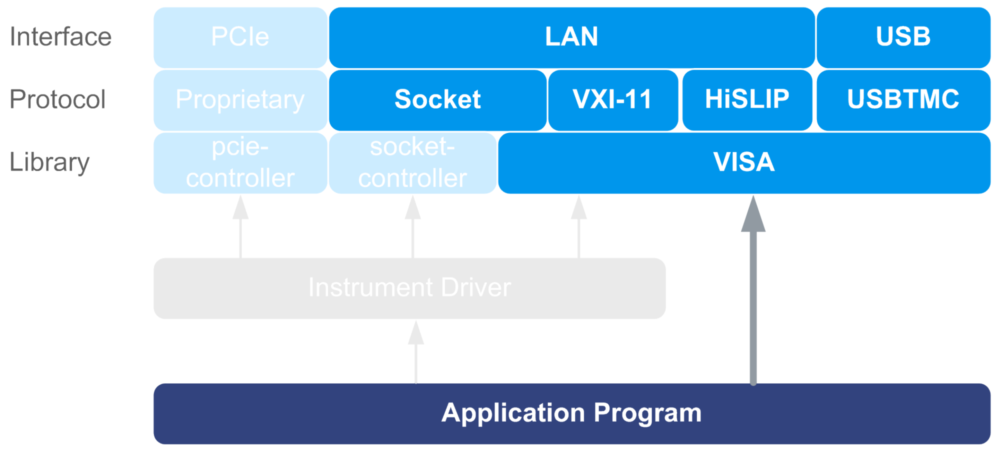


Figure 10-2: Remote control program using VISA

Protocol	Remote control program
Socket	`viOpen (..., "TCPIP:rssgs100a100010::5025::SOCKET", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
VXI-11	`viOpen (..., "TCPIP:rssgs100a100010::inst0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
HiSLIP	`viOpen (..., "TCPIP:rssgs100a100010::hislip0::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`
USBTMC	`viOpen (..., "USB::0x0aad::0x0088::1000010::INSTR", ...)` `viPrintf (..., "SOUR:FREQ 2GHz\n")`

- Remote control program using instrument driver (VISA available)

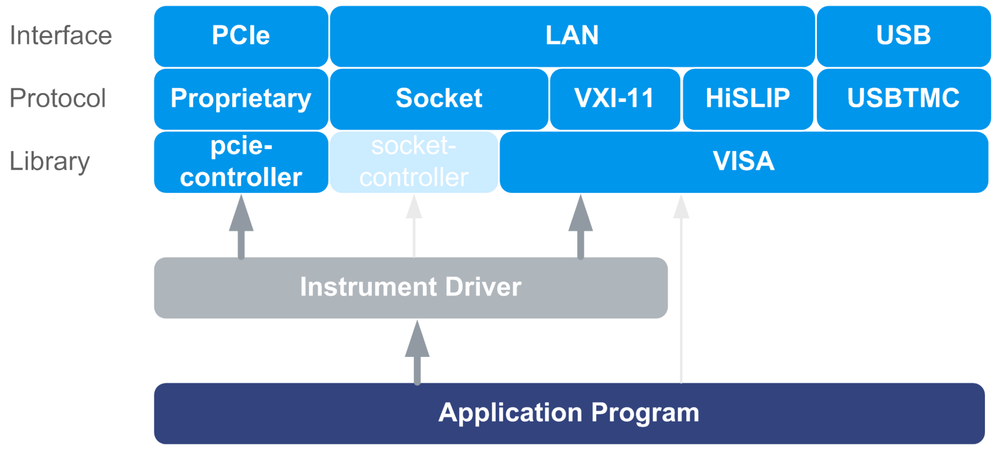


Figure 10-3: Remote control program using instrument driver (VISA available)

Protocol	Remote control program
Socket	`rssgs_init ("TCPIP:rssgs100a100010::5025::SOCKET", ...)` `rssgs_SetFrequency (..., 2e9)`
VXI-11	`rssgs_init ("TCPIP:rssgs100a100010::inst0::INSTR", ...)` `rssgs_SetFrequency (..., 2e9)`
HiSLIP	`rssgs_init ("TCPIP:rssgs100a100010::hislip0::INSTR", ...)` `rssgs_SetFrequency (..., 2e9)`
USBTMC	`rssgs_init ("USB::0x0aad::0x0088::1000010::INSTR", ...)` `rssgs_SetFrequency (..., 2e9)`
PCIe	`rssgs_init ("PCIe::0x162f::0x132e::1000010::INSTR", ...)` `rssgs_SetFrequency (..., 2e9)`

- Remote control program using instrument driver (VISA not available)

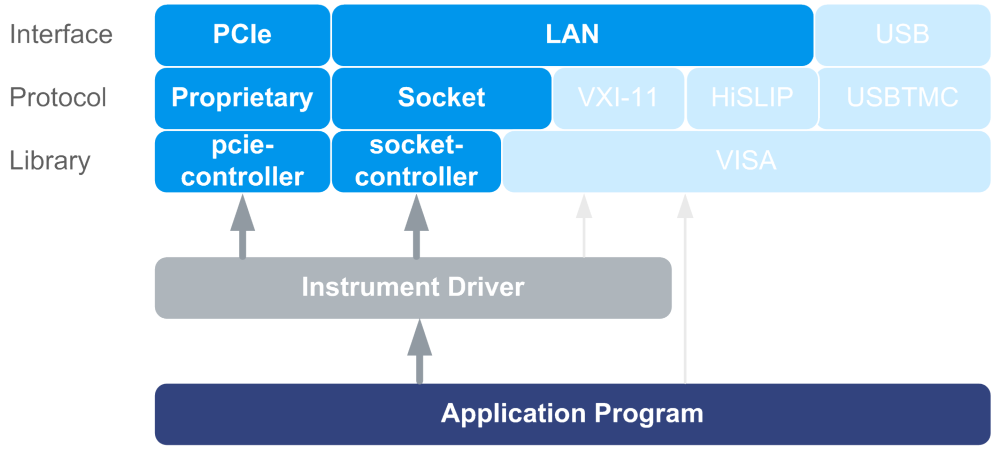


Figure 10-4: Remote control program using instrument driver (VISA not available)

Protocol	Remote control program
Socket	`rssgs_init ("TCPIP:rssgs100a100010::5025::SOCKET", ...)` `rssgs_SetFrequency (..., 2e9)`
PCIe	`rssgs_init ("PCIe::0x162f::0x132e::1000010::INSTR", ...)` `rssgs_SetFrequency (..., 2e9)`

10.1.2 LAN Interface

To be integrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols.

For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol. They are connected using a RJ45 cable (shielded or unshielded twisted-pair category 5). 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.

10.1.2.1 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 used
- **host address** is the IP address or host name of the device
  See also Chapter 6.4.3, "Finding Out the Default Hostname of the Instrument", on page 65.
- **[::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**.

You can find the IP address in the "SGMA-GUI > Instrument Name > Setup > Remote" dialog, and also adjust it manually, if necessary.

See below 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 10.1.2.2, "HiSLIP Protocol", on page 160.

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 10.1.2.3, "VXI-11 Protocol", on page 161

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 10.1.2.4, "Socket Communication", on page 161.

Example:

- Instrument has the IP address *10.113.11.91*; the valid resource string using VXI-11 protocol is:
  `TCPIP::10.113.11.91::INSTR`
- The DNS host name is *rssgs100a100021*; the valid resource string is:
  `TCPIP::rssgs100a100021::hislip0` (HiSLIP)
  `TCPIP::rssgs100a100021::inst0` (VXI-11)
- A raw socket connection can be established using:
  `TCPIP::10.113.11.91::5025::SOCKET`

10.1.2.2 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

10.1.2.3 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.

10.1.2.4 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 require a VISA installation on the remote controller side.

The simplest way to establish socket communication is to use the built-in telnet program. The telnet program is part of every operating system and supports communication with the software on a command-by-command basis.

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 instruments 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 running on a connected PC.

10.1.3 USB Interface

For remote control via USB connection, the PC and the instrument must be connected via the USB 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.

USB resource string

The syntax of the used USB resource string is:
`USB::<vendor ID>::<product ID>::<serial number>[::INSTR]`, where:

- **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)

You can retrieve the USB resource string from the "SGMA-GUI > Instrument Name > Setup > Remote" dialog.

Example:

`USB::0x0AAD::0x0088::100021::INSTR`

0x0AAD is the vendor ID for Rohde&Schwarz

0x0088 is the product ID for the R&S SGS

100021 is the serial number of the particular instrument

10.1.4 PCI Express Interface

A PCI Express (PCIe) connector is provided on the rear panel of the instrument.

Refer to Chapter 10.3, "Advanced Remote Control Using PCIe", on page 165 for a description of how to set up a remote control connection via PCIe and the permitted cables.

Via PCI Express some commands can be sent to the instrument with optimized speed (memory-mapped remote control), e.g. frequency or level settings. This allows minimum setup time.

PCIe resource string

The syntax of the used PCIe resource string is:
`PCIe::<vendor ID>::<product ID>::<serial number>[::INSTR]`, where:

- **PCIe** 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)

You can retrieve the PCIe resource string from the "SGMA-GUI > Instrument Name > Setup > Remote" dialog.

Example:

`PCIe::0x162f::0x132e::100021::INSTR`

0x162f is the vendor ID for Rohde&Schwarz

0x132e is the product ID for the R&S SGS

100021 is the serial number of the particular instrument

10.1.5 GPIB Interface (IEC/IEEE Bus Interface)

The R&S SGS is not equipped with an IEC/IEEE bus interface.

To be able to control the instrument via the GPIB bus:

1. Connect a GPIB-to-LAN or a GPIB-to-USB adapter to the instrument.
2. Use a GPIB bus cable to connect the instrument and the controller.
3. Provide the GPIB bus card, the card drivers and the program libraries for the programming language in the controller.
4. In the "SGMA-GUI > Setup > Instruments > instrument name > Remote Control", set the "GPIB Address".
   See "GPIB Address" on page 54.
5. If the controller is equipped with several GPIB bus cards, define the used "Board Number".

GPIB address

The controller must address the instrument with the GPIB bus channel. GPIB provides channel addresses from 0 to 30.

The GPIB resource string is `GPIB::<address>[::INSTR]`, where:

- **GPIB** denotes the used interface
- **<address>** indicates 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.

Any connected IEC bus cable must be terminated by an instrument or controller.

10.2 Starting a Remote Control Session

The instrument and the controller have to be connected with a 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.

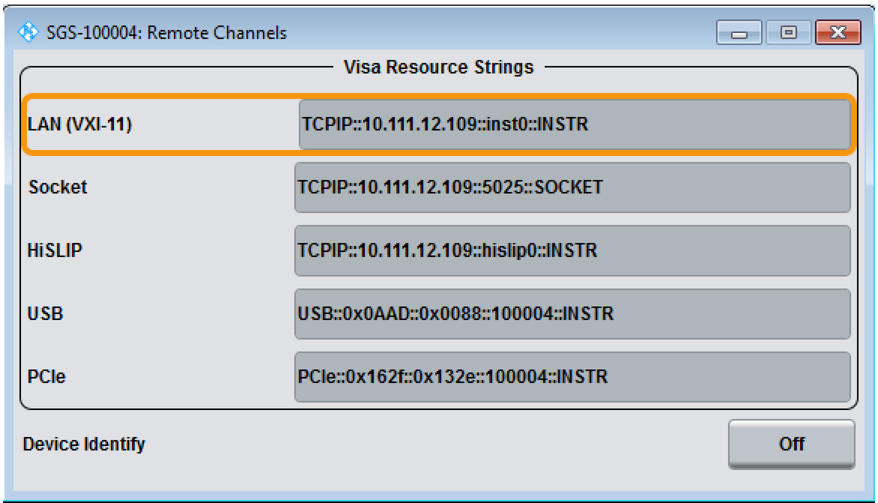
See Chapter 10.1.2, "LAN Interface", on page 158, Chapter 10.1.3, "USB Interface", on page 161 or Chapter 10.1.4, "PCI Express Interface", on page 162 for details.

The VISA resource strings are indicated in the "SGMA-GUI main panel > Instrument name > Setup > Remote Channels" dialog.

10.2.1 How to Find the VISA Resource String

To find the VISA resource strings of your instrument:

► Select "SGMA-GUI main panel > Instrument name > Setup > Remote Channels".



The "Remote Channel Settings" dialog shows all specified resource strings of the supported remote control interfaces.

10.2.2 Example: Remote Control over LAN Using Socket Communication

This section provides an example on how to establish a remote control connection over telnet protocol and a simple sockets-based program example that can be further developed (see also Chapter B, "Telnet program examples", on page 303).

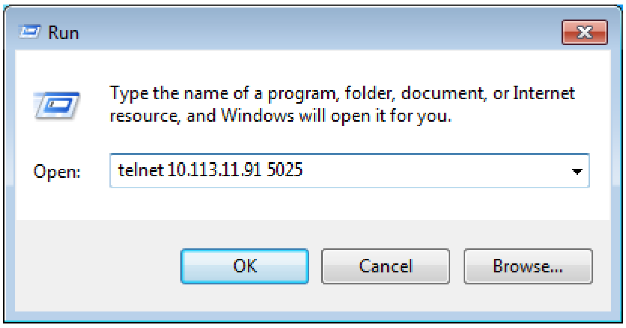
Basic knowledge of programming and operation of the controller are assumed. A description of the interface commands can be obtained from the relevant manuals.

Refer to the getting started manual for an example on how to set up remote control connection over LAN using VXI-11 protocol.

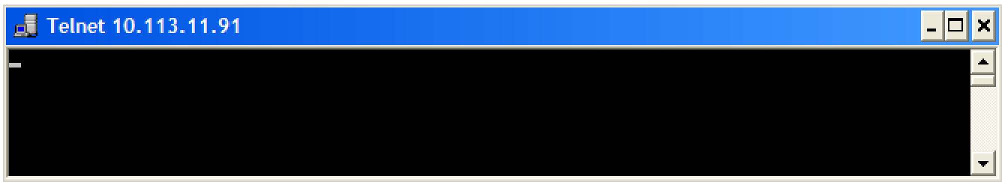
To set up a Telnet connection

To control the software, only a telnet program is required. The telnet program is part of every operating system.

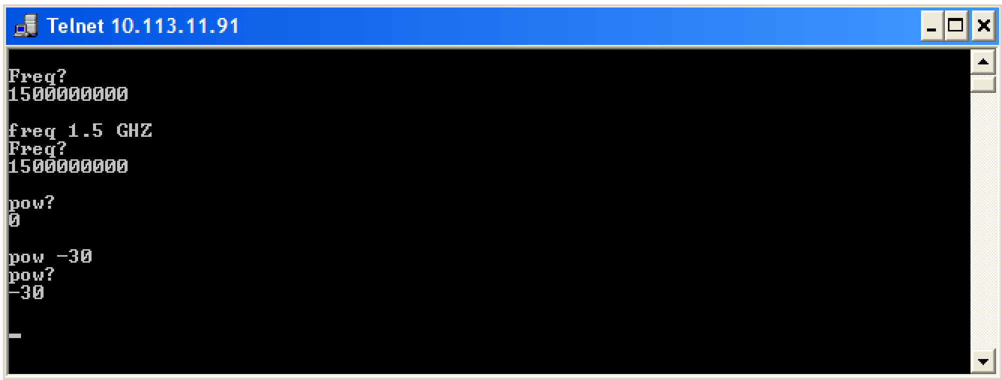
1. To establish a Telnet connection with the R&S SGS, start the telnet program. Enter the socket address.
   The socket address is a combination of the IP address or the host name of the R&S SGS and the number of the port configured for remote-control via telnet.
   Tip: The R&S SGS uses the port number 5025 for remote connection via Telnet.



   The connection to the instrument is set up and remote-control commands can be sent.



2. Even if the cursor is not visible on the screen, enter blind a remote-control command and confirm with Enter.



10.3 Advanced Remote Control Using PCIe

The PCIe bus is a high-speed serial bus, composed of point-to-point serial links. A pair of serial links, one transmitting and one receiving link, make up a lane.

Fast settings

The PCIe interface can be utilized not only to transfer text messages e.g. SCPI commands but also to carry register based remote control messages. The latter mode is called fast settings mode. The specially for this purpose provided instrument's driver is mandatory for the instrument control with fast settings. This instrument driver contains special functions for fast setup.

To use the advantage of the fast settings, the following prerequisites must be fulfilled:

- Using the PCIe interface is mandatory (see also Chapter 10.3.1, "Setting Up a Remote Control Connection via PCIe", on page 166)
- The fast settings must be enabled with the function `rssgs_useFastSettings` (see also Chapter 10.3.5, "Enabling Fast Settings", on page 170).

The instrument driver automatically uses the fast settings method whenever possible - currently only for the parameters frequency, level, RF state, modulator state - and sends SCPI messages in all other cases.

Remote control programs written for PCIe will, without modifications, also run if one of the other control channels, LAN or USB is used.

10.3.1 Setting Up a Remote Control Connection via PCIe

To set up a remote control connection vie PCIe, perform the following steps:

1. Download the drivers, see 10.3.2.
2. Configure the controller, see 10.3.3
3. Connect the controller and the instrument, see 10.3.4
4. Enable fast settings, see 10.3.5.

10.3.2 Download the Drivers

All required driver files are available for download on the product page at:

http://www.rohde-schwarz.com/product/SGS100A.html > "Downloads" > "Drivers"

Provided are the following files:

- `LabWindows/CVI, Linux/OSX driver rssgs` (`InstrumentDriver`)
  `C` source code files which provide a functional application programming interface (API) to R&S SGS instruments. Required if you want to control an instrument via PCIe.
- `Low-Level SGS drivers`
  Archive file that contains the following:
  – `KernelDriver`

`C` source code files from which you can build a Linux kernel mode driver for the R&S SGS PCIe remote control interface.

  – `SgsDriverDemo`
    `C` source code module for a demo program using the instrument driver API.
  – `SharedLibraries-Dlls`
    Shared libraries (Dlls) for remote control channels Socket and PCIe. To be used with the instrument driver.
- `VXIplug&play x64/x86 driver rssgs`

Download the required archive and extract the files on a remote PC.

10.3.3 Configuring the Controller

This section lists the steps necessary to configure a controller with Linux or Windows operating system.

10.3.3.1 Building and Installing the Hardware Driver

The hardware driver defines the way to communicate with the instrument via PCIe interface.

For Windows operating systems, the hardware driver is installed automatically together with the installation of the R&S SGMA-GUI software.

See also section "Installation of R&S SGMA-GUI Software" in the getting started manual.

For Linux operating system, the source code of the driver is included in the `Low-Level SGS drivers` file.

To build and install this driver, root authority is required.

1. Copy folder `KernelDriver` to your `hdd`
2. Go to directory `host`.
3. On the command line, enter `make`.

   The driver `sgshost.ko` is automatically built.
4. Enter `make install`.

   Device nodes `sgsX` are created under the folder `/dev` (X from 0 to 31).
   The module `sgshost` is loaded.
5. Enter `lsmod` to verify the module.

10.3.3.2 Making Shared Libraries Accessible

Two library files per operating system are included in `SharedLibraries-Dlls` file:

- For Linux operating system
  `libsocketcontroller.so` and `libpciecontroller.so`
- For Windows operating system
  `SocketController.dll` and `PCIeController.dll`

These libraries act as the dynamic link libraries for programs using the socket or PCIe interface.

Linux operating system

► To make the libraries accessible, perform one of the following:

a) Append the environment variable LD_LIBRARY_PATH with the path of these two files e.g. by changing the `/etc/environment` file.
b) Move these two files to `/usr/lib` or `/lib` directory.

Windows operating system

► To make the libraries accessible, perform one of the following:

a) Copy these two files to the folder of your executable.
b) Copy these two files to the `WINDOWS\system32` folder.

10.3.3.3 Building a Program

The help file `rssgs_vxi.chm` shows all functions of the instrument which you can use in your own remote control program.

An example file is provided (`SgsDriverDemo.c`), too.

Building the example program (Linux)

1. Copy folders `InstrumentDriver` and `SgsDriverDemo` to your hard disk.
2. Go to folder `Build`
3. On the command line, enter `cmake ..`
4. Enter `make`

   Folder `Build` contains the executable `SgsDriverDemo`.

Building the example program (Windows)

1. Copy folders `InstrumentDriver` and `SgsDriverDemo` to your hard disk.
2. Open `SgsDriverDemo.vcproj` with Visual Studio.
3. Build the program.

Running the example program

► On the command line, enter `./SgsDriverDemo RESOURCESTRING [cmd]`.

Where

- `RESOURCESTRING` is the (VISA) resource string of your instrument, e.g. `TCPIP::ipaddress::5025::SOCKET` or `PCIE::0x162f::0x132e::serialno::INSTR`.
  Where `ipaddress` is the IP address or hostname of your instrument and `serialno` is its serial number.
- `cmd` is an optional command (see table).

The following table list the available commands.

Command	Description
`?`	Usage
`q`	Quit
`f` value	Set frequency
`f?`	Query frequency
`l` value	Set level
`l?`	Query level
`r` value	Set RF state (value = `0 | 1 | ON | OFF`)
`r?`	Query RF state

If you enter an additional optional command, `SgsDriverDemo` executes it and enters a loop waiting for further commands.

Example:

`TCPIP::10.111.11.44::5025::SOCKET ?`

Lists the available commands.

10.3.4 Connecting the Controller and the Instrument

A PCIe connector is provided on the rear panel of the instrument.

NOTICE

Risk of device failure

The R&S SGS is equipped with a single lane PCIe interface that supports hot plugging.

Do not connect an external PC to the PCIe connector of the instrument during operation if this external PC does not support hot-plugging!

Permitted PCIe cables

PCIe extension cables must fulfill the following requirements:

- **Single lane connectors**
- **Max. cable length of 5 m.**

For example: OSS-PCIe-CBL-x1 cable from One Stop Systems or 74576-000x cable from Molex.

Connecting an external PC that does not support hot-plugging

1. Switch off the external PC and the instrument.
   See also Chapter 2.1.5, "Switching the Instrument On and Off", on page 17.
2. Connect the instrument and the controller with the suitable cable.
3. Switch on the instrument.
4. Wait until the instrument has completed the booting (the "POWER" LED on the instrument's front panel is constantly on).
5. Switch on the external PC.

10.3.5 Enabling Fast Settings

► To enable the special PCI express feature fast settings, enable the function `rssgs_UseFastSettings (ViSession instrumentHandle, ViBoolean fastEnabled, ViBoolean asynchronousEnabled)` included in the instrument driver.

Settings for some parameters like level and frequency accelerate.

To disable the fast settings, call the function `rssgs_UseFastSettings` with argument `fastEnabled=false`.

10.4 Advanced Remote Control Using Fast Socket

Fast settings

The socket interface can be utilized not only to transfer text messages e.g. SCPI commands but also to carry register based remote control messages. The latter mode is called fast settings mode. The fast socket communication is based on the Ethernet protocol which does not support routing. Therefore a controller PC can only control devices within its own network segment using the fast socket method.

To use the advantage of the fast settings, the following prerequisites must be fulfilled:

- On Windows operating systems, the fast socket driver must be installed.
- The application program must be run with root/administrator rights.
- The fast settings must be enabled with the function `rssgs_useFastSettings` (see also Chapter 10.3.5, "Enabling Fast Settings", on page 170).

The instrument driver uses the fast settings method whenever possible, currently for the parameters frequency, level, RF state, I/Q modulator state, IQ wideband state. In all other cases, SCPI messages are sent.

10.4.1 Setting Up a Remote Control Connection via Fast Socket

Download the required archive and extract the files on a remote PC, as described in Chapter 10.3.2, "Download the Drivers", on page 166.

Windows operating systems

To set up a remote control connection via fast socket for Windows operating systems, perform the following steps:

1. Connect the controller and the instrument, see Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22.
2. Install the protocol driver to the controller, see Chapter 10.4.2, "Installing the Protocol Driver", on page 172.
3. On the controller start the driver by using one of the following:
   a) Start the Windows console user interface as an administrator.
   Excute the command `net start SGMANDISPROT`.
   b) Use a program for opening the driver.
   See for example the example file `SgsDriverDemo.c`.
4. Start the application with administrator rights.
5. Enable fast settings, see Chapter 10.4.3, "Enabling Fast Settings", on page 172.

Linux operating systems

To set up a remote control connection via fast socket for Linux operating systems, perform the following steps:

1. Connect the controller and the instrument, see Chapter 2.3.2, "Connecting a Remote PC via LAN", on page 22.
2. Start the application as root.
3. Enable fast settings, see Chapter 10.4.3, "Enabling Fast Settings", on page 172.

10.4.2 Installing the Protocol Driver

The protocol driver defines the way to communicate with the instrument via the LAN fast socket interface.

For Linux operating system, no special driver is needed.

For Windows operating systems, the `SGMANDISPROT` driver is required. The protocol driver is installed automatically together with the installation of the R&S SGMA-GUI software. It is also provided in the `Low-Level SGS drivers` file.

To install the driver manually on a Windows operating system:

1. Open "Control Panel > Network and Sharing Center".
2. Select the network adapter on which you want to install the driver and click it.
   The "Local Area Connection Status" dialog opens.
3. Click "Properties" to open the "Local Area Connection Properties" dialog.
4. Click "Install" to open the "Select Network Feature Type" dialog.
5. Select "Protocol" and select "Add".
6. In the "Select Network Protocol" dialog, select "Have Disk".
   Navigate to the directory where the driver is saved and click "OK" to install the driver.

10.4.3 Enabling Fast Settings

► To enable the fast settings for the fast socket, call function `rssgs_UseFastSettings (ViSession instrumentHandle, ViBoolean fastEnabled, ViBoolean asynchronousEnabled)` included in the instrument driver.

  Settings for some parameters like level and frequency accelerate.

To disable the fast settings, call the function `rssgs_UseFastSettings` with argument `fastEnabled=false`.

10.5 LXI Configuration

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.

On the R&S SGS the LXI functionality is already installed and enabled. 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 of the instrument
- Performing SCPI remote diagnostics

10.5.1 Default State of the Network Settings

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

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

The LAN reset also resets the following parameters for the R&S SGS:

Parameter	Value
Hostname	<Instrument-specific host name>
Description	Signal generator
Negotiation	Auto detect
VXI-11 discovery	Enabled

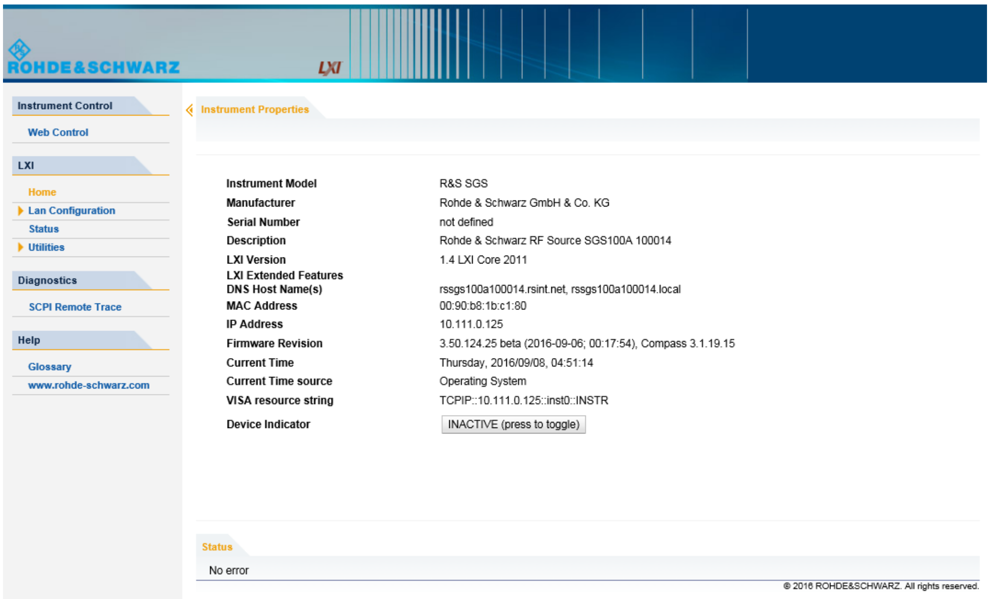
The LAN settings are configured using the instrument's LXI Browser Settings.

10.5.2 LXI Browser Settings

To access the instrument via the web browser:

► Type in the instrument's host name or IP address in the address field of the browser on your PC, for example "http://10.111.0.125".
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 in the browser dialog. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates that no LAN cable is connected.
  - "Lan Configuration" allows you to configure LAN parameters and to initiate a ping, see Chapter 10.5.3, "LAN Configuration", on page 174.
  - "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" opens the R&S SGS Web-GUI for remote access to the instrument, see Chapter 4.2, "Configuring a CW Signal with the R&S SGS100A Web-GUI", on page 33.
- "Diagnostics"
  - "SCPI Remote Trace" records messages exchanged via the remote control interface, see Chapter 10.5.3.4, "SCPI Remote Trace", on page 177.
- "Help"
  - "Glossary" explains terms related to the LXI standard.
  - www.rohde-schwarz.com opens the Rohde & Schwarz home page.

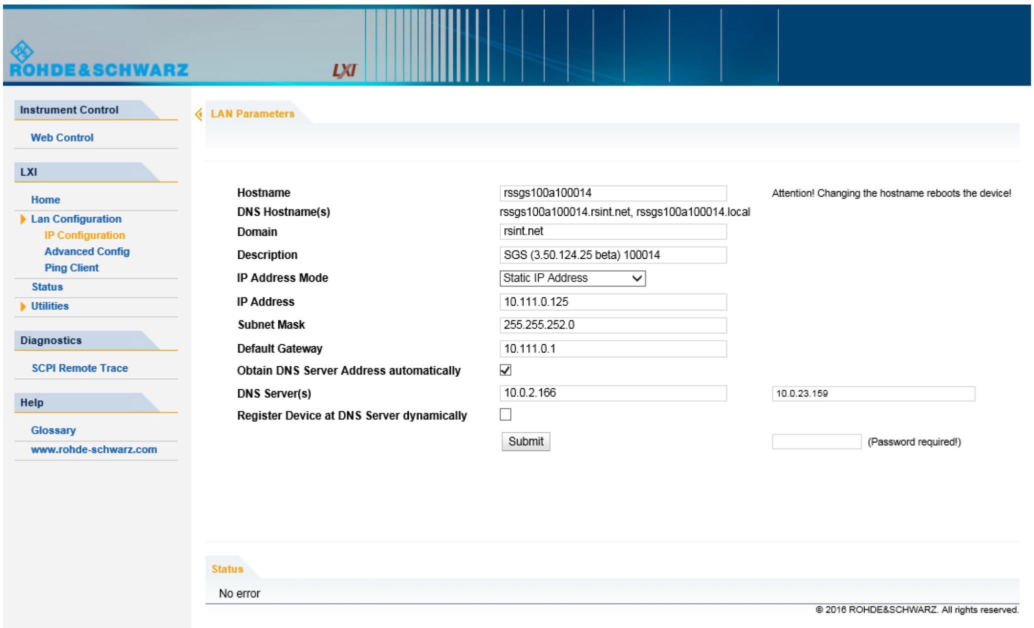
10.5.3 LAN Configuration

The "LAN Configuration" web page displays all mandatory LAN parameters and allows their modification.

It comprises the following navigation entries.

10.5.3.1 IP Configuration

The "IP configuration" web page displays all mandatory LAN parameters and allows their modification.



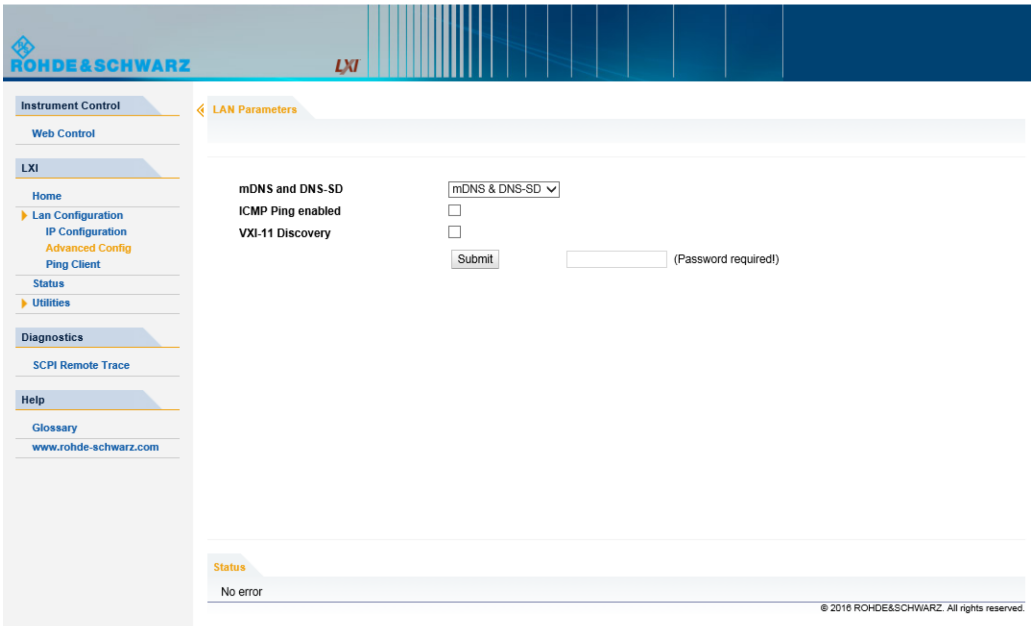
The "IP Address Mode" selects a configuration mode for the IP address of the instrument. With static configuration, the entered IP address, subnet mask, and default gateway are used. With dynamic configuration, DHCP or dynamic link local addressing (automatic IP) are used to obtain the instrument IP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

Password protection

Changing the LAN configuration is password-protected and requires the security password. The default password is "instrument".

10.5.3.2 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.

Password protection

Changing the LAN configuration is password-protected and requires the security password. The default password is "instrument".

10.5.3.3 Ping Client

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

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

To initiate a ping at the instrument:

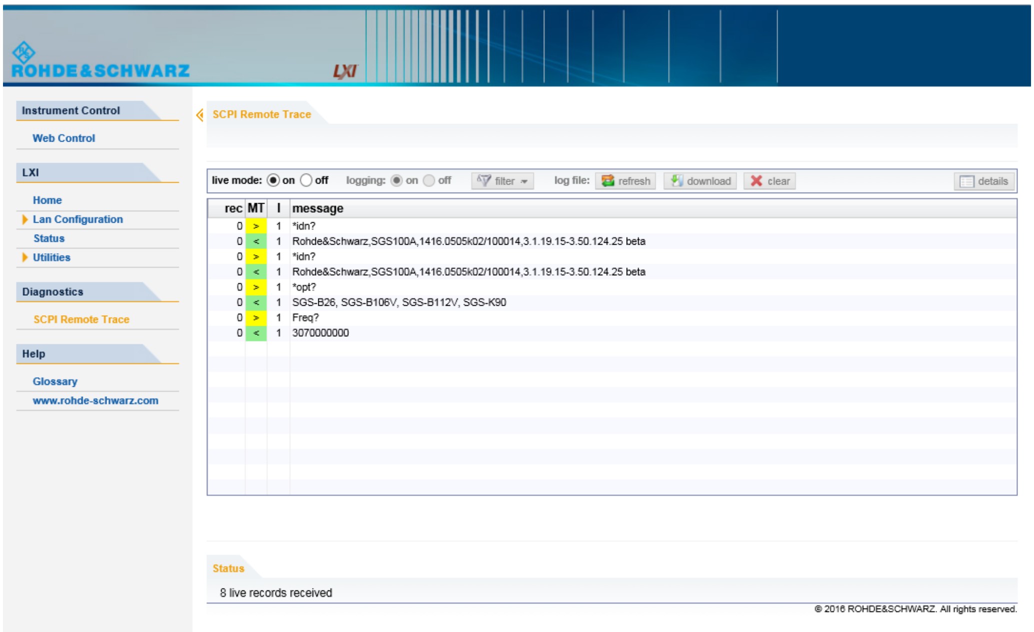
1. On the "Ping Client" page, enter the IP address of the host in the "Destination Address" field (for example 10.111.0.125).
2. Select "Submit".

10.5.3.4 SCPI Remote Trace

The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S SGS, see Chapter 10.5.4, "How to Record SCPI Commands and Messages exchanged via the LXI Web Browser Interface", on page 179.

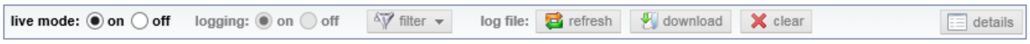
A recorded trace (message log) can be evaluated directly in the dialog. Use the highlighting and navigation functions provided by the lower toolbar to locate error messages and messages containing arbitrary search strings. You can also export the message log to a `*.csv` file and evaluate the file using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

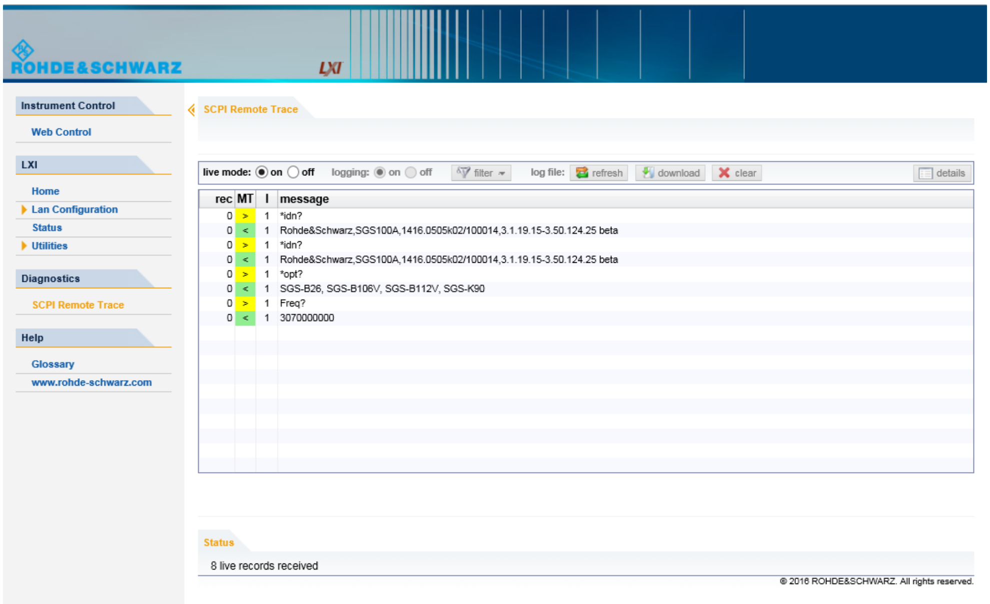
- **I**: number of the subinstrument
- "message": indicates the type of the message. Possible values and related message contents are:
  – > = incoming command
  – < = outgoing response to a query
  – E = error message, denoted in red
  – T = execution time, i.e. time required by the instrument to process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

10.5.4 How to Record 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 SGS.

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 SGS in the browser's address bar.
   The R&S SGS'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 SGS 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 stores them in an internal database. If "live mode" is disabled, you can display the recent traces upon request, using the "refresh" button. You can also store the log in a file.

10.6 Using the R&S SGMA-GUI to Monitor the Remote Control Operation

The R&S SGMA-GUI can be used to monitor the behavior of one or more instruments while they are remote controlled.

A typical configuration consists of one monitor, controllers and instruments. The monitor is the remote PC on which the R&S SGMA-GUI is installed and the controller is the remote PC on which the application program runs.

Simultaneous control of an instrument from a controller and a monitor may lead to collisions whenever both the controller and the monitor utilize the same remote channel. These collisions are indicated by an error message in the "Info" line, e.g. "Query interrupted" or "Resource locked". Simultaneous monitoring and control over the same remote channel is only possible, if the used protocols support `viLock()/viUnlock()` and the remote program use these functions.

The Table 10-2 shows whether a collision-free communication over a particular combination of remote channels is possible or not and if there are any restrictions.

Table 10-2: Cross-reference between used remote channels and collision-free communication

Monitor/ Controller	LAN (VXI-11)	LAN (HiSLIP)	USB	LAN (Socket)	PCIe
LAN (VXI-11)	OK*	OK	OK	OK	OK
LAN (HiSLIP)	OK	OK	OK	OK	OK
USB	OK	OK	`viLock/viUnlock`	OK	OK
LAN (Socket)	OK	OK	OK	X	OK
PCIe	OK	OK	OK	OK	X

Where:

- **OK**: communication possible, no collisions
  *) the R&S SGMA-GUI always uses the LAN device name **instr1**, see also Chapter 10.1.2.3, "VXI-11 Protocol", on page 161.
- **X**: communication is not possible without collisions
- `viLock/viUnlock`: communication is only possible, if the remote control commands are enclosed in a `viLock () - viUnlock()` pair.

The R&S SGMA-GUI uses the `viLock()/viUnlock()` functions.

The figure below shows an example of configuration where the monitor and the controller are two different computers, connected to the same instrument over two different hardware interfaces.

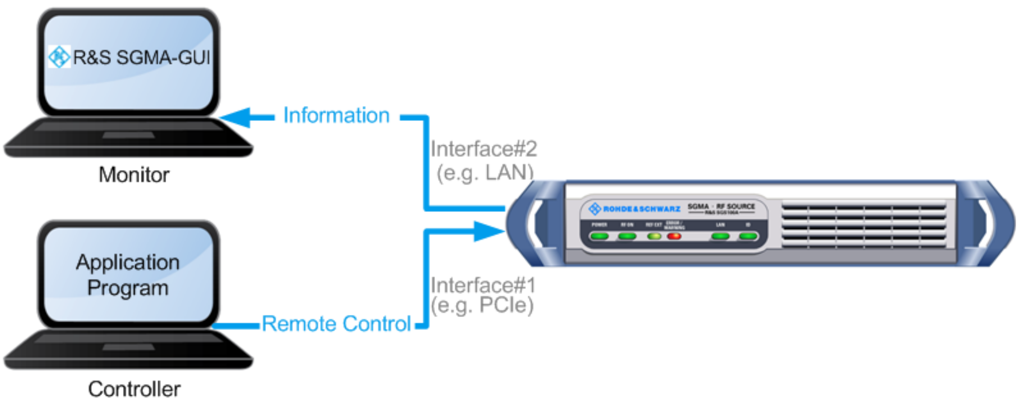


Figure 10-5: Example of a setup for remote control monitoring

Connecting and configuring the monitoring PCs

In the "Setup > Security > Security Settings" dialog, check the state of the LAN and USB interfaces and enable them if necessary.

1. Connect the monitoring PC to the instrument.

   Note: Choose the hardware interface considering the limitations described in Table 10-2.

2. Configure the instrument in the R&S SGMA-GUI, see Chapter 6.4.2, "Handling Instruments in the R&S SGMA-GUI", on page 62.

3. In the "SGMA-GUI > Setup > Instruments > Edit Instruments" dialog, disable "Exclusive Access".

   Note: The two functions "Exclusive Access" and monitoring are mutually exclusive.

4. Send remote control commands from the controller to the instrument.

5. Open the corresponding dialogs in the R&S SGMA-GUI. Observe the status of the parameters.

11 Remote Control Commands

In the following, all remote-control commands will be presented in detail with their parameters and the ranges of numerical values.

For an introduction to remote control and the status registers, refer to Chapter A, "Remote Control Basics", on page 281.

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 SGS follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

11.1 Programming Examples

This chapter provides simple programming examples for the R&S SGS. 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 (e.g. comments) start with two `//` characters.

At the beginning of most remote control program, an instrument (p)reset is recommended to set the R&S SGS to a defined state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

It is also recommended that you lock the instrument for remote control from the selected controller prior to further configuration. Use the `LOCK` command for this purpose.

We assume that the R&S SGS is fully equipped with all available options.

11.1.1 Performing General Task for Instrument Setup

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

```
// ******************************************************************
// Reset instrument first
// ******************************************************************

*RST; *CLS
// :SYSTem:PRESet
// :RESTart
// :SYSTem:FPReset

// ******************************************************************
// Lock the instrument to the controller
// ******************************************************************

:LOCK? 72349234
// Lock instrument to avoid interference by other controllers
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused

// ******************************************************************
// Launch selftest, diagnostic and internal adjustments and retrieve results
// ******************************************************************

:TEST:ALL:STARt?
:TEST:ALL:RESult?
// Response: RUN
// Call :TEST:ALL:RESult? repeatedly until finished (0 or 1 is returned)
```

```
:DIAGnostic:POINt:CATalog?
// Response: D_TEMP_RFB,D_TEMP_CPU,D_TEMP_DBL,...
:DIAGNostic:MEASure:POINt? 'D_TEMP_RFB'

// Calibration functions may take several minutes
// Set timeout values of controller accordingly

:CALibration:ALL:MEASure?
// starts the adjustment of all functions for the entire instrument
// Response: 0 / 1
// i.e. adjustment has been performed successfully / adjustment failed
:CALibration:FREQuency:MEASure?
// starts the adjustment of frequency and level
:CALibration:LEVel:MEASure?
// starts adjustments for maximum level accuracy

// Options R&S SGS-B106V or R&S SGS-B112V required for modulator functions
:CALibration:IQModulator:FULL?
:CALibration:IQModulator:LOCal

// ******************************************************************
// Query the entries in the error queue
// ******************************************************************

:SYSTem:SERRor?
// Query static errors
// :SYSTem:ERRor:CODE:COUNT?
// :SYSTem:ERRor:CODE:NEXT?
// :SYSTem:ERRor:NEXT?
// :STATus:QUEue:NEXT?
// :SYSTem:ERRor:CODE:ALL?
:SYSTem:ERRor:ALL?
// Query error queue

// ******************************************************************
// Query system information
// ******************************************************************

SYSTem:VERSion?


// ******************************************************************
// Activate eco mode
// ******************************************************************
:SYSTem:EMODe EM1

// ******************************************************************
// Query the installed common assemblies and HW options
// ******************************************************************
```

```
:SYSTem:SOFTware:OPTion1:NAME?
:SYSTem:SOFTware:OPTion1:DESignation?
:SYSTem:SOFTware:OPTion1:LICenses?
:SYSTem:SOFTware:OPTion1:EXPiration?

:SYSTem:HARDware:ASSembly1:NAME?
:SYSTem:HARDware:ASSembly1:PNUMber?
:SYSTem:HARDware:ASSembly1:SNUMber?
:SYSTem:HARDware:ASSembly1:REVision?

// *******************************************************************
// Unlock the instrument
// *******************************************************************

:UNL 72349234
```

11.1.2 Generating an I/Q Modulated Signal

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established. An external analog signal is provided at the I and Q connectors of the instrument.

```
// *******************************************************************
// Reset instrument first
// *******************************************************************

*RST; *CLS

// *******************************************************************
// Lock the instrument to the controller
// *******************************************************************

:LOCK? 72349234
// Lock instrument to avoid interference by other controllers
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused

// *******************************************************************
// Select normal operation mode
// *******************************************************************

:SOURce:OPMode NORMal

// *******************************************************************
// Set RF frequency and level
// *******************************************************************
```

```
:SOURce:FREQuency:CW 2 GHz
// :SOURce:PHASe 0
// :SOURce:PHASe:REFerence
:SOURce:POWer -10dBm
:SOURce:POWer:PEP?

// ******************************************************************
// Enable internal reference frequency source
// ******************************************************************

:SOURce:ROSCillator:SOURce INTernal

// ******************************************************************
// Enable internal LO source
// ******************************************************************

:SOURce:LOSCillator:SOURce INT

// ******************************************************************
// Define and enable impairments
// Enable modulation
// ******************************************************************

:SOURce:IQ:IMPairment:LEAKage:I -1
:SOURce:IQ:IMPairment:LEAKage:Q 1
:SOURce:IQ:IMPairment:IQRatio:MAGNitude 1
// Sets the gain imbalance to 1 %
:SOURce:IQ:IMPairment:IQRatio:MAGNitude?
// Response: 0.087 dB
:SOURce:IQ:IMPairment:QUADrature:ANGLe 2
:SOURce:IQ:WBSTate ON
:SOURce:IQ:CREStfactor 0.05

:SOURce:IQ:IMPairment:STATe ON
:SOURce:IQ:STATe ON

// ******************************************************************
// Enable output of the generated signal at the RF connector
// ******************************************************************

:OUTPut:STATe ON

// ******************************************************************
// Unlock the instrument
// ******************************************************************

:UNL 72349234
```

11.1.3 Adjusting Network and Remote Channel Settings

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

```
// *******************************************************************
// Reset instrument first
// *******************************************************************

*RST; *CLS

// *******************************************************************
// Lock the instrument to the controller
// *******************************************************************

:LOCK? 72349234
// Lock instrument to avoid interference by other controllers
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused

// *******************************************************************
// Query the VISA resource strings
// *******************************************************************

:SYSTem:COMMunicate:NETWork:RESource?
// Response: TCPIP::10.113.11.91::INSTR
:SYSTem:COMMunicate:SOCKet:RESource?
// Response: TCPIP:rssgs100a100021::5025::SOCKET
:SYSTem:COMMunicate:USB:RESource?
// Response: USB::0x0AAD::0x0088::100021::INSTR
:SYSTem:COMMunicate:PCIexpress:RESource?
// Response: PCIe::0x0AAD::4909::100021::INSTR

// *******************************************************************
// Query network settings
// *******************************************************************

:SYSTem:COMMunicate:NETWork:COMMon:HOSTname?
// Response: rssgs100a100021
:SYSTem:COMMunicate:NETWork:IPADdress:MODE?
// Response: AUTO
:SYSTem:COMMunicate:NETWork:IPADdress?
// Response: 10.113.11.91
:SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK?
//Response: 255.255.0.0
:SYSTem:COMMunicate:NETWork:IPADdress:GATeway?
//Response: 10.113.0.1
```

```
// *******************************************************************
// Changing network settings
// *******************************************************************

:SYSTem:PROTect1:STATe OFF,123456
// :SYSTem:COMMunicate:NETWork:COMMon:HOSTname "mySGS"
// :SYSTem:COMMunicate:NETWork:IPADdress:MODE STATic
// :SYSTem:COMMunicate:NETWork:IPADdress 9.8.7.6
:SYSTem:COMMunicate:NETWork:RESTart

// *******************************************************************
// Unlock the instrument
// *******************************************************************

:UNL 72349234
```

11.1.4 Advanced Task for Optimizing Performance

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

```
// *******************************************************************
// Reset instrument first
// *******************************************************************

*RST; *CLS
// :SYSTem:PRESet
// :RESTart
// :SYSTem:FPReset

// *******************************************************************
// Lock the instrument to the controller
// *******************************************************************

:LOCK? 72349234
// Lock instrument to avoid interference by other controllers
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused

// *******************************************************************
// Query and adjust the reference oscillator settings
// *******************************************************************

:SOURce:ROSCillator:SOURce?
// Response: EXT
```

```
:SOURce:ROSCillator:EXTernal:FREQuency?
// Response: 100MHZ
:SOURce:ROSCillator:EXTernal:SBANdwidth?
//Response: WIDE
:SOURce:ROSCillator:SOURce INTernal
:SOURce:ROSCillator:OUTput:FREQuency 100MHZ
:SOURce:ROSCillator:INTernal:ADJust:STATe OFF
// uses the calibrated adjustment value of the internal ref. frequency
:SOURce:ROSCillator:INTernal:ADJust:VALue?
:CONNector:REFLo:OUTPut?
// Response: REF

// ******************************************************************
// Optimizing the quality characteristics of the RF signal
// ******************************************************************

:SOURce:POWer:LMODe LNO
// optimize the signal to noise ratio
:SOURce:POWer:SCHaracteristic AUTO
// ensure highest dynamic range and fastest setting time
:SOURce:POWer:LEVel:IMMediate:AMPLitude -30dBm
:SOURce:POWer:LIMit:AMPLitude 30dBm
:SOURce:POWer:ALC:SONCe
:OUTPut:STATe:PON UNCHanged

// ******************************************************************
// Unlock the instrument
// ******************************************************************

:UNL 72349234
```

11.1.5 Enabling and Configuring an Extension Mode

In the following example we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established; the required application program is running on the remote PC. We assume that at least one R&S SGU is connected to the instrument, directly or over network/switch, i.e. there is a remote control connection between the instrument and the extension; we assume, that the required signal connections between the instrument and the extension are established, too.

```
// ******************************************************************
// Reset instrument first
// ******************************************************************

*RST; *CLS
// :SYSTem:PRESet
// :RESTart
// :SYSTem:FPReset
```

```
// ******************************************************************
// Lock the instrument to the controller
// ******************************************************************

:LOCK? 72349234
// Lock instrument to avoid interference by other controllers
// Use an arbitrary number
// Response: 1
// Request granted, i.e. the instrument is locked
// Abort program if request is refused

// ******************************************************************
// Confirm that there is no extension currently enabled for the instrument
// Scan the network for available extension instruments and
// query information on the available instruments:
// hostname/IP adress, serial number, used remote channel
// select and enable an extension
// ******************************************************************
:EXTension:SELect?
// 0
// no extension is currently enabled

:EXTension:INSTruments:SCAN:STATe 1
:EXTension:INSTruments:SCAN:STATe?
// 1
// scan process is running
:EXTension:INSTruments:SCAN:STATe?
// 0
// scan finished

:EXTension:INSTruments:REMote:LAN:NAME?
// rssgu100a100002,rssgu100a101010
:EXTension:INSTruments:REMote:CHANnel?
// LAN,LAN
:EXTension:INSTruments:REMote:SERial?
// 100002,101010
// there are two available extensions

// select and enalbe the first extension (rssgu100a100002)
:EXTension:SELect 1
// determines the extension
// all further remote control commands are related to this extension
:EXTension:REMote:STATe?
// 1
:EXTension:BUSY:STATe?
// 0
// extension is connected and ready for operation

// ******************************************************************
```

```
// Send remote commands to the extension to control it
// e.g. activate the RF optput of the extension and subsequently confirm this
// ******************************************************************
:EXTension:SEND ":OUTP:STAT ON"
:EXTension:SEND? ":OUTP:STAT?"
// 1
// the RF ouptput of the extension is active

// ******************************************************************
// Unlock the instrument
// ******************************************************************

:UNL 72349234
```

11.2 Common Commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the Status Reporting System.

Available common commands:

***CLS**

Clear status

Sets the status byte (STB), the standard event register (ESR) and the `EVENt` part of the `QUEStionable` and the `OPERation` registers to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

Usage: Setting only

***ESE** <Value>

Event status enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:

<Value>	Range:	0 to 255

***ESR?**

Event status read

Returns the contents of the event status register in decimal form and subsequently sets the register to zero.

Return values:

<Contents>	Range:	0 to 255

Usage: Query only

***IDN?**

Identification

Returns the instrument identification.

Return values:

<ID> "Rohde&Schwarz,<device type>,<part number>/<serial number>,<firmware version>"

Example:

```
Rohde&Schwarz,SGS,
1412.0000K02/000000,3.1.17.1-03.01.158
```

Usage: Query only

***IST?**

Individual status query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:

<ISTflag> 0 | 1

Usage: Query only

***OPC**

Operation complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query form writes a "1" into the output buffer as soon as all preceding commands have been executed. This is used for command synchronization.

***OPT?**

Option identification query

Queries the options included in the instrument. For a list of all available options and their description refer to the 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

***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.

***RST**

Reset

Sets the instrument to a defined default status. The default settings are indicated in the description of commands.

The command is equivalent to SYSTem:PRESet.

Usage: Setting only

***SAV** <Number>

Save

Stores the current instrument settings under the specified number in an intermediate memory. The settings can be recalled using the command *RCL with the associated number.

To transfer the stored instrument settings in a file, use the command :MMEMory:STORe:STATe.

***SRE** <Contents>

Service request enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents> Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

Range: 0 to 255

***STB?**

Status byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

Trigger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal. 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

11.3 General Commands

:RESTart

Restarts the instrument.

Usage: Event

:STANdby

Switches the instruments to stand by state. To return the instrument from standby to ready state, send the SCPI command :RESTart.

Usage: Event

:LOCK? <LockRequestId>

Sends a lock request ID which uniquely identifies the controller to the instrument.

Parameters:

<LockRequestId> Number

0
test query to prove whether the instrument is locked

Controller ID
request lock from the controller with the specified Controller ID

Return values:

<Value> Number

0
request refused; the instrument is already locked to other <Lock Request Id>, i.e. to another controller

1
request granted

Example:
```
:LOCK? 12345
Response: 1
:UNL 12345
```

Usage: Query only

Manual operation: See "Exclusive Access" on page 53

:UNLock <UnlockId>

Unlocks an instrument locked to a controller with Controller ID = `<Unlock Id>`.

Setting parameters:

<UnlockId> Number

Unlock ID which uniquely identifies the controller to the instrument. The value must match the Controller ID `<Lock Request Id>` set with the command `:LOCK?`.

0
Clear lock regardless of locking state

Usage: Setting only

Manual operation: See "Exclusive Access" on page 53

11.4 Preset Commands

The preset commands are not bundled into 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.

The following presetting actions are available:

- Activating the default state of all internal instrument functions (`*RST` on page 195). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. TCP/IP address or reference oscillator source settings.
- Activating the original state of delivery (factory reset, `:SYSTem:FPReset` on page 198). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

:SOURce<hw>:PRESet
:SYSTem:PRESet

Triggers an instrument reset. It has the same effect as:

- The `*RST` command
- The "SGMA-GUI > Instrument Name > Preset" function

For an overview of the settings affected by the preset function, see Chapter 7.11, "Preset", on page 116.

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 those that are not currently active) are reset to the factory values.

Usage: Event

Manual operation: See "Execute Factory Preset" on page 136

11.5 CALibration Subsystem

:CALibration:ALL[:MEASure]?

Starts all internal adjustments for which no external measuring equipment is needed.

Return values:
<All> 0 | 1 | OFF | ON

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Adjust All" on page 122

:CALibration:FREQuency[:MEASure]?

Performs all adjustments which affect the frequency.

Return values:
<Synthesis> 0 | 1 | OFF | ON

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Synthesis" on page 122

:CALibration:IQModulator:FULL?

Starts the adjustment of the I/Q modulator for the entire frequency range. The I/Q modulator is adjusted with respect to carrier leakage, I/Q imbalance and quadrature.

Return values:
<Modulator> 0 | 1

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "I/Q Modulator" on page 123

:CALibration:IQModulator:LOCal?

Starts the adjustment of the I/Q modulator for the current frequency. The I/Q modulator is adjusted with respect to carrier leakage, I/Q imbalance and quadrature.

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Adjust I/Q Modulator at Current Frequency" on page 122

:CALibration:LEVel[:MEASure]?

Starts all adjustments which affect the level.

Return values:
<Level> 0 | 1 | OFF | ON

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Level" on page 122

:CALibration:LEVel:TEMPerature?
:CALibration:FREQuency:TEMPerature?
:CALibration:IQModulator:TEMPerature?

Queries the delta temperature since the last performed adjustment.

Return values:
<Temperature> string

Usage: Query only

Manual operation: See "Delta Temperature" on page 123

:CALibration:OEXTension <OExtension>

This SCPI command is used when the instrument is in extension mode.

Enables you to run an internal adjustment only on the extension instrument.

Parameters:
<OExtension> 0 | 1 | OFF | ON
*RST: 0

Example: `:CAL:OEXT ON`
activates the mode for calibrating only the extension instrument
`:CAL:LEV:MEAS?`
calibrates only the extension instrument
`:CAL:OEXT OFF`
deactivates the mode for calibrating only the extension instrument

:CALibration<hw>:ROSCillator:DATA:MODE <Mode>

Defines whether the factory provided or a custom defined calibration value is used to adjust the reference oscillator.

Parameters:

<Mode> FACTory | CUSTomer

*RST: FACTory

Example:

```
:CALibration1:ROSCillator:DATA:MODE CUSTomer
:CALibration1:ROSCillator:DATA 35600
```

Manual operation: See "Active Adjustment Data" on page 139

:CALibration<hw>:ROSCillator[:DATA] <Data>

Sets the calibration value for the custom defined external adjustment.

Parameters:

<Data> integer

Range: 0 to INT_MAX

*RST: 0

Example: See `:CALibration<hw>:ROSCillator:DATA:MODE` on page 200

Manual operation: See "Calibration Value" on page 139

11.6 CONNector Subsystem

:CONNector:REFLo:OUTPut <Output>

Determines the signal provided at the output connector REF/LO OUT (rear of the instrument).

Parameters:

<Output> REF | LO | OFF

*RST: REF

Manual operation: See "REF/LO Output" on page 79

:CONNector:TRIGger:OMODe <Mode>

Sets the operating mode of the trigger connector.

The parameters `PVOut|PETRigger|PEMSource` are available only with option R&S SGS-K22.

Parameters:

<Mode> SVALid | SNValid | PVOut | PETRigger | PEMSource

SVALid|SNValid
signal valid /not valid

PVOut
pulse generator video out

PETRigger
pulse generator external trigger

PEMSource
external pulse modulator source

Manual operation: See "Trigger Connector Mode" on page 109

11.7 DIAGnostic Subsystem

:DIAGnostic:POINt:CATalog?

Queries the test points available in the instrument.

For description of the test points, see the service manual.

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

:DIAGnostic[:MEASure]:POINt? <Name>

Triggers voltage or temperature measurement at the specified test point and returns the measured value.

Use the command `:DIAGnostic:POINt:CATalog?` to retrieve a list of the available test points.

For description of the test points, see the service manual.

Query parameters:

<Name> string

Return values:

<Value> number

Default unit: V or °C

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

11.8 EXTension Subsystem

:EXTension:REMote:STATe?

Queries the state of the remote control connection to the extension.

Return values:

<State> 0 | 1 | OFF | ON

1|ON
connected

0|OFF
not connected

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

Usage: Query only

Manual operation: See "Available Instruments" on page 119

:EXTension:INSTruments:NAME?

Queries the list of the symbolic names of the available extension devices.

Usage: Query only

Manual operation: See "Available Instruments" on page 119

:EXTension:INSTruments:SCAN[:STATe] <State>

Starts a scan for the available extension instruments.

Setting parameters:

<State> 0 | 1 | OFF | ON

1
starts scan

0
aborts scan

*RST: OFF

Return values:

<State> 0 | 1 | OFF | ON

1
scan is running

0
scan finisched

*RST: OFF

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

Manual operation: See "Available Instruments" on page 119

:EXTension:INSTruments:REMote:CHANnel? <Channel>

Queries the remote channels of the available extension instruments. Possible interfaces are: `LAN`, `USB`, `SOCKet`, `PCIe`.

Parameters:

<Channel> <ChannelInstr#1>[,<ChannelInstr#2>,...]

Returns a list of the used remote channels of the available extensions, one interface per instrument. If an extension uses more than one remote channels, returned is the fastest one.

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

Usage: Query only

Manual operation: See "Available Instruments" on page 119

:EXTension:INSTruments:REMote:LAN:NAME?

Queries the IP addresses/instrument names of the available extension instruments.

Return values:

<IPAddress> <IPAdr_Inst#1>[,<IPAdr_Inst#2>,...]

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

Usage: Query only

Manual operation: See "Available Instruments" on page 119

:EXTension:INSTruments:REMote:SERial? <Serial>

Queiries the serial numbers of the available extension instruments.

Parameters:

<Serial> <SerialNumberInstr#1>[, <SerialNumberInstr#2>,...]

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

Usage: Query only

Manual operation: See "Available Instruments" on page 119

:EXTension:BUSY[:STATe]?

Queries the state of the extension instrument.

Return values:

<State> 0 | 1 | OFF | ON

0
the extension is connected to the master instrument and can be remotely operated

1
the extension is busy, i.e. in standby or locked state, or is performing a time consuming operation

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

Usage: Query only

Manual operation: See "Available Instruments" on page 119

:EXTension:SELect <SelNr>

Selects an extension by its index number. The subsequent SCPI commands are related to this extension.

Parameters:

<SelNr> float

0
no selection

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

:EXTension:SEND <Cmd>

In test setups without remote connection between the controller (remote PC) and the extension, the R&S SGS acts as a "bridge" between them. The command `:EXTension:SEND` sends a SCPI command to the extension instrument.

Parameters:

<Cmd> string

Example: see Chapter 11.1.5, "Enabling and Configuring an Extension Mode", on page 190

11.9 MMEMory Subsystem

The MMEMory subsystem (**M**ass **Mem**ory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

The files are stored on the internal flash memory of the instrument or on external USB memory devices.

The default directory is determined using the command `MMEMory:CDIR`.

Use the command `:SYSTem:MMEMory:PATH:USER?` to query the path of the directory for user-defined data.

The `/opt` directory is a protected and therefore a not accessible system directory. The files on this directory contain data that must not be changed. Therefore, this directory should not be accessed, since reconstruction of the system partition will lead to data loss.

11.9.1 File Naming Conventions

To enable files in different file systems to be used, the following file naming conventions should be observed.

The file name can be of any length and is case-sensitive, meaning it is distinguished between uppercase and lowercase letters.

The file and the optional file extension are separated by a dot. All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the file name). If possible, special characters should not be used. The use of the slashes "\" and "/" should be avoided since they are used in file paths. A number of names are reserved for the operating system, e.g. `CLOCK$`, `CON`, `AUX`, `COM1...COM4`, `LPT1...LPT3`, `NUL` and `PRN`.

In the R&S SGS all files in which lists and settings are stored are given a characteristic extension. The extension is separated from the actual file name by a dot (see Chapter 11.9.2, "Extensions for User Files", on page 207 for an overview of the file types).

The two characters "*" and "?" function as "wildcards", meaning they are used for selecting several files. The "?" character represents exactly one character, while the "*" character represents all characters up to the end of the file name. "*.*" therefore stands for all files in a directory.

When used in conjunction with the commands, the parameter <file_name> is specified as a string parameter with quotation marks. It can contain either the complete path including the drive, only the path and the file name, or only the file name. The file name must include the file extension. The same applies for the parameters <directory_name> and <path>.

Depending on how much information is provided, either the values specified in the parameter or the values specified with the command `MMEM:CDIR` (default directory) are used for the path and the drive settings in the commands.

Before the instrument settings can be stored in a file, they have to be stored in an intermediate memory using common command `*SAV <number>`. The specified number is subsequently used in the `:MMEMory:STORe:STATe` on page 214 command. Also, subsequently to loading a file with instrument settings with command `:MMEMory:LOAD:STATe` on page 212, these settings have to be activated with the common command `*RCL <number>`.

11.9.2 Extensions for User Files

The following table lists all available file extensions for user files.

Table 11-1: Automatically assigned file extensions in the instrument

Function	Contents	File suffix
R&S SGMA-GUI Save As/Open	Software settings	`*.savrcl`

11.9.3 Examples

In these examples, the current instrument setting is stored in the file `test.savrcltxt` in the directory `/var/sgs/`..

Storing and Loading Current Settings

1. Store the current setting in an intermediate memory with the number 4. This setting can be called using command `*RCL` and the associated number of the memory, for example `*RCL 4`.
```
*SAV 4
```
2. To store the settings in a file in a specific directory, specify the complete path.
```
MMEM:STOR:STAT 4,"/var/sgs/test.savrcltxt"
```
3. To store the settings in a file in the default drive, set the default drive and specify only the file name.
```
MMEM:CDIR '/var/sgs/'*SAV 4
MMEM:STOR:STAT 4,"test.savrcltxt"
```
4. Load the file `test.savrcltxt` in the `user` directory.
```
MMEM:LOAD:STAT 4,'/var/sgs/test.savrcltxt'
```
5. Activate the instrument setting of the file `test.savrcltxt`.
```
*RCL 4
```

Working with Files and Directories

1. Read out all files in the specified directory.
```
MMEM:CAT? 'usbuser'
```

Response: `127145265,175325184,"test,DIR,0","temp,DIR,0", "readme.txt,ASC,1324","state.savrcltxt,STAT,5327", "waveform.wv,BIN,2342"`

the directory `usbuser` contains the subdirectories `test` and `temp` as well as the files `readme.txt`, `state.savrcltxt` and `waveform.wv` which have different file types.

Tip: To query only the subdirectories of the current or specified directory, perform:
`MMEM:DCAT? 'usbuser'`

Response: `'test', 'temp'`

To query only the number of subdirectories in the current or specified directory, perform:

`MMEM:DCAT:LENG? 'usbuser'`

Response: `2`

2. To query the number of files in the current or specified directory, perform:
   `MMEM:CAT:LENG? 'usbuser'`
   Response: `3`
3. Create a new subdirectory for mass memory storage in the specified directory.
   `MMEM:MDIR 'usbnew'`
4. Copy the file `state` to a new file.
   `MMEM:COPY '/var/sgs/state.savrcltxt','usbnew'`
5. Rename the file `state`.
   `MMEM:MOVE 'state.savrcltxt','state_new.savrcltxt'`
6. Remove the `test` directory.
   `MMEM:RDIR 'usbtest'`

11.9.4 Remote Control Commands

:MMEMory:CATalog? <path>

Returns the content of a particular directory.

Query parameters:

<path> string

String parameter to specify the directory.
If you leave out the path, the command returns the contents of the directory selected with `:MMEMory:CDIRectory`.
The path may be relative or absolute.

Return values:

<UsedDiskSpace> Byte size of all files in the directory.

<FreeDiskSpace> Remaining disk space in bytes.

<FileInfo> <NameFileN>,<SuffixFileN>,<SizeFileN>

List of files, separated by commas

<NameFileN>
Name of the file.

<SuffixFileN>
Type of the file. Possible suffixes are: ASCii, BINary, DIRectory

<SizeFileN>
Size of the file in bytes.

Example: See "Working with Files and Directories" on page 207.

Usage: Query only

:MMEMory:CATalog:LENGth? <Path>

Returns the number of files in the current or in the specified directory.

Query parameters:

<Path> string

String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:

<FileCount> integer

Number of files.

Example: See "Working with Files and Directories" on page 207.

Usage: Query only

:MMEMory:CDIRectory <Directory>

Changes the default directory for mass memory storage. The directory is used for all subsequent `MMEM` commands if no path is specified with them.

Parameters:

<Directory> <directory_name>

String containing the path to another directory. The path can be relative or absolute.
To change to a higher directory, use two dots '..' .

Example: See "Working with Files and Directories" on page 207.

Usage: SCPI confirmed

:MMEMory:COPY <SourceFile>[,<DestinationFile>]

Copies an existing file to a new file. Instead of just a file, this command can also be used to copy a complete directory together with all its files.

Setting parameters:

<SourceFile> string

String containing the path and file name of the source file

<DestinationFile> string

String containing the path and name of the target file. The path can be relative or absolute.
If `<DestinationFile>` is not specified, the `<SourceFile>` is copied to the current directory, queried with the `:MMEMory:CDIRectory` command.
Note: Existing files with the same name in the destination directory are overwritten without an error message.

Example: See "Working with Files and Directories" on page 207.

Usage: Setting only
SCPI confirmed

: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/sgs/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/sgs/test.txt'`
Sends the data of the file `test.txt` from the instrument to the controller in the form of a binary block.
`Response: #15hallo`

Usage: SCPI confirmed

:MMEMory:DCATalog? <path>

Returns the subdirectories of a particular directory.

Query parameters:

<path> String parameter to specify the directory. If the directory is omitted, the command queries the content of the current directory, queried with `:MMEMory:CDIRectory` command.

Return values:

<Catalog> <file_entry>

Names of the subdirectories separated by colons. The first two strings are related to the parent directory.

Example: See "Working with Files and Directories" on page 207.

Usage: Query only

:MMEMory:DCATalog:LENGth? [<Path>]

Returns the number of subdirectories in the current or specified directory.

Query parameters:

<Path> String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory, to be queried with `:MMEMory:CDIRectory` command.

Return values:

<DirectoryCount> integer

Number of parent and subdirectories.

Example: See "Working with Files and Directories" on page 207.

Usage: Query only

:MMEMory:DELete <Filename>

Removes a file from the specified directory.

Setting parameters:

<Filename> string

String parameter to specify the name and directory of the file to be removed.

Example: See "Working with Files and Directories" on page 207.

Usage: Event
SCPI confirmed

:MEMory:HFRee?

Returns the used and available memory in Kb.

Return values:

<TotalPhysMemKb> integer

Total physical memory.

<ApplicMemKb> integer

Application memory.

<HeapUsedKb> integer

Used heap memory.

<HeapAvailableKb> integer

Available heap memory.

Usage: Query only

:MMEMory:LOAD:STATe <SavRclStateNumb>, <file_name>

Loads the specified file stored under the specified name in an internal memory.

After the file has been loaded, the instrument setting must be activated using an `*RCL` command.

Setting parameters:

<SavRclStateNumb> Determines to the specific <number> to be used with the `*RCL` command, e.g. `*RCL 4`.

<file_name> String parameter to specify the file name with extension `*.savrcltxt`.

Example: See "Storing and Loading Current Settings" on page 207.

Usage: Setting only

:MMEMory:MDIRectory <Directory>

Creates a subdirectory for mass memory storage in the specified directory. If no directory is specified, a subdirectory is created in the default directory. This command can also be used to create a directory tree.

Setting parameters:

<Directory> string

String parameter to specify the new directory.

Example: See "Working with Files and Directories" on page 207.

Usage: Event

:MMEMory:MOVE <SourceFile>, <DestinationFile>

Moves an existing file to a new location or, if no path is specified, renames an existing file.

Setting parameters:

<SourceFile> string

String parameter to specify the name of the file to be moved.

<DestinationFile> string

String parameters to specify the name of the new file.

Example: See "Working with Files and Directories" on page 207.

Usage: Event
SCPI confirmed

:MMEMory:MSIS <Msis>

Defines the drive or network resource (in the case of networks) for instruments with windows operating system, using `msis` (MSIS = Mass Storage Identification String).

Note: Instruments with Linux operating system ignore this command, since Linux does not use drive letter assignment.

Usage: SCPI confirmed

:MMEMory:RDIRectory <Directory>

Removes an existing directory from the mass memory storage system. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

Setting parameters:

<Directory> string

String parameter to specify the directory to be deleted.

Example: See "Working with Files and Directories" on page 207.

Usage: Event

:MMEMory:STORe:STATe <savrcl_state_nr>, <file_name>

Stores the current instrument setting in the specified file.

The instrument setting must first be stored in an internal memory with the same number using the common command `*SAV`.

Setting parameters:

<savrcl_state_nr> Corresponds to the specific `<number>` defined with the `*SAV` command, e.g. `*SAV 4`.

<file_name> String parameter to specify the file name with extension `*.savrcltxt`.

Example: See "Storing and Loading Current Settings" on page 207.

Usage: Event

11.10 Fast Speed Commands

This section describes special commands that allow a fast frequency and level setting.

:FFASt <Freq>

Special command to set the RF output frequency with minimum latency. No unit (e.g. Hz) allowed.

Bypasses the status system so command `*OPC?` cannot be appended.

Parameters:

<Freq> float

Example: `FFASt 12750000000`

:PFASt <Pow>

Special command to set the RF output level with minimum latency at the RF output connector. This value does not consider a specified offset. No unit (e.g. dBm) allowed.

Bypasses the status system so command `*OPC?` cannot be appended.

Parameters:

<Pow> float

Example: `:PFASt -20`

11.11 OUTPut Subsystem

:OUTPut:AFIXed:RANGe:LOWer?

Queries the minimum level which can be set without the attenuator being adjusted (Attenuator FIXed).

Return values:

<Lower> float

Default unit: dBm

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Usage: Query only

Manual operation: See "Level Range" on page 86

:OUTPut:AFIXed:RANGe:UPPer?

Queries the maximum level which can be set without the attenuator being adjusted (Attenuator FIXed).

Return values:

<Upper> float

Default unit: dBm

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Usage: Query only

Manual operation: See "Level Range" on page 86

:OUTPut:AMODe <AMode>

Switches the mode of the attenuator at the RF output.

Parameters:

<AMode>	AUTO | FIXed | APASsive **AUTO** The attenuator is switched automatically. The level settings are made in the full range. **APASsive** The attenuator is switched automatically. The level settings are made only for the passive reference circuits. The high-level ranges are not available. **FIXed** The level settings are made without switching the attenuator. When this operating mode is switched on, the attenuator is fixed to its current position and the resulting variation range is defined. *RST: AUTO

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Mode" on page 85

:OUTPut[:STATe]:PON <Pon>

Selects the state which the RF output assumes when the instrument is switched on.

Parameters:

<Pon>	OFF | UNCHanged *RST: UNCHanged

Example: See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.

Manual operation: See "Power-On State" on page 87

:OUTPut[:STATe] <State>

Activates/ deactivates the RF output.

Parameters:

<State>	0 | 1 | OFF | ON

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "RF On/Off" on page 60

11.12 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 SGS.

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.

: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 103

: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, it is recommended that you use an SRQ for command synchronization (MAV bit).

Suffix:
<ch> 1..3

Return values:
<Power> string

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 102

: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 102

: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 219.

Parameters:

<UseDefAp> 0 | 1 | OFF | ON

*RST: 1

Example: `SENS:POW:APER:DEF:STAT 0`

Deactivates the default aperture time of the sensor.

Manual operation: See "Use Default Aperture Time" on page 105

:SENSe<ch>[:POWer]:APERture:TIMe <ApTime>

Defines the aperture time (size of the acquisition interval) for the corresponding sensor.

Parameters:

<ApTime> float

Range: depends on connected power sensor
Increment: 1E-9
*RST: depends on connected power sensor

Example: `SENS:POW:APER:TIM 23ms`

Sets 23 ms aperture time.

Manual operation: See "Aperture Time" on page 105

: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: `SENS1:POW:CORR:SPD:STAT ON`

Activates the use of the S-parameters correction data of power sensor 1.

Manual operation: See " Use SParameter " on page 105

: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 104

: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 104

: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: `SENS1:FILT:TYPE NSR`
Selects fixed noise filter mode.
`SENS1:FILT:NSR 0.2`
Sets a noise content of 0.2.

Manual operation: See "Noise Content" on page 104

: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: `SENS1:FILT:TYPE NSR`
Selects fixed noise filter mode.
`SENS1:FILT:NSR .2`
Sets a noise content of 0.2.
`SENS1:FILT:NSR:MTIM 5`
Limits the settling time to 5 seconds.

Manual operation: See "Timeout" on page 104

: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 104

: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: `SENS1:FILT:TYPE AUTO`
Selects automatic filter selection.

Manual operation: See " Filter" on page 104

: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 103

: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 105

: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 " on page 103

: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 " on page 103

: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 " Serial Number " on page 102

: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:	`SENS1:SOUR RF` The sensor measures the power of the RF signal
Manual operation:	See " Source " on page 103

: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 103

: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

: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 " Serial Number " on page 102

:SENSe<ch>[:POWer]:ZERO

Performs zeroing of the sensor.

Zeroing is required after warm-up, i.e. after connecting the sensor.

Also, it is recommended 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.

Note: The RF power source must be switched off or disconnected from the sensor before zeroing.

Example: `SENS1:ZERO`
Executes zeroing.

Usage: Event

Manual operation: See " Zero " on page 103

: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:

```
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
```

Usage: Query only

Manual operation: See " Sensor Mapping List " on page 97

: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 :SLISt[:LIST]? on page 225.

Manual operation: See " Scan " on page 97

: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 :SLISt[:LIST]? on page 225.

Manual operation: See " Sensor Mapping List " on page 97

11.13 SOURce Subsystem

[:SOURce]:OPMode <OpMode>

Sets the operation mode.

Parameters:

<OpMode> NORMal | BBBYpass

NORMal
normal operation

BBBYpass
Baseband bypass mode

*RST: NORMal

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Operation Mode" on page 75

[:SOURce]:FREQuency[:CW|FIXed] <Cw>

Sets the RF frequency at the RF output connector of the selected instrument.

Note: Enabled frequency offset affects the result of this query. The query returns the frequency, including frequency offset.

See `[:SOURce]:FREQuency:OFFSet` on page 227.

Parameters:

<Cw> float

*RST: 1 GHz

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Freq/Freq (Offs)" on page 60

[:SOURce]:FREQuency:OFFSet <Offset>

Sets a frequency offset, for example include the frequency shift of downstream instrument.

Note: Enabled frequency offset affects the result of the query :SOURce:FREQuency:CW?

The query returns the frequency, including frequency offset.

Parameters:

<Offset> float

Range: -3e9 to 3e9
Increment: 0.001
*RST: 0

Example:

```
SOURce:FREQuency:OFFSet 0
SOURce:FREQuency:CW 6000000000
SOURce:FREQuency:OFFSet 20000000
SOURce:FREQuency:CW?
// 6020000000
```

Manual operation: See "Offset" on page 76

[:SOURce]:LOSCillator:SOURce <Source>

Selects the source of the local oscillator signal.

Parameters:

<Source> INTernal | EXTernal

`INT`: use built in oscillator; `EXT`: use signal at REF/LO IN connector

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Source" on page 78

[:SOURce]:PATH:COUNt?

Queries the number of installed RF paths.

Return values:

<Count> integer

Range: 1 to INT_MAX
*RST: 1

Example: `PATH:COUN?`
Queries the number of RF paths.
`Response: 1`
The instrument is equipped with one RF path.

Usage: Query only

11.14 SOURce:CORRection Subsystem

The output level is corrected in the `CORRection` subsystem. Correction is performed by user-defined table values being added to the output level for the respective RF frequency. In the R&S SGS, this subsystem is used to select, transfer and activate user correction tables.

Each list is stored as a file. The name of the user correction file can be freely selected. The file extension `*.uco` is assigned automatically and cannot be changed.

The files can be stored in a freely selectable directory and opened from there. The default directory is set using command `:MMEMory:CDIRectory` on page 209. In the case of files which are stored in the default directory, only the file name has to be specified in commands. Otherwise, the complete absolute path has to be specified with every command. The extension can be omitted in any case.

In the following command examples, the files are stored in the default directory.

[:SOURce]:CORRection:CSET:CATalog?

Requests a list of user correction tables. The individual lists are separated by commas.

The lists are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog> string

Example:

`MMEM:CDIR '/var/sgs/ucor'`
selects the directory for the user correction files.
`CORR:CSET:CAT?`
queries which correction tables are available.
Response:`UCOR1,UCOR2,UCOR3`
the correction tables `UCOR1, UCOR2 and UCOR3` are available.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

Transfers the frequency data to the table selected with `:CORRection:CSET:SELect`.

The numerical suffix at SOURce must not be used for this command.

Parameters:

<Frequency> Frequency#1[, Frequency#2, ...]

Range: 300 kHz to RFmax (depending on model)

Example:
`CORR:CSET '/var/sgs/ucor1'`
selects the table `ucor1`.
`CORR:CSET:DATA:FREQ 100MHz,102MHz,103MHz,...`
enters the frequency value in the table `ucor1`.

Manual operation: See " Edit User Cor. Data " on page 90

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts?

The command queries the number of frequency values in the selected table.

The numerical suffix at SOURce must not be used for this command.

Return values:

<Points> integer

Range: 0 to 10000
*RST: 0

Example:
`CORR:CSET '/var/sgs/'`
selects the table ucor1.
`CORR:CSET:DATA:FREQ:POIN?`
queries the number of frequency values in the table ucor1.
Response: `440`
the table ucor1 contains 440 frequency values.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA:POWer <Power>

Transfers the level data to the table selected with `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

`*RST` does not affect data lists. The numerical suffix at `SOURce` must not be used for this command.

Parameters:

<Power> Power#1[, Power#2, ...]

Example: `CORR:CSET '/var/sgs/ucor1'`
selects the table `ucor1`.
`CORR:CSET:DATA:POW 1dB, 0.8dB, 0.75dB,...`
enters the level values in the table `ucor1`.

Manual operation: See " Edit User Cor. Data " on page 90

[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

Queries the number of level values in the selected table.

The numerical suffix at `SOURce` must not be used for this command.

Return values:
<Points> integer

Range: 0 to 10000
*RST: 0

Example: `CORR:CSET '/var/sgs/ucor1'`
selects the table ucor1.
`CORR:CSET:DATA:POW:POIN?`
queries the number of level values in the table ucor1.
Response: `440`
the table ucor1 contains 440 level values.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

The command fills the selected user correction list with the level values measured by the power sensor for the given frequencies.

To select the used power sensor set the suffix in key word `SENSe`.

Example: `CORR:CSET:DATA:SENS:POW:SONC`
fills the user correction list with level values acquired by the power sensor connector to the SENSOR connector.

Usage: Event

Manual operation: See " Fill User Correction Data with Sensor" on page 95

[:SOURce]:CORRection:CSET:DELete <Filename>

Deletes the specified table.

The lists are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:CSET:CAT?`, in which case the file in the specified directory is deleted.

Setting parameters:
<Filename> <table name>

Example: `MMEM:CDIR '/var/sgs/ucor'`
selects the directory for the user correction files.
`CORR:CSET:DEL 'UCOR1'`
deletes the table `ucor1`.

Usage: Setting only

Manual operation: See " User Cor. Data " on page 90

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?

Requests a list of available ASCII files for export/import of user correction data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog> string

Example: `MMEM:CDIR '/var/sgs/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`CORR:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension `*.txt` are listed.
`CORR:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response: `'ucor1,ucor2'`
the ASCII files `ucor1.txt` and `ucor2.txt` are available.

Usage: Query only

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension <Extension>

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

Parameters:

<Extension> TXT | CSV

*RST: TXT

Example: `MMEM:CDIR '/var/sgs/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`CORR:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension *.txt are listed.
`CORR:DEXC:AFIL:CAT?`
queries the available files with extension *.txt.
Response: `'list1,list2'`
the ASCII files `ucor1.txt` and `ucor2.txt` are available.

Manual operation: See " Extension" on page 92

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect <Filename>

Selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:DEXC:AFIL:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:

<Filename> <ascii file name>

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL '/var/sgs/import_ucor.csv'`
selects that ASCII file `ucor.csv` is imported.
`CORR:DEXC:SEL '/var/sgs/import_ucor_imp'`
selects that the ASCII file `ucor.csv` is imported into user correction list `ucor_imp`.

Manual operation: See " Select ASCII Source/Destination " 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: `CORR:DEXC:MODE EXP`
selects that the user correction list is exported into an ASCII file.
`CORR:DEXC:AFIL:SEL '/var/sgs/import_ucor.csv'`
selects ASCII file ucor.csv as destination for the user correction list data.
`CORR:DEXC:AFIL:SEP:COL TAB`
the pairs of frequency and level values are separated by a tabulator.
`CORR:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`CORR:DEXC:SEL '/var/sgs/import_ucor_imp'`
selects that the user correction list ucor_imp is imported into ASCII file ucor.csv.

Manual operation: See " Column Separator" on page 92

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal <Decimal>

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

Parameters:

<Decimal> DOT | COMMa

*RST: DOT

Example: `CORR:DEXC:MODE EXP`

selects that the user correction list is exported into an ASCII file.

`CORR:DEXC:AFIL:SEL '/var/sgs/import_ucor.csv'`

selects ASCII file ucor.csv as destination for the user correction list data.

`CORR:DEXC:AFIL:SEP:COL TAB`

the pairs of frequency and level values are separated by a tabulator.

`CORR:DEXC:AFIL:SEP:DEC DOT`

selects the decimal separator dot.

`CORR:DEXC:SEL '/var/sgs/import_ucor_imp'`

selects that the user correction list `ucor_imp` is imported into ASCII file `ucor.csv`.

Manual operation: See " Decimal Point" on page 92

[:SOURce<hw>]:CORRection:DEXChange:EXECute

Starts the export or import of the selected file. When import is selected, the ASCII file is imported as user correction list. When export is selected, the user correction list is exported into the selected ASCII file.

Example: `CORR:DEXC:MODE IMP`

selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.

`CORR:DEXC:AFIL:SEL '/var/sgs/import_ucor.csv'`

selects that ASCII file ucor.csv is imported.

`CORR:DEXC:SEL '/var/sgs/import_ucor_imp'`

selects that the ASCII file `ucor.csv` is imported into user correction list `ucor_imp`.

`CORR:DEXC:EXEC`

starts the import of the ASCII file data into the user correction file.

Usage: Event

Manual operation: See " Import/Export " on page 93

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

Selects if user correction lists should be imported or exported. Depending on the selection her, the file select command define either the source or the destination for user correction lists and ASCII files.

Parameters:

<Mode> IMPort | EXPort

*RST: IMPort

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL '/var/sgs/ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var/sgs/ucor_imp'`
selects that the ASCII file `ucor.csv` is imported into user correction list `ucor_imp`.

Manual operation: See " Mode" on page 92

[:SOURce<hw>]:CORRection:DEXChange:SELect <Filename>

Selects the user correction list to be imported or exported.

The user correction files are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:DEXC:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:
<Filename> string

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL '/var/sgs/import_ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var/sgs/import_ucor_imp'`
selects that the ASCII file `ucor.csv` is imported into user correction list `ucor_imp`.

Manual operation: See " Select Destination/Source " on page 93

[:SOURce<hw>]:CORRection:CSET[:SELect] <Filename>

Selects or creates a file for the user correction data.

If the file does not exist, the instrument automatically creates a new file with the name you assigned. Note the predefined file extensions under Chapter 11.9.2, "Extensions for User Files", on page 207.

To determine the file location (directory/path) you can either enter it with the command directly, or use the command `MMEMory:CDIR`.

To activate level correction use the command `[:SOURce<hw>]:CORRection[:STATe]`.

Parameters:
<Filename> <table name>

Example: `CORR:CSET '/var/sgs/ucor1'`
selects the table `ucor1`.
`CORR ON`
activates level correction. Correction is performed using the table `ucor1`.

Manual operation: See " User Cor. Data " on page 90

[:SOURce<hw>]:CORRection[:STATe] <State>

Activates/deactivates level correction. Level correction is performed using the table which has been selected with the command `[:SOURce<hw>]:CORRection:CSET[:SELect]`.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `SOUR:CORR:CSET '/var/sgs/ucor1'`
selects the table `ucor1`.
`SOUR:CORR ON`
activates user correction.

Manual operation: See " State " on page 89

[:SOURce<hw>]:CORRection:VALue?

Queries the current value for user correction.

Return values:
<Value> float
Range: -100 to 100
Increment: 0.01
*RST: 0

Example: `CORR:VAL?`
queries the value currently used for level correction.
Response: `-3`
the correction value is - 3 dB.

Usage: Query only

Manual operation: See " User Correction " on page 89

[:SOURce<hw>]:CORRection:ZERoing:STATe <State>

Activates the zeroing procedure before filling the user correction data acquired by a sensor.

Parameters:
<State> 0 | 1 | OFF | ON

Manual operation: See " Fill User Correction Data with Sensor" on page 95

11.15 SOURce:IQ Subsystem

[:SOURce]:IQ:STATe <State>

Switches the I/Q modulation on and off.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Mod State" on page 60

[:SOURce]:IQ:IMPairment:IQRatio[:MAGNitude] <IqRatio>

Sets the ratio of I modulation to Q modulation (amplification “imbalance”). The input may be either in dB or %. The resolution is 0.001 dB, an input in percent is rounded to the closest valid value in dB. A query returns the value in dB.

Parameters:

<IqRatio> float

Range: -1 to 1
Increment: 1E-3
*RST: 0

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Gain Imbalance" on page 115

[:SOURce]:IQ:IMPairment:LEAKage:I <I>
[:SOURce]:IQ:IMPairment:LEAKage:Q <Q>

Sets the carrier leakage amplitude for the Q-signal component.

Parameters:

<Q> float

Range: -5 to 5
Increment: 0.01
*RST: 0
Default unit: PCT

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Offset" on page 115

[:SOURce]:IQ:IMPairment:QUADrature[:ANGLe] <Angle>

Sets the quadrature offset for the digital I/Q signal.

Parameters:

<Angle> float

Range: -8 to 8
Increment: 0.01
*RST: 0
Default unit: DEG

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Quadrature Offset" on page 116

[:SOURce]:IQ:IMPairment[:STATe] <State>

Activates/ deactivates the three impairment or correction values LEAKage, QUADrature and IQRatio for the baseband signal prior to input into the I/Q modulator.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "State" on page 115

[:SOURce]:IQ:CREStfactor <CrestFactor>

Sets the crest factor of the IQ modulation signal.

Parameters:

<CrestFactor> float

Range: 0 to 35
Increment: 0.01
*RST: 0

Example: see Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186

Manual operation: See "Crest Factor" on page 114

[:SOURce]:IQ:WBSTate <State>

Selects optimized settings for wideband modulation signals.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "I/Q Wideband" on page 114

11.16 SOURce:PHASe Subsystem

[:SOURce]:PHASe <Phase>

Specifies the phase variation relative to the current phase.

Parameters:

<Phase> float

Range: -360 to 360
Increment: 0.1
*RST: 0
Default unit: DEG

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "Delta Phase" on page 77

[:SOURce]:PHASe:REFerence

Adopts the phase set with command `[:SOURce]:PHASe` as the current phase.

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Usage: Event

Manual operation: See "Reset Delta Phase Display" on page 77

11.17 SOURce:POWer Subsystem

[:SOURce]:POWer:ALC:DSENsitivity <Sensitivity>

Sets the power detector sensitivity. Used for compatibility reasons only.

Parameters:

<Sensitivity> OFF | LOW | MED | HIGH

*RST: OFF

Manual operation: See "Detector Sensitivity" on page 88

[:SOURce]:POWer:ALC[:STATe] <State>

Activates/deactivates automatic level control.

Parameters:

<State> 1 | OFFTable | OFF | ONTable | AUTO | ON

*RST: ONTable

Example: See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.

Manual operation: See "State" on page 88

[:SOURce]:POWer:ALC:SONCe

Briefly activates level control for correction purposes.

Usage: Event

Manual operation: See "Readjust" on page 85

[:SOURce]:POWer:ATTenuation:RFOFf:MODE <Mode>

Determines the attenuator's state after the instrument is switched on.

Parameters:

<Mode> MAX | FATTenuated | FIXed | UNCHanged

*RST: MAX

Manual operation: See "RF-Off-Mode" on page 86

[:SOURce]:POWer:ATTenuation:SOVer[:OFFSet] <Offset>

Sets the switch-over offset value of the attenuator.

Parameters:

<Offset> float

Range: -10 to 10
Increment: 0.1
*RST: 0

Manual operation: See "SATT Switch-Over Offset" on page 86

[:SOURce]:POWer:LMODe <LevMode>

Selects the level mode.

Parameters:

<LevMode> NORM | LNOise | LDIStortion

NORM
automatic selection of the best settings

LNOISe
settings for lowest noise

LDIStortion
settings for lowest distortions

Example: See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.

Manual operation: See "Mode" on page 84

[:SOURce]:POWer:POWer <Amplitude>

Sets the level at the RF output connector.

This value does not consider a specified offset. The command `[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display, that means the level containing offset.

Parameters:

<Amplitude> float

Range: -20 to 25
Increment: 0.01
*RST: -10

Example: `POW:POW 15`
sets the RF level at output to 15 dBm.

Manual operation: See "Level/Level Offset" on page 61

[:SOURce]:POWer:SCHaracteristic <Characteristic>

Selects the characteristic for the level setting.

Parameters:

<Characteristic> AUTO | UNINterrupted | CVSWr | USER | MONotone

UNINterrupted
uninterrupted level setting

CVSWr
constant-VSWR

MONotone
strictly monotone

*RST: AUTO

Example: See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.

Manual operation: See "Setting Characteristic" on page 84

[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

Sets the RF level at the RF output connector of the instrument.

Parameters:

<Amplitude> float

Range: -20 to 25
Increment: 0.01
*RST: -10

Example: See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.

Manual operation: See "Level/Level Offset" on page 61

[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Note: The level offset is also effective for level sweeps!

The command specifies the constant level offset of a downstream attenuator/amplifier. If a level offset is entered, the level entered with `[:SOURce]:POWer:POWer` no longer corresponds to the RF output level.

The following correlation applies:

`:POWer` = RF output level + `POWer:OFFSet`.

Entering a level offset does not change the RF output level, but rather the query value of `:POWer`.

Parameters:

<Offset> float

Range: -100 to 100
Increment: 0.1
*RST: 0

Manual operation: See "Offset" on page 83

[:SOURce]:POWer:LIMit[:AMPLitude] <Amplitude>

Sets the upper limit of the RF signal power.

The value is not affected by an instrument preset and `*RST` function. This parameter is influenced only by the factory preset (`SYST:FPR`) and its factory value is equal to the upper limit.

Parameters:

<Amplitude> float

Range: -120 to 25
Increment: 0.01
Default unit: dBm

Example: See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.

Manual operation: See "Limit" on page 85

[:SOURce]:POWer:PEP?

Queries the RF signal's peak envelope power.

Return values:

<PEP> float

Example: see Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186

Usage: Query only

Manual operation: See "PEP" on page 61

[:SOURce]:POWer:RANGe:LOWer?
[:SOURce]:POWer:RANGe:UPPer?

Queries the minimum/maximum level range in the current level mode

Return values:

<Upper> float

Usage: Query only

Manual operation: See "Level Range" on page 84

11.18 SOURce:PULM Subsystem

This subsystem contains the commands for setting the pulse modulation.

Programming Examples

Example: Performing pulse modulation

This example shows a command sequence to perform pulse modulation.

```
// *******************************************************************
// Reset the instrument to start from an initial state
// *******************************************************************
*RST; *CLS

// *******************************************************************
// Set the RF signal frequency and level
// *******************************************************************
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// *******************************************************************
// Configure the pulse modulation settings
// *******************************************************************
// Select the internal modulation generator
SOURce:PULM:SOURce INT
// Set trigger mode
SOURce:PULM:TRIGger:MODE AUTO
// Select pulse mode
SOURce:PULM:MODE DOUB

// *******************************************************************
// Alternatively configure the pulse modulation settings for
// external modulation source
// *******************************************************************
// Select the external modulation source
SOURce:PULM:SOURce EXT
// Set the polarity of the externally applied modulation signal.
SOURce:PULM:POLarity NORMal
// Select the impedance for the external pulse modulation trigger input
SOURce:PULM:TRIGger:EXTernal:IMPedance G10K

// *******************************************************************
// Configure the pulse generator settings
// *******************************************************************
// Set pulse period
SOURce:PULM:PERiod 10 us
// Set pulse width
SOURce:PULM:WIDth 8 us
```

```
// Set double pulse width
SOURce:PULM:DOUBle:WIDTh 0.0000012
// Set double pulse delay
SOURce:PULM:DOUBle:DELay 0.0000045

// ******************************************************************
// Activate the signal output
// ******************************************************************
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1
```

Example: Generating a pulse train signal

This example shows a command sequence to create a pulse train signal.

Prior to the selection of the pulse train mode make sure that you have generated and selected a pulse train data list. Otherwise, the instrument generates an error.

```
// ******************************************************************
// Reset the instrument to start from an initial state
// ******************************************************************
*RST; *CLS

// ******************************************************************
// Set the RF signal frequency and level
// ******************************************************************
SOURce:FREQuency:CW 4000000000
SOURce:POWer:LEVel:IMMediate:AMPLitude -25

// ******************************************************************
// Create a pulse train data list
// ******************************************************************
// Select the directory
MMEM:CDIR '/var/user/Lists/'
// Create and/or select the pulse train data file
SOURce:PULM:TRAin:SEL 'P_FIVE'
// Enter the pulse train data
SOURce:PULM:TRAin:ONTime 10ns,30ns,40ns,20ns,10ns
SOURce:PULM:TRAin:OFFTime 30ns,40ns,50ns,40ns,30ns
SOURce:PULM:TRAin:REPetition 10,1,3,10,6

// ******************************************************************
// Select pulse train mode
// ******************************************************************
// Select the internal modulation generator and the pulse mode
SOURce:PULM:SOURce INTernal
SOURce:PULM:MODE PTRain
```

```
// ******************************************************************
// Activate the signal output
// ******************************************************************
SOURce:PGENerator:OUTPut:STATe 1
SOURce:PULM:STATe 1
OUTPut1:STATe 1
```


[:SOURce<hw>]:PULM:DELay <Delay>

Sets the pulse delay.

Parameters:

<Delay> float

Range: 0 to 100 s
Increment: 10 ns
*RST: 10 ns

Example: `PULM:DEL 13 us`
13 us elapse after a trigger before the first pulse is generated.

Manual operation: See "Pulse Delay" on page 109

[:SOURce<hw>]:PULM:DOUBle:DELay <Delay>

Sets the delay from the start of the first pulse to the start of the second pulse.

Parameters:

<Delay> float

Range: 40 ns to 100 s
Increment: 10 ns
*RST: 1 ns

Example: `PULM:DOUB:DEL 22 us`
22 us elapse between the beginning of the first pulse and the beginning of the second pulse in double-pulse mode.

Manual operation: See "Double Pulse Delay" on page 109

[:SOURce<hw>]:PULM:DOUBle:WIDTh <Width>

Sets the width of the second pulse in case of double pulse generation.

Example: `PULM:DOUB:WIDT 33 us`
sets a width of 33 us for the second pulse.

Manual operation: See "Double Pulse Width" on page 108

[:SOURce<hw>]:PULM:MODE <Mode>

Sets the mode of the pulse generator.

Parameters:

<Mode> SINGle | DOUBle

SINGle
Enables single pulse generation.

DOUBle
Enables double pulse generation. The two pulses are generated in one pulse period.

*RST: SINGle

Example: `PULM:MODE DOUB`
enables double pulse generation.

Manual operation: See "Pulse Mode" on page 108

[:SOURce<hw>]:PULM:PERiod <Period>

Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period> float

Range: 100 ns to 100 s
Increment: 10 ns
*RST: 10 ns

Example: `PULM:PER 220 us`
the pulse period is 220 us.

Manual operation: See "Pulse Period" on page 108

[:SOURce<hw>]:PULM:POLarity <Polarity>

Sets the polarity of the pulse modulator signal. This command is effective only for an external modulation signal.

Parameters:

<Polarity> NORMal | INVerted

NORMal
The RF signal is suppressed during the pulse pause.

INVerted
The RF signal is suppressed during the pulse.

*RST: NORMal

Example: `PULM:SOUR EXT`
selects the external modulation source.

Example: `PULM:POL INV`
selects inverted polarity.

Manual operation: See "Polarity" on page 107

[:SOURce<hw>]:PULM:SOURce <Source>

Selects the source for pulse modulation.

Parameters:

<Source> INTernal | EXTernal

INTernal
The internal pulse generator is used for the pulse modulation.

EXTernal
The signal applied externally via the trigger connector is used for the pulse modulation.

*RST: INTernal

Manual operation: See "Source" on page 107

[:SOURce<hw>]:PULM:STATe <State>

Activates the pulse modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `PULM:STAT ON`
activates pulse modulation.

Manual operation: See "State" on page 107

[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity <Polarity>

Selects the polarity of the Gate signal.

Parameters:

<Polarity> NORMal | INVerted

*RST: NORMal

Example: `PULM:TRIG:EXT:GATE:POL NORM`
The pulse signal is generated while the gate signal is high.

Manual operation: See "Gate Input Polarity" on page 110

[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance <Impedance>

Selects the impedance for external pulse trigger.

Parameters:

<Impedance> G50 | G10K
*RST: G50

Example: `SOUR:PULM:TRIG:EXT:IMP G50`
selects 50 Ohm as the trigger impedance for the external pulse trigger.

Manual operation: See "External Impedance" on page 107

[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe <Slope>

Sets the polarity of the active slope of an externally applied trigger signal.

Parameters:

<Slope> NEGative | POSitive
*RST: POSitive

Example: `PULM:TRIG:EXT:SLOP NEG`
The pulse generator is triggered on the negative slope of the external trigger signal.

Manual operation: See "Ext. Trigger Input Slope" on page 110

[:SOURce<hw>]:PULM:TRIGger:MODE <Mode>

Selects the trigger mode for pulse modulation.

Parameters:

<Mode> AUTO | EXTernal | EGATe

AUTO
The pulse modulation is generated continuously.

EXTernal
The pulse modulation is triggered by an external trigger event. The trigger signal is supplied via the trigger connector.

EGATe
The pulse modulation is gated by an external gate signal. The trigger signal is supplied via the trigger connector.

*RST: AUTO

Example: `PULM:TRIG:MODE EXT`
selects triggering by an external trigger event.

Manual operation: See "Trigger Mode" on page 110

[:SOURce<hw>]:PULM:WIDTh <Width>

Sets the width of the generated pulse. The width determines the pulse length. The pulse width must be at least 20ns less than the set pulse period.

Parameters:

<Width> float

Range: 20 ns to 100 s
Increment: 10 ns
*RST: 2 us

Example: `PULM:WIDT 33 us`
sets a width of 33 us for the pulse.

Manual operation: See "Pulse Width" on page 108

11.19 SOURce:ROSCillator Subsystem

[:SOURce]:ROSCillator:EXTernal:FREQuency <ExtFreq>

Selects the frequency of the external reference.

Parameters:

<ExtFreq> 10MHZ | 100MHZ | 1000MHZ | 13MHZ

`13MHZ` requires RF board with part number 1419.5308.02.
To find out the RF board installed in the instrument:
Select "SGMA-GUI > instrument name > Setup > Hardware Config" > "RF Assembly"
Observe the part number of the assembly "RfBoard".

Example: See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.

Manual operation: See "Ext. Ref. Input Frequency" on page 80

[:SOURce]:ROSCillator:OUTPut:FREQuency <OutputFreq>

Selects the output for the reference oscillator signal.

Parameters:

<OutputFreq>	10MHZ | 100MHZ | 1000MHZ | 13MHZ `13MHZ` requires RF board with part number 1419.5308.02.
Example:	See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.
Manual operation:	See "Output Frequency" on page 81

[:SOURce]:ROSCillator:SOURce <Source>

Select the reference oscillator signal source.

Parameters:

<Source>	INTernal | EXTernal
Example:	See Chapter 11.1.2, "Generating an I/Q Modulated Signal", on page 186.
Manual operation:	See "Ref. Oscillator Source/Ext Ref On/Off" on page 61

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue <Value>

Allows an application to shift the reference oscillator frequency by a small amount.

The setting range depends on the reference oscillator type and its factory calibration value. Allowed are the following ranges:

- For TCXO oscillator: Max - Min = 1023
- For OCXO oscillator: Max - Min = 65535 (option R&S SGS-B1 required.)

Parameters:

<Value>	integer Range: Min to Max *RST: 32767
Example:	See Chapter 11.1.4, "Advanced Task for Optimizing Performance", on page 189.
Manual operation:	See "DAC Value" on page 82

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] <State>

Determines whether the calibrated (`OFF`) or a user-defined (`ON`) adjustment value is used for fine adjustment of the frequency.

If user-defined values are used, the instrument is no longer in the calibrated state. However, the calibration value is not changed and the instrument resumes the calibrated state after sending the command `:SOURce:ROSCillator:INTernal:ADJust:STATe OFF`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: -

Example:
`ROSC:SOUR INT`
Selects the internal source.
`ROSC:ADJ ON`
Activates use of a user-defined adjustment value.
`ROSC:ADJ:VAL 1400`
Sets the adjustment value to 1400.

Manual operation: See "Adjustment Active" on page 82

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <SBandwidth>

Sets the synchronization bandwidth for an external reference signal.

Parameters:

<SBandwidth> WIDE | NARRow

NARRow
The synchronization bandwidth is 40 Hz.

WIDE
Synchronization bandwidth is 250 Hz.

Example:
`ROSC:SOUR EXT`
Selects the external source.
`ROSC:EXT:FREQ 10 MHz`
Informs the instrument that the external reference has a frequency of 10 MHz.
`ROSC:EXT:SBAN WID`
Selects wideband setting for synchronization bandwidth.

Manual operation: See "Synchronization Bandwidth" on page 80

11.20 STATus Subsystem

This system contains the commands for the status reporting system. See also Chapter A.5, "Status Reporting System", on page 293 for detailed information.

`*RST` on page 195 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 SGS 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 259.

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

11.21 SYSTem Subsystem

The `SYSTem` subsystem contains a series of commands for general functions which do not directly affect signal generation.

:SYSTem:EMODe <Mode>

Enables and selects the Eco Mode. With enabled eco mode `EM1` the doubler stage in a 12 GHz instrument is permanently switched off to reduce power consumption and the maximum frequency is limited to 6 GHz.

Parameters:

<Mode> OFF | EM1

*RST: OFF

Example: see Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184

:SYSTem:ERRor:ALL?

Queries the error/event queue for all unread items and removes them from the queue. The response is a comma separated list of error number and a short description of the error in FIFO order.

Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Return values:

<All> string

List of: Error/event_number,"Error/event_description>[;Device-dependent info]"
If the queue is empty, the response is `0,"No error"`

Example: `SYST:ERR:ALL?`
queries all entries in the error queue.
`Response: 0, 'no error'`
No errors have occurred since the error queue was last read out.

Usage: Query only

:SYSTem:ERRor:CODE:ALL?

Queries all entries in the error queue and then deletes them. Only the error numbers are returned and not the entire error text.

Return values:

<All> string

0
"No error", i.e. the error queue is empty

positive value
Positive error numbers denote device-specific errors

negative value
Negative error numbers denote error messages defined by SCPI.

Example: `SYST:ERR:CODE:ALL`
queries all entries in the error queue.
`Response: 0`
no errors have occurred since the error queue was last read out.

Usage: Query only

:SYSTem:ERRor:CODE[:NEXT]?

Queries the oldest entry in the error queue and then deletes it. Only the error number is returned and not the entire error text.

Return values:

<Next> string

0
"No error", i.e. the error queue is empty

positive value
Positive error numbers denote device-specific errors

negative value
Negative error numbers denote error messages defined by SCPI.

Example: `SYST:ERR:CODE`
queries the oldest entry in the error queue.
`Response: 0`
No errors have occurred since the error queue was last read out.

Usage: Query only

:SYSTem:ERRor:COUNt?

Queries the number of entries in the error queue. If the error queue is empty, '0' is returned.

Return values:

<Count> string

Example: `SYST:ERR:COUN`
queries the number of entries in the error queue.
`Response: 1`
One error has occurred since the error queue was last read out.

Usage: Query only

:SYSTem:ERRor[:NEXT]?

Queries the error/event queue for the oldest item and removes it from the queue. The response consists of an error number and a short description of the error.

Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Return values:
<Next> string

Error/event_number,"Error/event_description>[;Device-dependent info]"
If the queue is empty, the response is `0,"No error"`

Example: `SYST:ERR?`
queries the oldest entry in the error queue.
`Response: 0, 'no error'`
No errors have occurred since the error queue was last read out.

Usage: Query only

:SYSTem:SERRor?

Returns a list of all errors existing at the time when the query is started. This list corresponds to the display on the info page under manual control.

Return values:
<Serror> string

Example: `SYST:SERR`
queries all errors existing in the error queue.

Example: `Response: -221, 'Settings conflict', 153, 'Input voltage out of range'`
The two returned errors have occurred since the error queue was last queried.

Usage: Query only

:SYSTem: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:COMMunicate:NETWork:IPADdress <IpAddress>

Sets the IP address.

Parameters:

<IpAddress> string
Range: 0.0.0.0. to ff.ff.ff.ff

Example: `SYSTem:COMMunicate:NETWork:IPADdress '7.8.9.10'`
sets the IP address of the instrument.

Manual operation: See "IP Address" on page 134

:SYSTem:COMMunicate:NETWork:IPADdress:MODE <Mode>

Selects manual or automatic setting of the IP address.

Parameters:

<Mode> AUTO | STATic
*RST: AUTO

Example: `SYSTem:COMMunicate:NETWork:IPADdress:MODE AUTO`
the IP address is assigned automatically (DHCP)

Manual operation: See "Address Mode" on page 133

:SYSTem:COMMunicate:NETWork:MACaddress <MacAddress>

Queries the MAC address of the network adapter.

Parameters:

<MacAddress> string

Example: `SYST:COMM:NETW:MAC`
queries the MAC address.

:SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Return values:

<State> 0 | 1 | OFF | ON

Usage: Query only

:SYSTem:COMMunicate:NETWork:RESTart

Restarts the network connection to the instrument, terminates the connection and sets it up again.

Example: `SYSTem:COMMunicate:NETWork:RESTart`

Usage: Event

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

Sets the individual host name of the R&S SGS.

Note: it is recommended that you do not change the host name in order to avoid problems with the networdk connection. However, if you change the host name be sure to use an unique name.

The host name is a protected parameter, To change it, first disable protection level 1 with command `:SYSTem:PROTect<ch>[:STATe]` on page 264.

Parameters:
<Hostname> string

Example: `SYSTem:PROTect1:STATe OFF,123456`
`SYSTem:COMMunicate:NETWork:HOSTname 'SIGGEN'`
sets the individual computer name of the R&S SGS.

Manual operation: See "Hostname" on page 133

:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway <Gateway>

Sets the IP address of the default gateway.

Parameters:
<Gateway> string
Range: 0.0.0.0 to ff.ff.ff.ff

Example: `SYSTem:COMMunicate:NETWork:IPADdress:GATeway '1.2.3.4'`
sets the IP address of the default gateway.

Manual operation: See "Default Gateway" on page 134

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

Sets the subnet mask.

Parameters:
<Mask> string

Example: `SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK '255.255.0.0'`
determines the subnet mask.

Manual operation: See "Subnet Mask" on page 134

:SYSTem:COMMunicate:NETWork:RESource?

Queries the VISA resource string, used for remote control of the instrument with VXI-11 protocol.

Return values:
<Resource> string

Example: `SYSTem:COMMunicate:NETWork:RESource?`
Response: "`TCPIP::192.1.2.3::INSTR`"

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 135

:SYSTem:COMMunicate:SERial:BAUD <Baud>

Sets the baudrate for the serial remote control interface.

Parameters:
<Baud> 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200
*RST: 115200

Example: `SYSTem:COMMunicate:SERial:BAUD 115200`
determines 115200 baudrate.

:SYSTem:COMMunicate:SERial:PARity <Parity>

Sets the parity for the serial remote control interface.

Parameters:
<Parity> NONE | ODD | EVEN
*RST: NONE

Example: `SYST:COMM:SER:PAR NONE`
selects parity NONE.

:SYSTem:COMMunicate:SERial:RESource?

Queries the visa resource string for the serial remote control interface. This string is used for remote control of the instrument.

Return values:
<Resource> string

Example: `SYSTem:COMMunicate:SERial:RESource?`
queries the VISA resource string.
Response: "`ASRL1::INSTR`"

Usage: Query only

:SYSTem:COMMunicate:SERial:SBITs <SBits>

Sets the number of stop bits for the serial remote control interface.

Parameters:

<SBits> 1 | 2

*RST: 1

Example: `SYST:COMM:SER:SBIT 2`
selects 2 stop bits.

:SYSTem:COMMunicate:HISLip:RESource?

Queries the VISA resource string, used for remote control of the instrument with HiSLIP protocol.

Return values:

<Resource> string

Example: `SYSTem:COMMunicate:HISLip:RESource?`
Response: `"TCPIP::192.1.2.3::hislip0::INSTR"`

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 135

:SYSTem:COMMunicate:PCIexpress:RESource?

Queries the visa resource string for remote control via the PCIe interface.

Return values:

<Resource> string

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 135

:SYSTem:COMMunicate:SOCKet:RESource?

Queries the visa resource string for remote control via LAN interface, using TCP/IP socket protocol.

Return values:

<Resource> string

Example: `SYSTem:COMMunicate:SOCKet:RESource?`
Response: `"TCPIP::10.113.1.150::5025::SOCKET"`

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 135

:SYSTem:COMMunicate:USB:RESource?

Queries the visa resource string for remote control via the USB interface.

Return values:

<Resource> string

Example: `SYSTem:COMMunicate:USB:RESource?`
queries the VISA resource string for remote control via the USB interface.
Response: "`USB::72::000000::INSTR`"

Usage: Query only

Manual operation: See "Visa Resource Strings" on page 135

: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?
// 1
// the startup of the instrument is completed
```

Usage: Query only

:SYSTem:PROTect<ch>[:STATe] <State>[, <Key>]

Activates/deactivates the specified protection level.

Parameters:

<State> select
*RST: 1

Setting parameters:

<Key> integer
The respective functions are disabled when the protection level is activated. No password is required for activation. A password must be entered to deactivate the protection level. The password for the first level is 123456.
This protection level can be used to lock-out internal adjustments.

Example: `SYSTem:PROTect1:STATe ON`
activates protection level 1. Internal adjustments are only possible after deactivating the lock-out.
`SYSTem:PROTect1:STATe OFF,123456`
deactivates protection level 1. Internal adjustments are enabled again.

:SYSTem:HARDware:ASSembly<dir>:NAME?

The query returns a list of hardware assembly names.

Suffix:
<dir> 1..2
Defines the section: 1 = common assembly, 2 = RF assembly.

Return values:
<Name> string

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Assembly" on page 124

:SYSTem:HARDware:ASSembly<dir>:PNUMber?

The query returns the list of hardware module part numbers.

Suffix:
<dir> 1..2
Defines the section: 1 = common assembly, 2 = RF assembly.

Return values:
<PNumber> string

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Assembly" on page 124

:SYSTem:HARDware:ASSembly<dir>:REVision?

Queries the list of hardware module revisions.

Suffix:
<dir> 1..2
Defines the section: 1 = common assembly, 2 = RF assembly.

Return values:
<Revision> string

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Assembly" on page 124

:SYSTem:HARDware:ASSembly<dir>:SNUMber?

Queries the list of hardware module serial numbers.

Suffix:

<dir> 1..2
Defines the section: 1 = common assembly, 2 = RF assembly.

Return values:

<SNumber> string

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Assembly" on page 124

:SYSTem:SOFTware:OPTion<dir>:DESignation?

Queries the list of option descriptions.

Suffix:

<dir> 1..2
Defines the section: 1 = hardware, 2 = software.

Return values:

<Designation> string

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Hardware / Software/WinIQSIM" on page 126

:SYSTem:SOFTware:OPTion<dir>:EXPiration?

Queries the list of option expiration informations.

Suffix:

<dir> 1..2
Defines the section: 1 = hardware, 2 = software.

Return values:

<Expiration> string

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

Manual operation: See "Hardware / Software/WinIQSIM" on page 126

:SYSTem:SOFTware:OPTion<dir>:LICenses?

Queries the list of option license counts.

Suffix:

<dir>	1..2 Defines the section: 1 = hardware, 2 = software.

Return values:

<Licenses>	string
Example:	See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.
Usage:	Query only
Manual operation:	See "Hardware / Software/WinIQSIM" on page 126

:SYSTem:SOFTware:OPTion<dir>:NAME?

Queries the list of option names.

Suffix:

<dir>	1..2 Defines the section: 1 = hardware, 2 = software.

Return values:

<Name>	string
Example:	See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.
Usage:	Query only
Manual operation:	See "Hardware / Software/WinIQSIM" on page 126

:SYSTem:MMEMory:PATH:USER?

Queries the user directory, that means the directory the instrument stores user files on.

Return values:

<PathUser>	string
Example:	`SYSTem:MMEMory:PATH:USER?` Response: "/var/sgs/"'
Usage:	Query only

:SYSTem:OSYStem?

Queries the operating system of the instrument.

Return values:

<OperSystem>	string

Example: `SYSTem:OSYStem?`
Response: `"Linux"`

Usage: Query only

11.22 TEST Subsystem

The TEST system contains the commands for performing the routines as well as for direct manipulation of the hardware assemblies (`:TEST:DIRect`).

The self tests return a "0" if the test is performed successfully, otherwise a value other than "0" is returned. None of the commands of this system have an `*RST` value.

NOTICE

Improper use can destroy the assembly

The respective hardware assembly responds directly to the `:TEST:DIRect` command; any safety mechanisms are bypassed. The command is intended for servicing purposes and should be used only by the Rohde & Schwarz service personnel.

:TEST:ALL:STARt

Starts the selftest. Use the command `:TEST:ALL:RESult?` to query the result.

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Event

:TEST:ALL:RESult?

Queries the result of the performed selftest. Start the selftest with `:TEST:ALL:STARt`.

Return values:
<Result> 0 | 1 | RUNning | STOPped
*RST: STOPped

Example: See Chapter 11.1.1, "Performing General Task for Instrument Setup", on page 184.

Usage: Query only

:TEST:KEYBoard[:STATe] <State>

Enable/disable keyboard and LED test state.

Parameters:

<State>	0 | 1 | OFF | ON

11.23 UNIT Subsystem

The `UNIT` subsystem contains the commands specifying which units are valid if no unit is indicated in a command. These settings are valid for the entire instrument.

:UNIT:ANGLe <Angle>

Sets the default angle unit for remote control. Does not influence the manual control parameter units and the display.

Parameters:

<Angle> DEGRee | RADian

*RST: RADian

Example: `UNIT:ANGL DEG`
sets DEG as a default unit for all commands which determine angle values.

:UNIT:POWer <Power>

Defines the default unit for power parameters. This setting affects the GUI, as well as all remote control commands that determine power values.

Parameters:

<Power> V | DBUV | DBM

*RST: DBM

Example: `UNIT:POW V`
sets V as a default unit for all commands which determine power values.

11.24 List of R&S SGS Commands

12 Maintenance

The instrument does not need periodic maintenance. Only cleaning the instrument is essential.

Follow the instructions in the service manual and the safety instructions when exchanging modules or ordering spare parts. The order number for spare parts is included in the service manual. The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) and alignment.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

12.1 Cleaning

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth. Make sure that the fan openings are not obstructed.

WARNING

Shock hazard

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

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument. For example, cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances.

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

NOTICE

Risk of instrument damage due to obstructed fans

If the instrument is operated in dusty areas, the fans may become obstructed by dust or other particles in the process of time. Make sure to check and, if necessary, clean the fans regularly to ensure they operate properly at all times. If the instrument is run with obstructed fans for a longer period, it may become overheated which may cause damage.

12.2 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 Error Messages and Troubleshooting

This chapter describes the error messages of the R&S SGS. The error messages are output in the "Info" line on the screen and entered in the error/event queue of the status reporting system.

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. Some error messages require that the error must be eliminated before correct instrument operation can be ensured. The "Info" window with a list of current messages and a detailed description of each message can be opened with the "Info" button (see also Chapter 6.2.1, "Info Dialog", on page 57).

13.1 Status Information

The status messages are displayed in the Info line of the R&S SGMA-GUI main panel. The status information gives the user an overview of the main operating states and settings of the instrument. The states are indicated for information only and do not necessitate any action by the user.

Status Information displayed in the Info line

AttFixed
Attenuator fixed mode is active.

The uninterrupted level settings are made in a fixed range without attenuator switching. The variation range is set automatically when this mode is activated. The range is displayed with the parameter "SGMA-GUI > Instrument Name > Level > Attenuator Fixed Range".

13.2 Error Messages

Messages indicate errors in the instrument. They are displayed in the info line in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

See also Chapter 6.2.1, "Info Dialog", on page 57 and Chapter 6.2.2, "Understanding the Messages in the Info Bar", on page 58.

13.2.1 Volatile messages

Volatile messages report automatic settings in the instrument (e.g. switching off of incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.

Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

SCPI command: `:SYSTem:ERRor:ALL?` and `:SYSTem:ERRor[:NEXT]?`.

13.2.2 Permanent messages

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

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

SCPI command: `:SYSTem:SERRor?`

13.3 SCPI-Error Messages

The SCPI error messages are the same in all SCPI instruments. Detailed information and an overview of all error messages as defined in SCPI standard can be found in the corresponding documentation.

The errors are assigned negative numbers. The error text being entered into the error/event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation as to the respective error.

13.4 Device-Specific Error Messages

The following table contains all error messages specific for the instrument in alphabetical order, as well as an explanation of the error situation. The positive error codes mark the errors specific of the instrument.

The device-specific error messages set bit 3 in the ESR register.

The index provides a list of the error messages sorted according to their error codes.

Error Code	Error	Description	Remedy
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 are missing.	The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the instrument.
183	Adjustment data invalid	Adjustment data are invalid and must be restored.	The adjustment data have to be generated again by an internal or external adjustment or to be loaded into the instrument.
200	Cannot access hardware	The data transmission to a module was unsuccessful.	The module is not installed, not properly installed or missing.
201	Hardware revision out of date	A later version of certain parts of the instrument is necessary to execute the function selected.	The driver does not support the installed version of a module.
202	Cannot access the EEPROM	A error occurs when writing or reading a EEPROM.	The EEPROM might be defect and has to be replaced.
203	Invalid EEPROM data		
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. For instance, the file extension for mapping files is `*.map`. It is not possible to enter another file extension when selecting a list.	Check the selected list type.
460	Cannot open file	The selected file can not be opened.	Check the path and file name.
461	Cannot write file	The file can not be written.	Check if the file is read-only.
462	Cannot read file	The file can not be read.	Check if the file contents are compatible with the file type.
463	Filename missing	The required operation cannot be executed because the file name is not specified.	A file name has to be entered when creating a new list.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extension. For instance, the file extension for the mapping files is `*.map`. It is not possible to enter another file extension when storing a list.

Error Code	Error	Description	Remedy
465	File contains invalid data	The selected file contains data that is not valid for the file type.	Check the file extension. The file extension determines the data that is valid for this file type. If the file extension is changed the lists are no longer recognized and the data are therefore invalid.
468	Cannot find directory	Required folder cannot be found.	Check drive and path.
469	No files found	Folder is empty	

Annex

A Remote Control Basics

This chapter provides basic information on operating an instrument via remote control.

A.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.3, "SCPI Command Structure", on page 282. 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.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.3 SCPI Command Structure

SCPI commands consist of a so-called header and, in most cases, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

A.3.1 Syntax for Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk (*) and possibly one or more parameters.

Examples:

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

A.3.2 Syntax for Device-Specific Commands

Not all commands used in the following examples are necessarily implemented in the instrument.

For demonstration purposes only, assume the existence of the following commands for this section:

- `DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`
- `FORMat:READings:DATA <type>[,<length>]`
- `HCOPy:DEVice:COLor <Boolean>`
- `HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`
- `HCOPy[:IMMediate]`
- `HCOPy:ITEM:ALL`
- `HCOPy:ITEM:LABel <string>`
- `HCOPy:PAGE:DIMensions:QUADrant[<N>]`
- `HCOPy:PAGE:ORIentation LANDscape | PORTrait`
- `HCOPy:PAGE:SCALe <numeric value>`
- `MMEMory:COPY <file_source>,<file_destination>`
- `SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
- `SENSe:FREQuency:STOP <numeric value>`
- `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`HCOPy:DEVice:COLor ON` is equivalent to `HCOP:DEV:COL ON`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: `HCOPy:PAGE:DIMensions:QUADrant[<N>]`

Command: `HCOP:PAGE:DIM:QUAD2`

This command refers to the quadrant 2.

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `HCOPy[:IMMediate]`

Command: `HCOP:IMM` is equivalent to `HCOP`

Optional mnemonics with numeric suffixes

Do not omit an optional mnemonic if it includes a numeric suffix that is relevant for the effect of the command.

Example:

Definition:`DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`

Command: `DISP:MAX ON` refers to window 1.

In order to refer to a window other than 1, you must include the optional `WINDow` parameter with the suffix for the required window.

`DISP:WIND2:MAX ON` refers to window 2.

Parameters

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma (,). For a description of the parameter types, refer to Chapter A.3.3, "SCPI Parameters", on page 286.

Example:

Definition:`HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`

Command:`HCOP:DEV:CMAP:COL:RGB 3,32,44`

Special characters

<table>
<tr><td>|</td><td>Parameters
A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
Example:
Definition:HCOPy:PAGE:ORIentation LANDscape | PORTrait
Command HCOP:PAGE:ORI LAND specifies landscape orientation
Command HCOP:PAGE:ORI PORT specifies portrait orientation
Mnemonics
A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used.
Example:
DefinitionSENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>
The two following commands with identical meaning can be created:
SENS:BAND:RES 1
SENS:BWID:RES 1</td></tr>
<tr><td>[ ]</td><td>Mnemonics in square brackets are optional and may be inserted into the header or omitted.
Example: HCOPy[:IMMediate]
HCOP:IMM is equivalent to HCOP</td></tr>
<tr><td>{ }</td><td>Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
Example: SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}
The following are valid commands:
SENS:LIST:FREQ 10
SENS:LIST:FREQ 10,20
SENS:LIST:FREQ 10,20,30,40</td></tr>
</table>

A.3.3 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `SENS:FREQ:STOP 1.5GHz` = `SENS:FREQ:STOP 1.5E9`

Units

For physical quantities, the unit can be entered. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)
- N (nano)

If the unit is missing, the basic unit is used.

Example:

`SENSe:FREQ:STOP 1.5GHz` = `SENSe:FREQ:STOP 1.5E9`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:

`HCOP:PAGE:SCAL 90PCT`

Special numeric values

The texts listed below are interpreted as special numeric values. In the case of a query, the numeric value is provided.

- **MIN/MAX**
  MINimum and MAXimum denote the minimum and maximum value.
- **DEF**
  DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.
- **UP/DOWN**
  UP, DOWN increases or reduces the numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP, DOWN.
- **INF/NINF**

INFinity, Negative INFinity (NINF) represent the numeric values 9.9E37 or -9.9E37, respectively. INF and NINF are only sent as instrument responses.

- **NAN**
  Not A Number (NAN) represents the value 9.91E37. NAN is only sent as a instrument response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Example:

Setting command: `SENSe:LIST:FREQ MAXimum`

Query: `SENS:LIST:FREQ?, Response: 3.5E9`

Queries for special numeric values

The numeric values associated to `MAXimum/MINimum/DEFault` can be queried by adding the corresponding mnemonics to the command. They must be entered following the quotation mark.

Example: `SENSe:LIST:FREQ? MAXimum`

Returns the maximum numeric value as a result.

Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `HCOPy:DEV:COL ON`

Query: `HCOPy:DEV:COL?`

Response: `1`

Text parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:

Setting command: `HCOPy:PAGE:ORIentation LANDscape`

Query: `HCOP:PAGE:ORI?`

Response: `LAND`

Character strings

Strings must always be entered in quotation marks (' or ").

Example:

`HCOP:ITEM:LABel "Test1"` or `HCOP:ITEM:LABel 'Test1'`

Block data

Block data is a format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

`FORMat:READings:DATA #45168xxxxxxxx`

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

A.3.4 Overview of Syntax Elements

The following table provides an overview of the syntax elements:

:	The colon separates the mnemonics of a command. In a command line the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
' ' "	Quotation marks introduce a string and terminate it (both single and double quotation marks are possible).
#	The hash symbol introduces binary, octal, hexadecimal and block data. • Binary: #B10110 • Octal: #O7612 • Hexa: #HF3A7 • Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

A.3.5 Structure of a command line

A command line may consist of one or several commands. It is terminated by one of the following:

- a <New Line>
- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

`MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL`

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Example:

`HCOP:ITEM ALL;:HCOP:IMM`

This command line contains two commands. Both commands are part of the `HCOP` command system, i.e. they have one level in common.

When abbreviating the command line, the second command begins with the level below HCOP. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

`HCOP:ITEM ALL;IMM`

A new command line always begins with the complete path.

Example:

`HCOP:ITEM ALL`

`HCOP:IMM`

A.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`

A.4 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command is one which finishes executing before the next command starts executing. Commands that are processed quickly are usually implemented as sequential commands. Sequential commands are not implemented in the instrument, however the execution time of most commands is so short that they act as sequential commands when sent in different command lines.
- An overlapping command is one which does not automatically finish executing before the next command starts executing. Usually, overlapping commands take longer to process and allow the program to do other tasks while being executed. If overlapping commands do have to be executed in a defined order, e.g. in order to avoid wrong measurement results, they must be serviced sequentially. This is called synchronization between the controller and the instrument.

Setting commands within one command line, even though they may be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line.

As a general rule, send commands and queries in different program messages.

A.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-1: Synchronization using *OPC, *OPC? and *WAI*

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This 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.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.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).

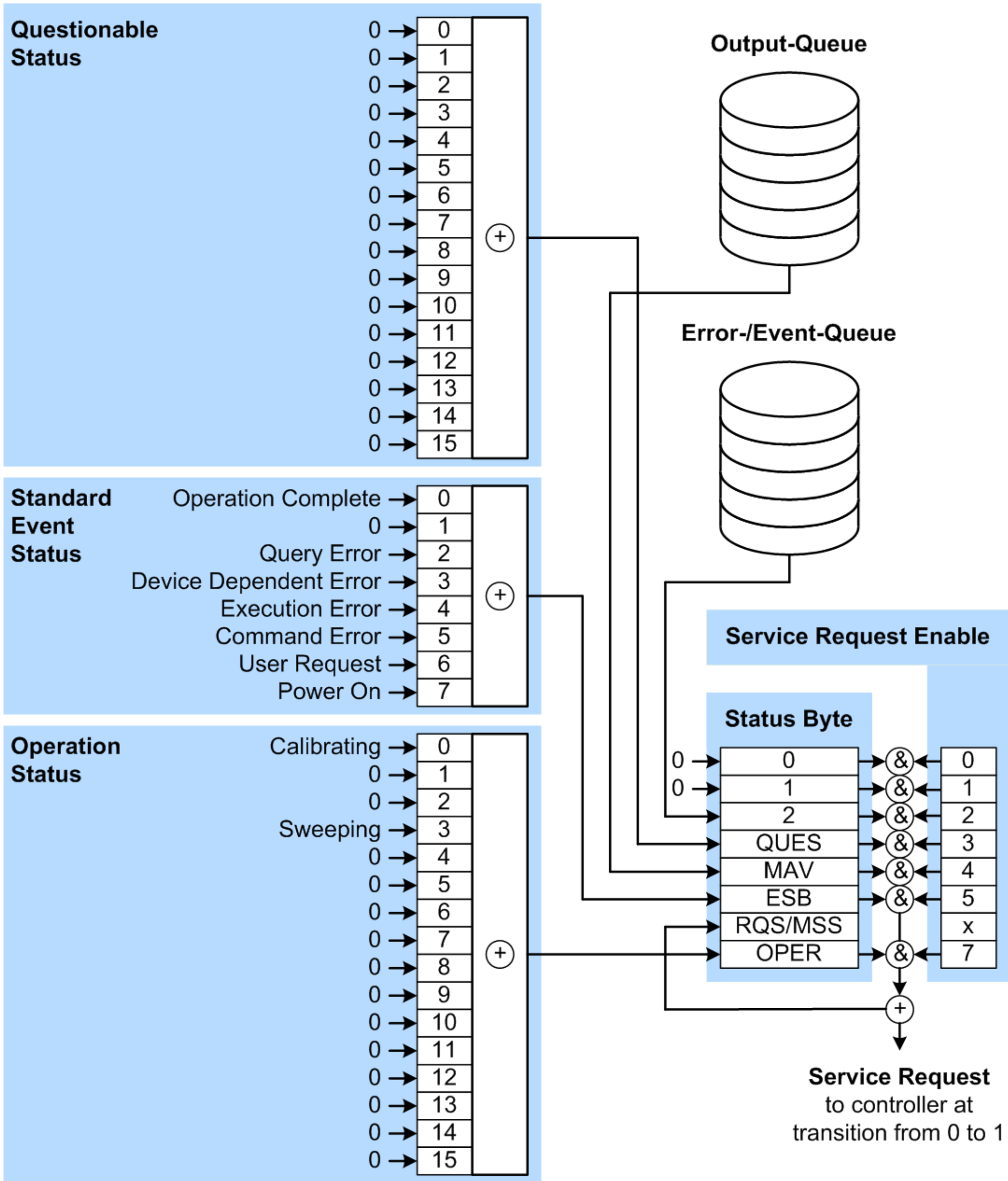


Figure A-1: Graphical overview of the status registers hierarchy

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 SGS uses the following status registers:

- **Status Byte** (STB) and **Service Request Enable** (SRE), see Chapter A.5.3, "Status Byte (STB) and Service Request Enable Register (SRE)", on page 297.

- **Standard Event Status**, i.e. the Event status Register (ESR) and the Event Status Enable (ESE), see Chapter A.5.4, "Event Status Register (ESR) and Event Status Enable Register (ESE)", on page 298.
- **Questionable Status** and **Operation Status**, the (SCPI status registers, see Chapter A.5.2, "Structure of a SCPI Status Register", on page 295, Chapter A.5.5, "Questionable Status Register (STATus:QUEStionable)", on page 298 and Chapter A.5.6, "Operation Status Register (STATus:OPERation)", on page 299.
- **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.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.

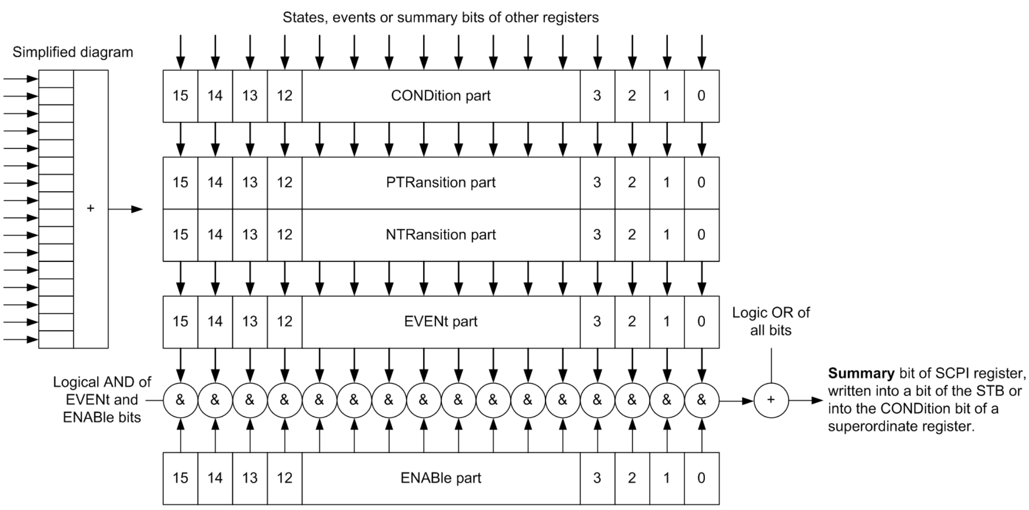


Figure A-2: The status-register model

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.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-2: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
2	Error Queue not empty The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	QUEStionable status register summary bit The bit is set if an `EVENt` bit is set in the `QUEStionable` status register and the associated `ENABle` bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by querying the `STATus:QUEStionable` status register.
4	MAV bit (message available) The bit is set if a message is available in the output queue which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	ESB bit Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	MSS bit (master status summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	`STATus:OPERation` status register summary bit The bit is set if an `EVENt` bit is set in the `OPERation` status register and the associated `ENABle` bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by querying the `STATus:OPERation` status register.

A.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-3: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	Not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.
5	Command Error This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	User Request This bit is set when the instrument is switched over to manual control.
7	Power On (supply voltage on) This bit is set on switching on the instrument.

A.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-4: Meaning of the bits used in the questionable status register

Bit No.	Meaning
0–15	Not used

A.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-5: 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.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**

A.5.7.1 Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. An SRQ is always initiated if one or several of bits 2, 4 or 5 of the status byte are set and enabled in the SRE. Each of these bits combines the information of the error queue or the output buffer. To use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Example:

Use command *OPC to generate an SRQ .

*ESE 1 - set bit 0 of ESE (Operation Complete)

*SRE 32 - set bit 5 of SRE (ESB).

After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

A.5.7.2 Serial Poll

In a serial poll, just as with command *STB, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster.

The serial poll method is defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

A.5.7.3 Query of an instrument status

Each part of any status register can be read using queries. There are two types of commands:

- The common commands *ESR?, *IDN?, *IST?, *STB? query the higher-level registers.
- The commands of the STATus system query the SCPI registers (STATus:QUEStionable...)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

A.5.7.4 Error Queue

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain text error messages that can be looked up in the Error Log or queried via remote control using SYSTem:ERRor[:NEXT]?. 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.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-6: 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.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.

B 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 SGS 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;
}
```

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