R&S®Spectrum Rider FPH
Handheld Spectrum Analyzer
User Manual

1321.1011.02 — 02.00

ROHDE&SCHWARZ

Test & Measurement

User Manual

This manual describes the following R&S®FPH model and options:

- R&S® FPH (1321.1111.02)
- R&S ®FPH-B3 (1321.0667.02)
- R&S ®FPH-B4 (1321.0673.02)
- R&S ®FPH-B22 (1321.0680.02)
- R&S ® FPH-K7 (1321.0696.02)
- R&S ® FPH-K9 (1321.0709.02)
- R&S ® FPH-K19 (1321.0721.02)
- R&S ® FPH-K29 (1321.0738.02)

The contents of this manual correspond to firmware version 1.00 or higher.

The firmware of the R&S Spectrum Rider makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual: R&S®Spectrum Rider is abbreviated as R&S Spectrum Rider, R&S®Instrument View is abbreviated as R&S Instrument View

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.

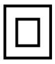
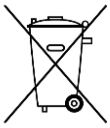
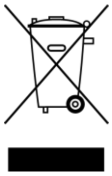
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English.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

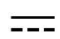
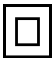
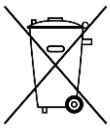
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa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

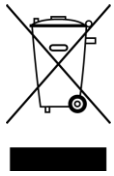
Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto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

Safety instructions for rechargeable lithium ion batteries

⚠ WARNING

Risk of serious personal injury or even death.

You must fully observe the following instructions in order to avoid serious personal injury – or even death – due to an explosion and/or fire.

1. Do not dismantle, open or crush the batteries or drop them from a great height. If mechanical damage occurs, there is a risk that chemicals may be released. Gases that are released can cause breathing difficulties. Immediately ventilate the area and in serious cases consult a doctor.
   Irritation can occur if the chemicals that are released come in contact with the skin or eyes. If this happens, immediately and thoroughly rinse the skin or eyes with water and consult a doctor.
2. Do not expose cells or batteries to heat or fire. Do not store them in direct sunlight. If overheating occurs, there is the risk of an explosion or a fire, which can lead to serious personal injuries.
3. Keep the batteries clean and dry. If the terminals become soiled, clean them with a dry, clean cloth.
4. Charge the batteries prior to using them.
   Only use the appropriate Rohde & Schwarz charger to charge the batteries. See the device manual or data sheet for the exact designation of the charger.
   If the batteries are improperly charged, there is a risk of explosion, which can cause serious personal injury.
5. The charging temperature must be between 0 °C and 45 °C
   (see manual for information on possible restrictions).
6. Discharging may take place only at temperatures between 0 °C and 50 °C
   (see manual for information on possible restrictions).
7. Only charge batteries until they are fully charged. Frequent overcharging can reduce the battery lifetime.
8. Remove the battery from the device when the battery is not being used. Following a longer period of storage, it may be necessary to charge and discharge the battery several times in order to obtain the full capacity.
9. Only use the battery with designated Rohde & Schwarz devices. See the device manual for details.
10. Do not dispose of the batteries with unsorted municipal waste. The batteries must be collected separately. After the end of their life, dispose of the batteries at a suitable collection point or via a Rohde & Schwarz customer service center.

    
    EU labeling for batteries and secondary cells
11. Keep this safety information for future reference.

Instrucciones de seguridad para baterías recargables de ión litio

⚠ ADVERTENCIA

Posibilidad de lesiones graves que en determinadas circunstancias puede causar la muerte.

Tenga en cuenta los siguientes avisos en caso de explosión y/o incendio para impedir lesiones graves en personas que, en determinadas circunstancias, podrían incluso causar la muerte.

1. No desarme las baterías, no las abra, no las triture ni las deje caer desde una gran altura.
   En caso de daños mecánicos existe el riesgo de salida de sustancias químicas.
   En caso de salida de gases pueden producirse dificultades respiratorias. Ventile inmediatamente la habitación y acuda a un médico en casos graves.
   Si sustancias químicas provenientes de la batería entran en contacto con la piel o los ojos pueden producirse irritaciones. Enjuague en estos casos la piel y los ojos inmediatamente con abundante agua y acuda a un médico.
2. No exponga las celdas o baterías al calor ni al fuego. No las almacene bajo la luz solar directa. En caso de sobrecalentamiento existe peligro de explosión o de incendio, lo que puede provocar lesiones graves en personas.
3. Mantenga las baterías limpias y secas. Si los conectores están sucios, límpielos con un paño seco y limpio.
4. Cargue las baterías antes de su uso.
   Solamente está permitido cargar la batería con el correspondiente cargador de Rohde & Schwarz. Consulte en el manual o en las especificaciones técnicas del equipo la denominación exacta del cargador.
   Si las baterías se cargan de forma incorrecta existe peligro de explosión, lo que podría causar lesiones graves en personas.
5. La temperatura de carga debe encontrarse entre 0 °C y 45 °C
   (consulte el manual para posibles restricciones).
6. La descarga solamente puede efectuarse entre 0 °C y 50°C
   (consulte el manual para posibles restricciones).
7. Cargue las baterías solamente el tiempo necesario hasta que se hayan cargado por completo. La sobrecarga frecuente reduce la vida útil de la batería.
8. Extraiga la batería del equipo si no se va a utilizar. Después de un periodo de almacenamiento prolongado puede ser necesario cargar y descargar varias veces la batería para recuperar su capacidad completa.
9. Utilice la batería exclusivamente con los equipos Rohde & Schwarz correspondientes. Consulte para ello el manual del equipo.
10. No elimine las baterías junto con los residuos urbanos sin clasificar, sino por separado. Para eliminar la batería una vez finalizada su vida útil, diríjase a un punto de recogida de residuos adecuado o a una oficina de representación de Rohde & Schwarz.

    Etiquetado de la UE para baterías y acumuladores
11. Conserve estas instrucciones de seguridad para fines de información y consulta posterior.

Sicherheitshinweise
für wiederaufladbare Li-Ion-Batterien

⚠ WARNUNG

Mögliche schwere Verletzungen, unter Umständen mit Todesfolge.

Beachten Sie die folgenden Hinweise vollständig, um schwere Verletzungen von Personen - unter Umständen mit Todesfolge - durch Explosion und/oder Brand zu verhindern.

1. Batterien nicht zerlegen, öffnen, zerkleinern oder aus großer Höhe fallen lassen.
   Bei mechanischer Beschädigung besteht die Gefahr des Austritts von Chemikalien. Austretende Gase können zu Atembeschwerden führen. Sofort lüften, in schweren Fällen einen Arzt konsultieren.
   Bei Haut- oder Augenkontakt mit austretenden Chemikalien können Hautirritationen und Reizungen auftreten. In diesen Fällen die Haut oder Augen sofort gründlich mit Wasser ausspülen und einen Arzt konsultieren.
2. Zellen oder Batterien weder Hitze noch Feuer aussetzen. Nicht im direkten Sonnenlicht lagern. Bei Überhitzung besteht die Gefahr einer Explosion oder eines Brandes, was zu schweren Verletzungen bei Personen führen kann.
3. Batterien sauber und trocken halten. Falls die Anschlüsse verschmutzt sind, mit einem trockenen, sauberen Tuch reinigen.
4. Batterien vor dem Gebrauch laden.
   Die Batterie darf ausschließlich mit dem entsprechenden Rohde &Schwarz Ladegerät geladen werden. Siehe Handbuch oder Datenblatt des Gerätes für die genaue Bezeichnung des Ladegerätes.
   Wenn Batterien unsachgemäß geladen werden, besteht Explosionsgefahr, was zu schweren Verletzungen bei Personen führen kann.
5. Die Ladetemperatur muss zwischen 0 °C und 45 °C betragen
   (für mögliche Einschränkungen siehe Handbuch).
6. Ein Entladen darf nur zwischen 0 °C und 50 °C erfolgen
   (für mögliche Einschränkungen siehe Handbuch).
7. Batterien nur so lange laden, bis sie vollständig aufgeladen sind. Ein häufiges Überladen führt zu einer geringeren Lebensdauer der Batterie.
8. Die Batterie aus dem Gerät entfernen, wenn sie nicht benutzt wird. Nach längerer Lagerzeit kann es erforderlich sein, die Batterie mehrmals zu laden und zu entladen, um die volle Leistungsfähigkeit zu erlangen.
9. Die Batterie nur mit dafür vorgesehenen Rohde & Schwarz-Geräten betreiben. Siehe dazu das Handbuch des Gerätes.
10. Die Batterien nicht über unsortierten Siedlungsabfall entsorgen, sondern getrennt sammeln. Nach Ende der Lebensdauer über eine geeignete Sammelstelle oder eine Rohde&Schwarz-Kundendienststelle entsorgen.

    
    EU - Kennzeichnung für Batterien und Akkumulatoren
11. Diese Sicherheitsinformationen für zukünftige Informations- und Nachschlagezwecke aufbewahren.

Consignes de sécurité pour batteries rechargeables lithium-ion

⚠ AVERTISSEMENT Risque de blessures graves pouvant entraîner la mort.

Respecter intégralement les consignes ci-dessous afin d'éliminer tout risque de blessures graves voire mortelles par suite d'explosion et/ou d'incendie.

1. Ne pas démonter, ouvrir ou découper les batteries ni les faire tomber d'une hauteur importante. Des produits chimiques peuvent s'écouler en cas de détérioration mécanique et les gaz libérés peuvent provoquer des difficultés respiratoires. Aérer immédiatement les locaux. Dans les cas graves, consulter un médecin. Si la peau ou les yeux entrent en contact avec les produits chimiques libérés, des irritations peuvent se produire. Rincer immédiatement et abondamment la peau ou les yeux à l'eau claire et consulter un médecin.
2. Ne pas exposer les cellules ou les batteries à la chaleur ou au feu. Ne pas les stocker dans un endroit exposé à la lumière directe du soleil. Toute surchauffe risque de provoquer une explosion ou un incendie, ce qui peut entraîner des blessures graves.
3. Conserver les batteries dans un lieu sec et propre. Nettoyer les points de contact sales à l'aide d'un chiffon sec et propre.
4. Charger les batteries avant utilisation. Utiliser seulement le chargeur Rohde & Schwarz approprié pour recharger les batteries. Les références exactes du chargeur sont indiquées dans le manuel ou la fiche technique de l'appareil. Une recharge incorrecte des batteries peut entraîner des explosions susceptibles de causer des blessures graves.
5. Recharger impérativement à des températures comprises entre 0 °C et 45 °C (restrictions éventuelles : voir le manuel).
6. Décharger impérativement à des températures comprises entre 0 °C et 50 °C (restrictions éventuelles : voir le manuel).
7. Terminer la charge dès que les batteries sont complètement rechargées. Une surcharge répétée diminue la longévité des batteries.
8. Retirer les batteries de l'appareil lorsqu'elles ne sont pas utilisées. Après un stockage prolongé, plusieurs cycles de recharge et de décharge peuvent s'avérer nécessaires pour rétablir la pleine capacité des batteries.
9. Utiliser les batteries exclusivement dans les appareils Rohde & Schwarz auxquels elles sont destinées. Voir le manuel fourni avec chaque appareil.
10. Ne pas éliminer les batteries avec les déchets municipaux non triés mais s'assurer qu'elles soient collectées séparément. Recycler les batteries en fin de vie en les confiant à un point de collecte compétent ou à un point de service après-vente Rohde & Schwarz.

    
    Marquage UE pour batteries et accumulateurs

11. Conserver ces consignes de sécurité de sorte à pouvoir vous y reporter ou vérifier ultérieurement certains points.

Customer Support

Technical support – where and when you need it

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

Up-to-date information and upgrades

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

Europe, Africa, Middle East

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

North America

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ROHDE&SCHWARZ

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Quality management and environmental management

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde & Schwarz Produktes entschieden. Sie erhalten damit ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unserer Qualitäts- und Umweltmanagementsysteme entwickelt, gefertigt und geprüft. Rohde & Schwarz ist unter anderem nach den Managementsystemen ISO 9001 und ISO 14001 zertifiziert.

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

Dear customer,
You have decided to buy a Rohde & Schwarz product. This product has been manufactured using the most advanced methods. It was developed, manufactured and tested in compliance with our quality management and environmental management systems. Rohde & Schwarz has been certified, for example, according to the ISO 9001 and ISO 14001 management systems.

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

Cher client,
Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests de ce produit ont été effectués selon nos systèmes de management de qualité et de management environnemental. La société Rohde & Schwarz a été homologuée, entre autres, conformément aux systèmes de management ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de management environnemental certifié selon ISO 14001

Contents

1 Preface

1.1 Documentation Overview

The user documentation for the R&S Spectrum Rider is divided as follows:

- **Getting Started**
- **User Manual**
- **Service Manual**
- **Release Notes**
- **Internet Site**

Getting Started

The Getting Started provides basic information on the instrument's functions.

It covers the following topics:

- Overview of all elements of the front and rear panels.
- Basic information on how to set up the R&S Spectrum Rider.
- Information on how to operate the R&S Spectrum Rider in a network.
- Instructions on how to perform measurements.

User Manual

The User Manual provides a detailed description on the instrument's functions.

In this manual, a detailed description on the instrument's functions are provided. Furthermore, it provides a detailed description of the instrument's remote control commands and information on the instrument's status reporting system.

It covers the following topics:

- Instructions on how to set up and operate the R&S Spectrum Rider in its various operating modes.
- Instructions on how to perform measurements with the R&S Spectrum Rider.
- Instructions on how to work with the available software options and applications.

Service Manual

The Service Manual provides information on maintenance.

It covers the following topics:

- Instructions on how to perform a performance test.
- Instructions on how to repair the R&S Spectrum Rider including a spare parts list.
- Mechanical drawings.

Release Notes

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

Internet Site

The internet site at: http://www.rohde-schwarz.com/product/fph.html provides the most up to date information on the R&S Spectrum Rider. The most recent manuals are available as printable PDF files in the download area.

Also provided for download are firmware updates including the corresponding release notes, instrument drivers, current data sheets, application notes and image versions.

1.2 Conventions Used in the Documentation

The following conventions are used throughout the R&S Spectrum Rider manual.

1.2.1 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 underline blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.2.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen or a key on the instrument or on a keyboard.

1.2.3 Other Conventions

Remote commands may include abbreviations to simplify input. In the description of such commands, all parts that have to be entered are written in capital letters. Additional text in lower-case characters is for information only.

2 Welcome to the R&S Spectrum Rider

The R&S Spectrum Rider is a new generation Rohde & Schwarz signal and spectrum analyzer developed to meet demanding customer requirements. Offering touchscreen input, the analyzer enhances user experience in making measurements fast and easy.

This user manual contains a description of the functionality that the instrument provides. The latest version is available for download at the product homepage (http://www2.rohde-schwarz.com/product/FPH.html).

3 Getting Started

The following chapters are identical to those in the printed R&S Spectrum RiderGetting Started manual.

3.1 Preparing for Use

3.1.1 Putting into Operation

This chapter assists you in using the R&S Spectrum Rider for the first time. It describes the basic steps to be taken when setting up the instrument 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 or in electronic format on the documentation CD-ROM.
  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 will prevent damage to the instrument. The instrument's data sheet may contain additional operating conditions.

NOTICE

Risk of electrostatic discharge (ESD)

Electrostatic discharge (ESD) can cause damage to 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 safety instructions delivered in electronic format on the documentation CD-ROM.

NOTICE

Risk of instrument damage during operation

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

- 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.

EMI impact on measurement results

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.
- Always terminate open cable ends.
- Note the EMC classification in the data sheet.

3.1.1.1 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.

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.

3.1.1.2 Accessory List

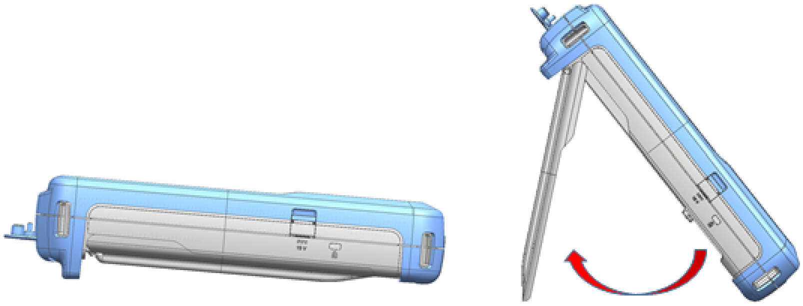
The instrument comes with the following accessories:

- Power supply cable and adapter set
- Li-ion rechargeable battery
- USB2.0 cable A-Mini
- Side strap
- Printed Getting Started manual
- Document folder containing safety instructions and calibration certificate
- R&S Spectrum Rider CD-Rom

3.1.1.3 Setting up the R&S Spectrum Rider

The R&S Spectrum Rider is designed for lab operation as well as for service and maintenance applications on-site.

Depending on the environment, you can adjust the viewing angle of the display and either lay it out horizontally or prop it up using the support on the back of the R&S Spectrum Rider.



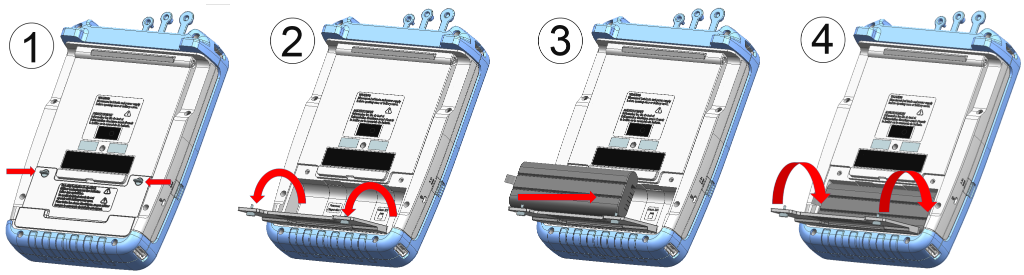
When laid out horizontally for operation from above, the R&S Spectrum Rider is tilted slightly due to the micro-stand at the back. This position provides the optimum viewing angle for the display.

To allow easy operation from the front and still be able to read the display, you can swing out the support on the back of the R&S Spectrum Rider.

For use on site or service measurements, it is best to hold the instrument in both hands. All the controls are easy to reach. It is also recommended to use the shoulder strap (R&S HA-Z323, order number 1321.1363.00) while working on the device under test (DUT) as it provides the ease of work during transport.

Before you turn on the R&S Spectrum Rider, you should insert the lithium ion battery included in the delivery into the battery compartment located at the back of the R&S Spectrum Rider.

Insert Battery



1. Unscrew the two thumb screws located on the battery compartment.
2. Open the cover.
3. Insert the battery into the R&S Spectrum Rider.
4. Close the cover and screw back the thumb screws.

You can operate the R&S Spectrum Rider with the AC adapter or the battery. Both are included in the delivery.

3.1.1.4 Using the AC Adapter

NOTICE

Risk of instrument damage

To avoid instrument damage,

- Only use the power supply included in the delivery (R&S HA-Z301) only.
- Make sure that the AC supply voltage is compatible to the voltage specified on the power supply unit.
- Attach the appropriate adapter to the power supply.

Connect the AC adapter (R&S HA-Z301, order number 1321.1386.00) to the DC port on the left side of the R&S Spectrum Rider (item 1 of Figure 3-1). Make sure to fully insert the plug into the port.

Depending on the system you need, firmly connect the appropriate power cable included in the delivery to the AC adapter (item 2 of Figure 3-1).

Finally, connect the plug to an AC power outlet.

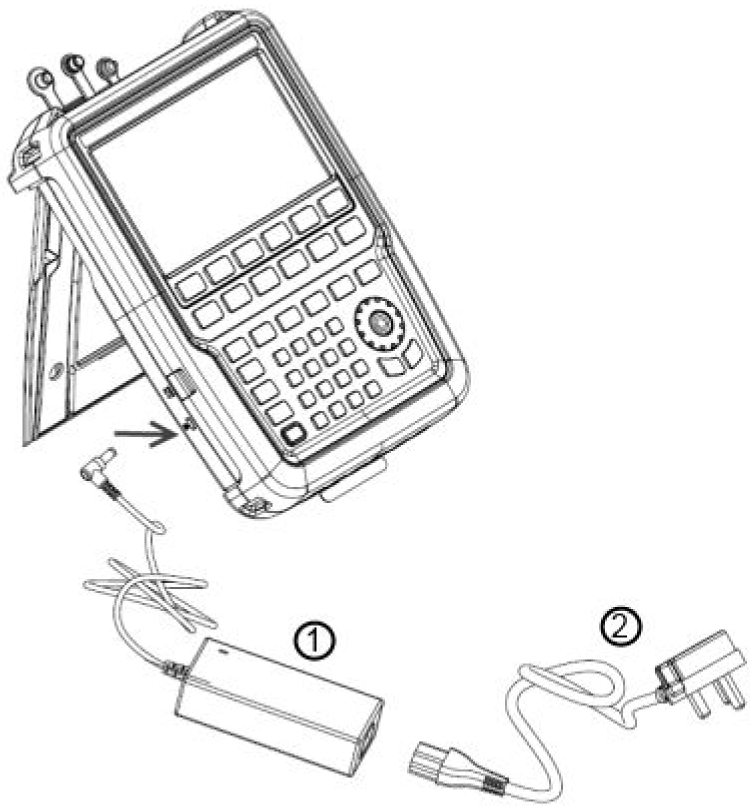


Figure 3-1: AC adapter

1 = AC adapter
2 = Power cable

The voltage range of the AC power supply is 100 V to 240 V AC.

After the R&S Spectrum Rider is connected to the power supply, you can turn it on with the POWER key on the front panel.

3.1.1.5 Battery Operation

The R&S Spectrum Rider has a smart battery indicator which displays the battery charging status on the POWER key as well as the battery icon shown at the top right corner of the display in . See Chapter 3.2.3.1, "Title Bar", on page 38.

The lithium ion battery has a capacity of approximately 6.4 Ah and it allows operation of up to 8 hours when it is fully charged.

The actual operation time depends on the current charge status, the ambient temperature and the operating mode of the R&S Spectrum Rider.

When the R&S Spectrum Rider is in operation, the power's LED displays green on the button, the battery charging status can also be viewed on the "Title Bar". See Chapter 3.2.3.1, "Title Bar", on page 38.

When the R&S Spectrum Rider is not in operation, the power's LED displays blue for a fully charged battery and it blinks in blue to indicate a battery charging process.

The battery charging and discharging process of the battery icon shown on the "Measurement Title" is illustrated below:

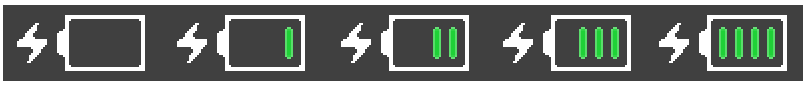


Figure 3-2: Battery charging process

Figure 3-3: Battery discharging process

While charging, the green slot on the battery icon is added from the right to left to indicate that the battery is charging while connected to the power supply.

When battery is fully charged, there will be four green slots in the battery icon. Every single slot is approximately 25% of the battery capacity. See Figure 3-2.

During the discharging process, the white slot in the battery icon is reduced until it turns to a single red slot. This shows that the battery has reached low level. See Figure 3-3.

Charging time is about 3 hours when the R&S Spectrum Rider is in inactive mode (i.e. R&S Spectrum Rider is switched off). If the instrument is in active mode (i.e. R&S Spectrum Rider is switched on), the charging time is extended to about 4 hours because the charging current is reduced as the power is partially drained by the usage of the R&S Spectrum Rider.

During operation in the field, you can also charge the battery with the car adapter (R&S HA-Z302, order number 1321.1340.02). You can connect the car adapter to the DC port. With the car adapter, you are able to charge the R&S Spectrum Rider via the car's cigarette lighter socket. A replacement battery (R&S HA-Z306, order number 1321.1334.02) with the same capacity and charging time as the delivered battery included in the standard delivery is also available if required.

Battery dispatched during delivery is not fully charged, for battery operation you have to charge it first.

To charge the battery, connect the charger to AC power adapter included in the delivery. For more information, see "Using an external battery charger" on page 25.

Using an external battery charger

You can also use an external battery charger (R&S HA-Z303, order no. 1321.1328.02) to charge the battery.

To charge the battery externally, put the battery into the external charger and supply it with power via the AC power adapter.

An amber LED on the charger indicates the charging process. The LED turns to green when the battery is fully charged. A red LED on the charger indicates that the battery is not charging or the charging failed.

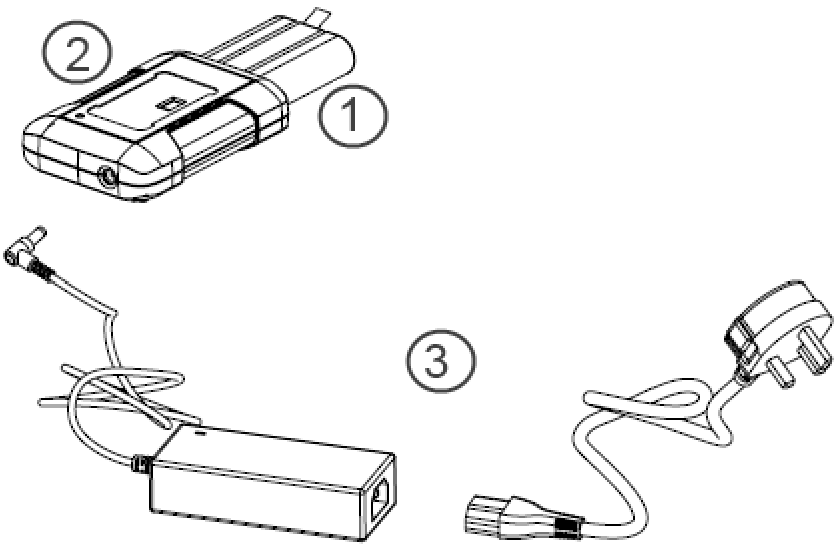


Figure 3-4: External battery charger

1 = Lithium ion battery R&S HA-Z306
2 = External charger R&S HA-Z303
3 = Power supply unit R&S HA-Z301 or car adapter R&S HA-Z302

⚠ WARNING

Prohibition of operating R&S Spectrum Rider

Turn off the R&S Spectrum Rider while driving or while the engine is on.

Operation of the R&S Spectrum Rider via the cigarette lighter socket while driving or while the engine is on is prohibited.

3.1.1.6 Battery Maintenance

The R&S Spectrum Rider comes with a lithium-ion battery. In general, these batteries are easy to handle. When you handle the battery, follow the instruction mentioned in the safety instructions and in the following chapters.

Handling

- The battery has been designed for a specific application. Do not use it for any other applications.
- Do not connect batteries in series or parallel as it can cause serious damage.
- Observe correct polarities during installation and charging.
- Do not heat over 70°C. The battery contains thermal fuses that could activate and render the battery inoperable.
- The battery contains an electronic device for protection against deep discharge, overcharge and short-circuiting between the terminals.
  – If you cannot discharge the battery, it may be deep discharged. Charge the battery for 0.5 hours and check again.
  – If you cannot charge the battery, it may be overcharged. Discharge the battery and check again.
  – If the battery has been short-circuited, charge it to reset the electronics.
  – If the battery still does not work, contact the Rohde & Schwarz customer support.
- Do not allow metallic objects to come into contact with the terminals.
- Do not solder directly to the battery.

Storage

The battery self-discharges while not in use. When storing the battery for an extended period of time, make sure to

- Handle the battery carefully to avoid short circuits. Make sure that leads and terminals are insulated.
- Keep the battery in the supplied packaging prior to use. The temperature should not exceed 30°C.

- Store the battery at an initial state of charge between 15% and 50% of its capacity. When calculating the initial state of charge, consider
  - The maximum consumption of electronic devices
  - The self-discharge of the battery - the higher the state of charge, the higher the rate of self-discharge
- Avoid a deep discharge of the battery. A deep discharge occurs when the state of charge falls below 5% of the battery's capacity.
- Recharge the battery at least every six months.

Should the battery voltage be low or even 0 V, the battery protection circuit may have gone into a sleep mode. In that case, reset the battery with an approved charger.

Transportation

No special regulations apply for transporting the battery. The battery cells contain no metallic lithium.

End of Life

The capacity of the battery decreases after it has gone through numerous charge cycles and nearing its end of life. When the battery is dead, do not open the battery. Do not dispose it in fire.

3.1.2 Switching the Instrument On and Off

Switching the instrument on

The instrument can be powered with an AC or DC (battery operated or via car adapter) input. See Chapter 3.1.1.4, "Using the AC Adapter", on page 23.

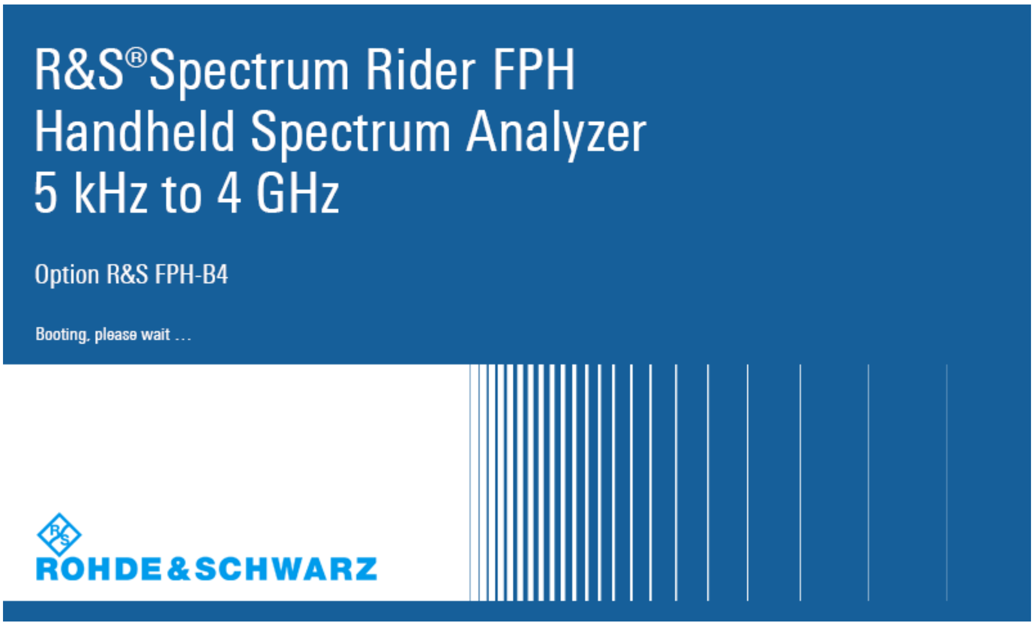
Press the POWER key to switch on the instrument. A green LED shows that the instrument is in operation mode.

See details in Chapter 3.1.1.5, "Battery Operation", on page 24.

During booting, the R&S Spectrum Rider displays a splash screen to indicate the operable frequency range of the instrument. If frequency upgrade option has been installed, the splash screen will show "5 kHz to 3 GHz" for R&S FPH-B3 option or "5 kHz to 4 GHz" for R&S FPH-B4 option. The spalsh screen shows "5kHz to 2 GHz" by default.

Depending on the frequency upgrade option installed, the respective splash screen is loaded. Refer to the instrument brochure for the list of options available.

After booting, the instrument is ready for operation.



Switching the instrument off

Press the POWER key to switch off the instrument. A blue LED button indicates that the battery is fully charged, a blinking blue LED shows that the battery charging is in process. See Chapter 3.1.1.5, "Battery Operation", on page 24.

In case the battery is not inserted into R&S Spectrum Rider, the amber LED is displayed.

In general, a red LED indicates that there is a battery charging error.

Table 3-1: Summary of LED indication on POWER key

LED indication on POWER key		Descriptions
Green LED		Instrument is in operation mode.
Blue LED		Instrument is in switch off mode with a fully charge battery. A blinking blue LED indicates that the battery charging is in process.
Amber LED		Instrument is in switch off mode with AC supply and there is no battery in it.
Red LED		There is an error in the battery charging.
LED "OFF"		This is an indication that there is no AC or DC supply to the instrument. The instrument is in a switch off mode.

NOTICE

Risk of losing data

If a running instrument (without battery) is disconnected directly from the power cord, the instrument loses its current settings. Furthermore, program data may be lost.

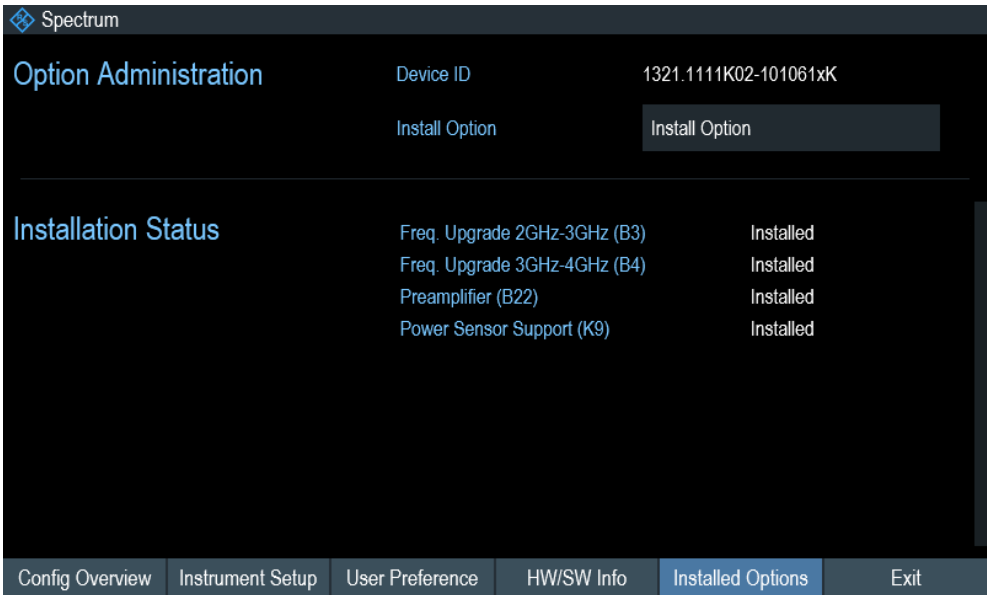
Press the POWER key first to shut down the application properly.

3.1.3 Checking the Supplied Options

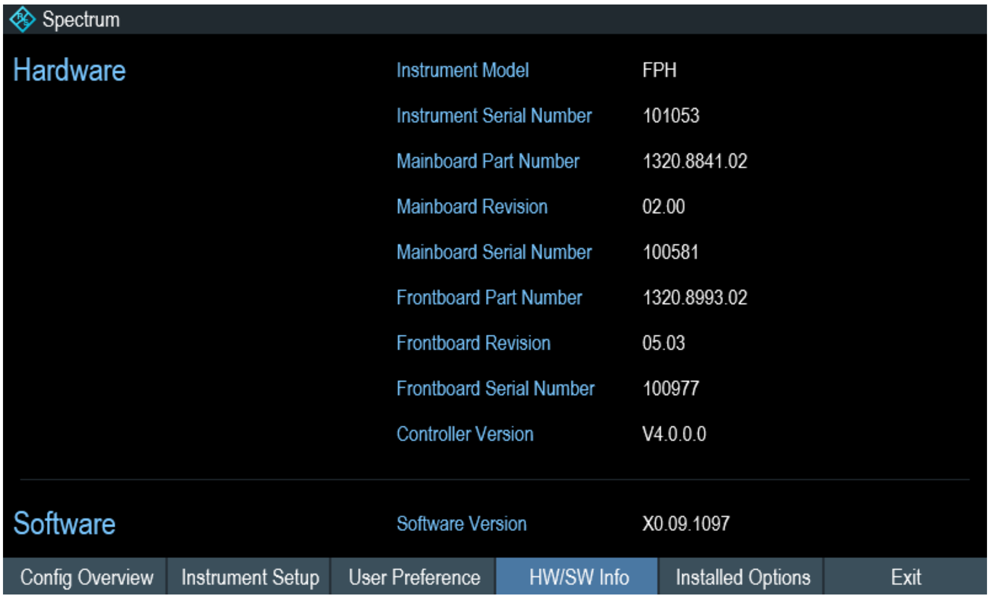
The instrument can be equipped with different hardware and installed options. For a list of R&S Spectrum Rider supported hardware and installed options, refer to the instrument brochure for the list of options available.

In order to check whether the installed options correspond to the options indicated in the delivery note, proceed as follows.

1. Press the SETUP key.
2. Select the "Installed Options" softkey.
   A list of all available options and the current status of the options are displayed.



3. Check the availability of the installed options as indicated in the delivery note.
4. Check the availability of the hardware options as indicated in the delivery note.
5. Press the "HW/SW Info" softkey.
   A list with hardware and firmware information is displayed.



3.2 Instrument Tour

This chapter describes the front panel, including all function keys and connectors.

It also contains general system configuration on the R&S Spectrum Rider as well as the connectivity of the instrument to PC.

3.2.1 Overview Control

Figure 3-5: Front Panel of R&S Spectrum Rider

1 = RF Input (N-connector)
2 = BNC connectors
3 = Headphone jack
4 = USB ports
5 = Touch-sensitive screen area
6 = Softkey labels (on display)
7 = Softkey
8 = System Keys
9 = DC port (behind protective cap)
10 = Kensington lock
11 = Function Keys
12 = Power key
13 = Alphanumeric key
14 = Unit keys
15 = Back key
16 = Cancel key
17 = Rotary knob
18 = Screenshot key
19 = LAN and Mini USB ports (behind protective cap)
**20 = SD Card Slot (not visible as it is located behind the battery compartment)

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.

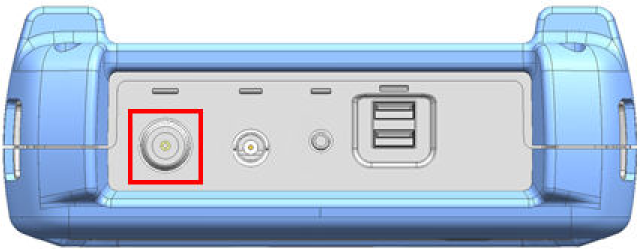
The outside of the instrument can be cleaned sufficiently using a soft, lintfree dust cloth.

3.2.2 Connectors of the R&S Spectrum Rider

The R&S Spectrum Rider has several connectors. The connectors are either on the upper, left or right side of the instrument.

3.2.2.1 RF Input

The RF input 50Ω is located on the top of the R&S Spectrum Rider.



Connect a cable or DUT to the RF input with an N connector. Use a cable to connect the DUT to the R&S Spectrum Rider, if necessary.

Make sure not to overload the R&S Spectrum Rider when a DUT is connected.

The maximum power that is permissible at the RF input is 20 dBm (or 100 mW).

The RF input is protected from static discharges and voltage pulses by a limiting circuit.

NOTICE

RF power overload

The R&S Spectrum Rider maybe loaded with up to 30 dBm (or 1 W) for up to three minutes. If you apply 1 W for a longer period, the R&S Spectrum Rider may be destroyed.

WARNING

Risk of electric shock

In order to avoid electrical shock the DC input voltage you must never exceed the value specified on the housing.

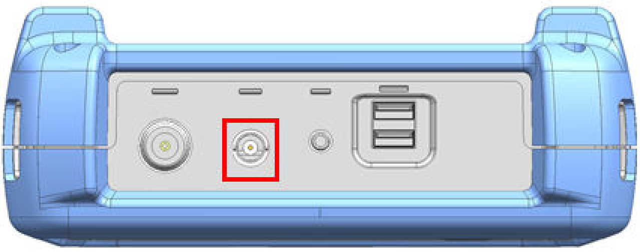
NOTICE

Risk of damage of the R&S Spectrum Rider

To avoid damage to the coupling capacitor, input attenuator or the mixer, the DC input voltage must never exceed the value specified in the data sheet.

3.2.2.2 BNC Connector

The BNC connector is located on the top of the R&S Spectrum Rider.



You can connect the BNC connector for various applications. It supports an external trigger signal or an external reference signal.

When the BNC connector is configured as a trigger input, it controls the start of a measurement. The trigger mode is selected in the "Sweep" menu, see Chapter 3.2.5.5, "Function Keys", on page 45. The trigger threshold is similar to that of TTL signals.

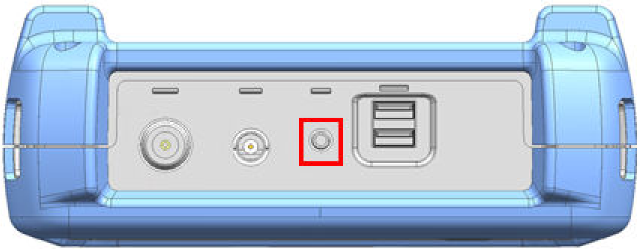
When the BNC connector is configure as reference input, you can apply a 10 MHz external reference signal to it for frequency synchronization. The external reference label Ext Ref is displayed at the top right corner of the trace window to indicate that the reference signal is supplied via external signal input. The label turns green when the reference signal is detected.

The level of the reference signal must be larger than 0 dBm. If there is no reference signal present at the BNC connector, the R&S Spectrum Rider displays an appropriate message. Thus, measurements without a valid reference can be avoided.

For more information on configuring the BNC connector for the appropriate signal, see "Configuring the BNC connector" on page 51 and Chapter 3.2.7.2, "Using the GPS receiver", on page 51.

3.2.2.3 Headphone Jack

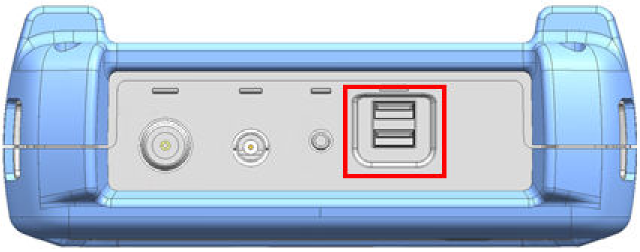
The 3.5 mm connector for headphones is located on the top of the R&S Spectrum Rider.



The internal impedance of the connector is approximately 10 Ohm.

3.2.2.4 USB Port

The two USB ports are located on top of the R&S Spectrum Rider.

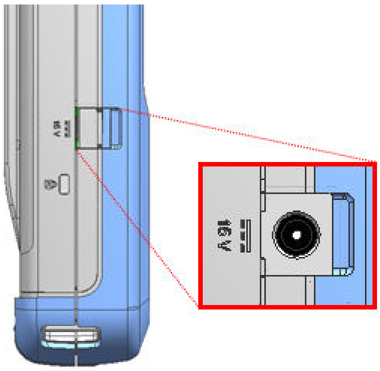


You can use the USB interface to connect a memory stick and store data sets or screenshots.

The USB connector can also be used to control the operation of the power sensor and GPS receiver. See Chapter 3.3.2, "Using a Power Sensor", on page 74 and Chapter 3.2.7.2, "Using the GPS receiver", on page 51.

3.2.2.5 DC Port

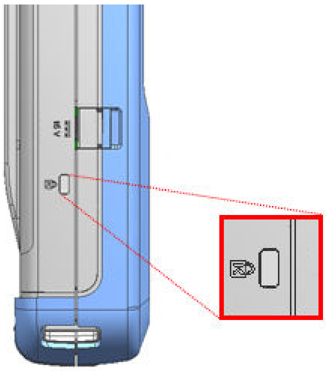
The DC port is located on the left side of the R&S Spectrum Rider behind a protective cap.



The R&S Spectrum Rider is supplied with power by the AC/DC transformer power supply via the DC connector. You can also use the DC connector to charge the battery.

3.2.2.6 Mechanical Locking Device

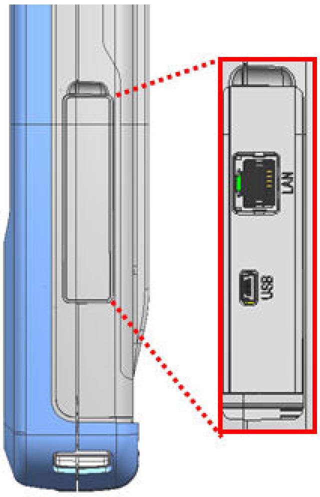
The Kensington lock is located on the left side of the R&S Spectrum Rider behind a protective cap.



A Kensington Lock can be anchored to the R&S Spectrum Rider housing to secure the R&S Spectrum Rider to a workstation mechanically.

3.2.2.7 Mini USB and LAN Port

The mini USB and LAN ports are located on the right side of the R&S Spectrum Rider behind a protective cap.

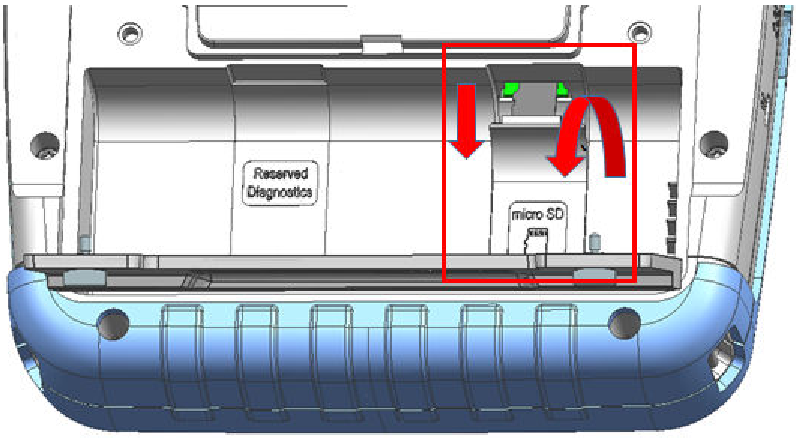


You can connect the R&S Spectrum Rider to a PC via USB or LAN and transfer data in both directions.

Configure the USB and LAN connection via the "Instrument Setup" menu. For more information, see Chapter 3.2.7.1, "Configuring the Hardware", on page 51.

3.2.2.8 SD Card Slot

The SD card slot is located behind the battery compartment of the R&S Spectrum Rider.



Peel open the SD card protective cap to access to the SD card slot. You can use the SD card to store data sets or screenshots.

3.2.3 Touchscreen Display

All measurement results are displayed on the screen. Additionally, the screen display provides status and setting information and it allows you to change the parameters setting with touchscreen gesture. The touch-sensitive screen offers an alternative means of user interaction for quick and easy handling of the instrument.

NOTICE

Risk of touchscreen damage during operation

The touchscreen may be damaged by inappropriate tools or excessive force.

Observe the following instructions when operating or cleaning the touchscreen:

- Never touch the screen with ball point pens or other pointed objects with sharp edges.
- It is recommended that you operate the touchscreen by finger only. As an alternative, you may use a stylus pen with a smooth soft tip.
- Never apply excessive force to the screen. Touch it gently.
- Never scratch the screen surface, e.g. with a finger nail. Never rub it strongly, for example with a dust cloth.

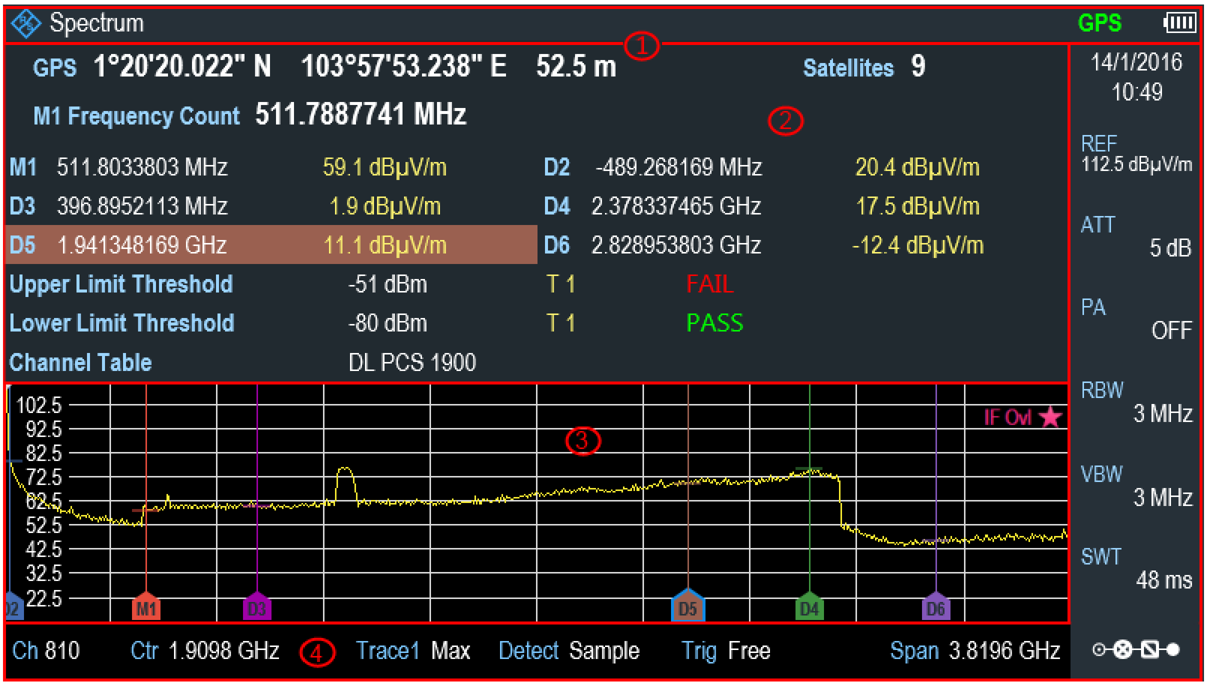


Figure 3-6: R&S Spectrum Rider touchscreen element

The touchscreen display can be divided into several sections:

1. Title Bar
2. Measurement Result View
3. Measurement Trace Window
4. Parameter View

A touchscreen is a screen that is touch-sensitive, i.e. it reacts in a specified way when a particular element on the screen is tapped by a finger.

Touchscreen gesture

Special touchscreen features are provided to enhance user experience in using the instrument:

- Swipe horizontally in the trace window, the gesture is used to change the center frequency.
- Swipe vertically in the trace window, the gesture is used to change reference level.
- Pinch and stretch to change the span parameter.
- Double tap on the trace window to add a new marker.
- Tab and drag on the marker icon, the gesture is used to change the marker position.
- Draw a "x" to delete all markers.

3.2.3.1 Title Bar

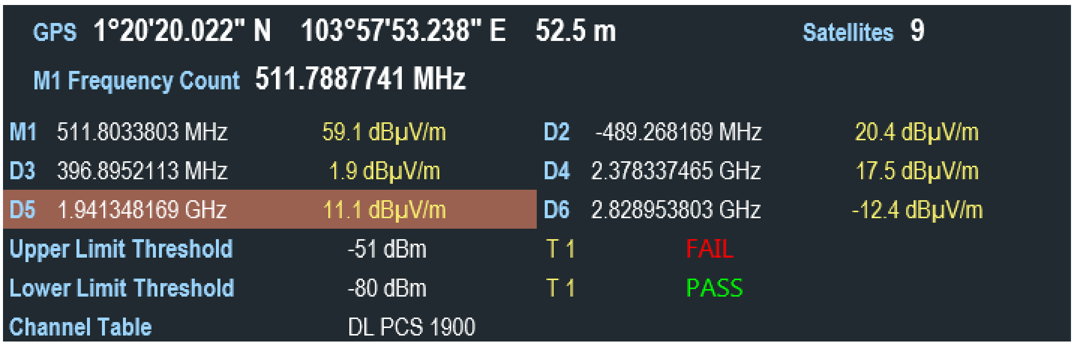
The "Title bar" is located on top of the layout.

It is used to display static content:

- Basic information such as R&S logo, measurement mode name (i.e. Spectrum, Power Meter) and battery status.
- Accessories name connected to the instrument, i.e power sensor, GPS receiver.
- Standard information such as measurement standard name, channel table name etc.

3.2.3.2 Measurement Result View

The "Measurement result view" is located below the "Title bar".



It displays measurement results of the followings:

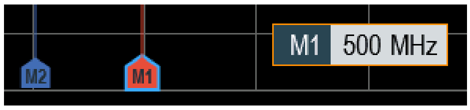
- GPS information
- Marker values
  – Including marker function such as marker noise measurement, frequency counter and N dB down bandwidth measurement when activated.

- Limit lines
- Channel Table

When the marker measurement is enabled and selected in the "Measurement result view", an entry box for marker positioning is displayed. On the selected marker, you can also see the function measurement result is displayed in the "Measurement result view", e.g. "Frequency Count".

The selected marker is highlighted in the "Measurement result view", it is also reflected on the marker in the "Measurement trace window".

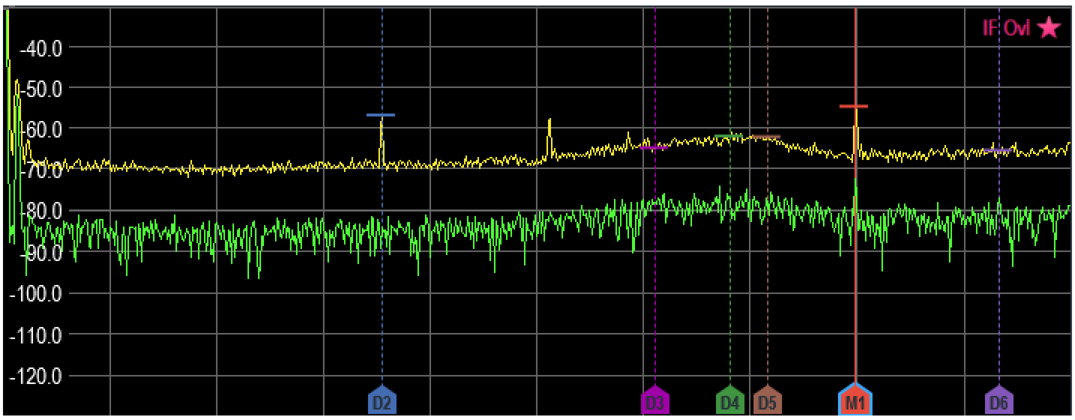
Table 3-2: Highlighted marker

Highlighted marker in the "Measurement result view"	**Highlighted marker in the "Measurement trace window"**
	 Note: There is a blue frame on the highlighted "M1" marker.

For more information on marker measurement, see "Using Markers" on page 71.

3.2.3.3 Measurement Trace Window

The "Measurement trace window" is the main user interface window in R&S Spectrum Rider. It displays the measurement traces where markers and limit lines are also displayed.



Device warning messages (e.g IF Ovl) are displayed at the top right hand corner of the window.

NOTICE

Device Warning Message

- IF Ovl: This message indicates that the downconverter of the intermediate frequency (IF) is overloaded in R&S Spectrum Rider.
- In general, a star ★ indicates that the measurement is still in progress.

3.2.3.4 Parameter View

The "Parameter view" contains the important trace setting parameters for the spectrum measurement.

It displays the time and date information at the top right corner of the layout and at the bottom right corner it displays the "Configuration Overview" button. See Figure 3-6.

You can select any parameter in the "Parameter view" to adjust the configurations of the spectrum measurement. See details of each of the parameter in the R&S Spectrum Rider user manual.

Parameter Settings	Description
"Center", "Start", "Stop" 	This display setting is function-specific depending on the softkey ("Center Freq", "Start Freq", "Stop Freq") selected in the softkey label. See Chapter 3.2.5.3, "Softkey", on page 44. It displays an entry box to configure the center frequency, start or stop frequency for the spectrum measurement.
"Trace" 	Select "Trace" to display the trace menu with a list of settings ("Clear/Write", "Average", "Min Hold", "Max Hold").
"Detect" 	Select "Detect" to display the trace detector menu with a list of settings ("Auto Peak", "Max Peak", "Min Peak", "Sample", "RMS").
"Trig" 	Select "Trig" to display the gate trigger menu with a list of settings ("Free Run", "Ext. Rise", "Ext". "Fall").
"Span" 	Select "Span" to display an entry box to configure the span of the spectrum measurement.
"REF" 	Select "REF" to display an entry box to configure the reference level for the spectrum measurement.

"ATT" 	Select "ATT" to display an entry box to configure the attenuation setting for the spectrum measurement.
"AMP" 	Select "AMP" to toggle between the "ON" and "OFF" status for the optional preamplifier (R&S FPH-B22) of the spectrum measurement. Note: When the optional preamplifier (R&S FPH-B22) is absent, this menu is not available.
"RBW" 	Select "RBW" to display an entry box to configure the resolution bandwidth of the spectrum measurement.
"VBW" 	Select "VBW" to display an entry box to configure the video bandwidth of the spectrum measurement.
"SWT" 	Select "SWT" to display an entry box to configure the sweep time of the spectrum measurement.
"Config Overview" 	Select "Config Overview" to display the configuration overview window for more configuration options for the spectrum measurement. See "Configuration Overview" on page 41.

Configuration Overview

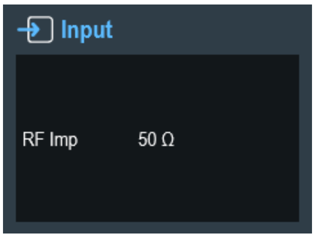
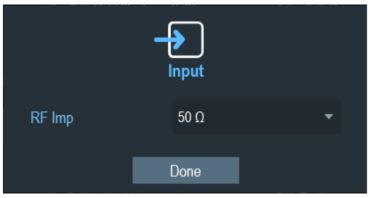
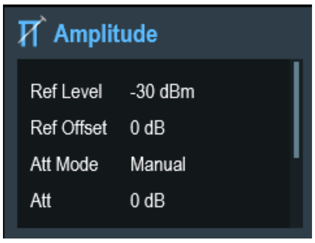
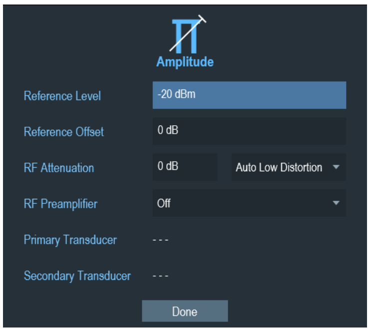
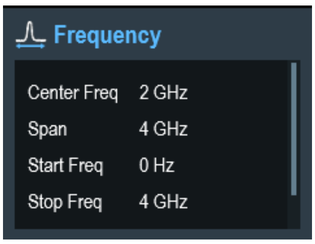
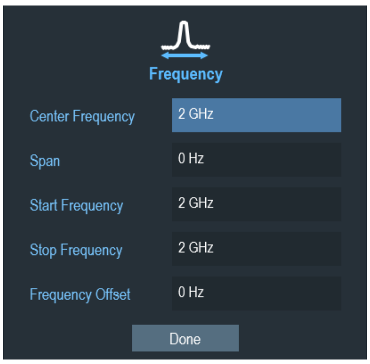
This is a dedicated button located at the bottom of the "Parameter View", it is operation mode dependent. See Figure 3-6.

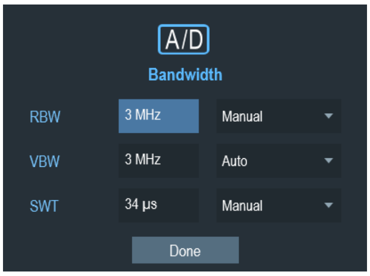
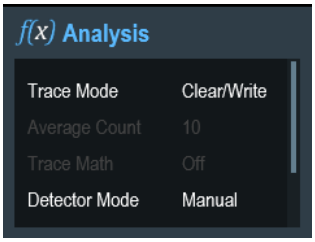
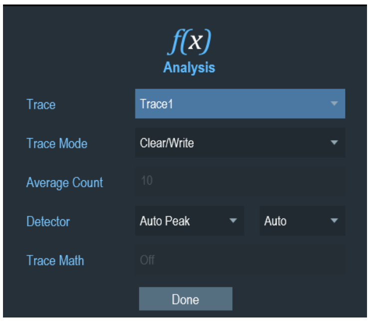
When you select this button, it opens the "Config Overview" window. Accessing it without the touchscreen input is possible via the SETUP key. See Chapter 3.2.5.4, "System Keys", on page 44.

The "Config Overview" illustrates the flow of spectrum measurement at different stages and the relevant parameters which have impact on the measurement at each stage.

The "Config Overview" window is divided into six categories:

Table 3-3: Corresponding dialog box of "Config Overview" window

"Config Overview" Block	Corresponding Dialog Box	Description
		Select "Input" to configure RF impedance.
		Select "Amplitude" to configure reference level, reference offset, preamplifier (R&S FPH-B22, order number 1321.0680.02), RF attenuation level and mode. It also provides configuration to set the transducer table used in the signal measurement. Note: When the optional preamplifier (R&S FPH-B22) is absent, the menu item "RF Preamplifier" is not available.
		Select "Frequency" to configure the center frequency, frequency offset and span of the spectrum measurement.

<table>
<tr>
<td>
</td>
<td>
</td>
<td>Select "Bandwidth" to configure resolution bandwidth, video bandwidth and sweep time for the spectrum measurement.</td>
</tr>
<tr>
<td>
</td>
<td>
</td>
<td>Select "Analysis" to configure trace mode, trace detector and the number of count used to average up the measurement for the trace display.

It also provides configuration to set the "Trace Math" method used to calculate the differences in the current trace measurement and measurement saved in the memory.</td>
</tr>
<tr>
<td>
</td>
<td>
</td>
<td>Select "Trigger" to configure the trigger source, trigger level and the trigger delay setting on the spectrum measurement.</td>
</tr>
</table>

3.2.4 On-screen Keyboard

The on-screen keyboard is an additional means of interacting with the instrument. It provides an ease of use together with the touch-screen input.

Accessing the on-screen keyboard is only available for text-based entry, e.g. save or open a filename.

Touchscreen interface

If the touchscreen interface is not activated, the on-screen keyboard will be disabled.

The on-screen keyboard display can be switched on and off as desired using the "On-screen keyboard" icon highlighted at the top right hand corner.

3.2.5 Front Panel Keys

3.2.5.1 POWER Key

The POWER key is located on the lower left of the front panel. It starts up and shuts down the instrument.

See Chapter 3.1.2, "Switching the Instrument On and Off", on page 27.

See also Chapter 3.2.1, "Overview Control", on page 31.

3.2.5.2 Screenshot Key

The screenshot key provides a quick way to capture screenshot of the current screen at anytime.

For more information, see the R&S Spectrum Rider user manual.

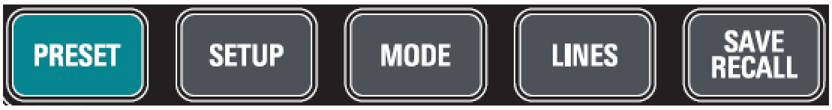
3.2.5.3 Softkey

The six softkeys on the front panel are used to access the softkey label. See Chapter 3.2.1, "Overview Control", on page 31.

The softkeys label are function specific depending on the key selected on the front panel of the instrument. See Chapter 3.2.5.5, "Function Keys", on page 45.

3.2.5.4 System Keys

System keys configure the instrument to a predefined state, change basic settings, configure evaluation setting and provide save and recall functions.



A detailed description of the corresponding functions is provided in the R&S Spectrum Rider user manual.

SYSTEM Keys	Descriptions
PRESET	Resets the instrument to the default state.
SETUP	Provides basic instrument configuration functions: ● Reference frequency (external/internal) and hardware selection ● Date, time, display, audio and regional configuration ● Battery low indicator ● LAN interface ● Disabling and enabling of options ● Information about instrument configuration including firmware version and system error messages
MODE	Provides the selection between applications.
LINES	Configures limit lines.
SAVE RECALL	Provides a file manager function to facilitate the saving and recalling of result and instrument settings.

3.2.5.5 Function Keys

Function keys provide access to the most common measurement settings and functions in the instrument.

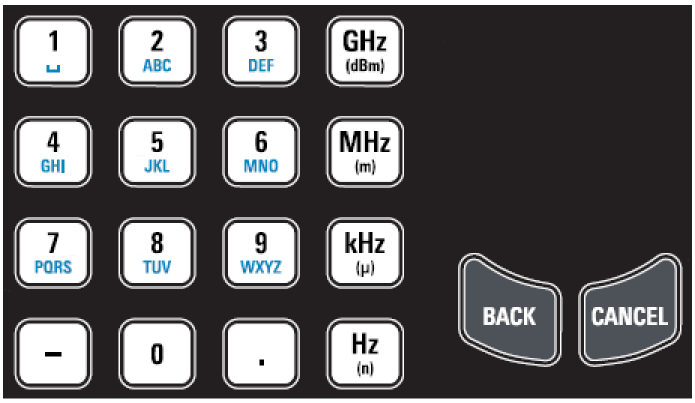
A detailed description of the corresponding functions is provided in the R&S Spectrum Rider user manual.

FUNCTION Keys	Descriptions
FREQ	Sets the center frequency, frequency step size, frequency offset as well as the start and stop frequencies for the frequency range under consideration.
SPAN	Sets the frequency span to be analyzed.

FUNCTION Keys	Descriptions
AMPT	Sets the reference level, the displayed dynamic range, the RF attenuation and the unit for the level display. Sets the level offset and the input impedance. Activates the preamplifier (R&S FPH-B22, order number 1321.0680.02). Set transducer tables to compensate primary and secondary RF path losses.
WIZARD	Performs a sequence of standardized and recurring measurements.
BW	Sets the resolution bandwidth and the video bandwidth.
SWEEP	Sets the sweep time. Sets the trigger mode, trigger threshold and the trigger delay of the external trigger signal. Selects continuous measurement or single measurement.
TRACE	Configures the measured data acquisition and the analysis of the measurement data.
MARKER	Sets and positions the absolute and relative measurement markers (markers and delta markers). Marker positioning using peak, next peak, minimum level, reference level and center frequency. Marker search limit function. Provide the following marker functions: ● Marker mode function which provide capability to measure noise, measure frequency using frequency counter and measure bandwidth using the N dB down setting. ● Marker display setting using the frequency or channel table. ● AM and FM marker demodulation.
MEAS	This key provides functionality to select and configure measurement such as: ● Spectrum

3.2.5.6 Keypad

The keypad is used to enter alphanumeric parameters, including the corresponding units.



It contains the following keys:

Type of key	Description
Alphanumeric keys	Enter numbers and (special) characters in edit dialog boxes.
Decimal point	Inserts a decimal point "." at the cursor position.
Sign key	Changes the sign of a numeric parameter. In the case of an alphanumeric parameter, inserts a "-" at the cursor position.
Unit keys (GHz/-dBm MHz/ dBm, kHz/dB and Hz/dB)	These keys add the selected unit to the entered numeric value and complete the entry. In the case of level entries (e.g. in dB) or dimensionless values, all units have the value "1" as multiplying factor. Thus, they also act like a enter key function.
CANCEL key	Closes all kinds of dialog boxes, if the edit mode is not active. Quits the edit mode, if the edit mode is active. In dialog boxes that contain a "Cancel" button it activates that button. For "Edit" dialog boxes the following mechanism is used: ● If data entry has been started, it retains the original value and closes the dialog box. ● If data entry has not been started or has been completed, it closes the dialog box.
BACK key	If an alphanumeric entry has already been started, this key deletes the character to the left of the cursor. Note: If an entry is confirmed with enter the back key restores the value entered before. This can be used to toggle for example between two frequencies.

3.2.5.7 Navigation Controls

The rotary knob provides navigation controls in the display or within dialog boxes.

The rotary knob has several functions:

- Increments (clockwise direction) or decrements (counter-clockwise direction) the instrument parameters at a defined step width in the case of a numeric entry
- Shifts markers and limit lines on the screen
- Moves the scroll bar vertically if the scroll bar is in focused
- Acts as the enter key when pressed

3.2.6 Managing Options

For special measurement tasks, you can equip the R&S Spectrum Rider with various firmware options.

3.2.6.1 Enabling Options

To enable options, you have to enter a key code. The key code is based on the unique serial number of the R&S Spectrum Rider.

1. Press the SETUP key.
2. Select the "Installed Options" softkey.
   A list of all available options and the current status of the options is displayed. See Chapter 3.1.3, "Checking the Supplied Options", on page 29.
3. Select the "Install Option" button from the dialog box.
   The R&S Spectrum Rider opens an entry field to enter the option key.
4. Enter in the appropriate option key.
5. Confirm the entry with the rotary knob.
   If you have entered the correct code, the instrument displays a message: "installation successful".
   If you have entered an incorrect code, the instrument displays message: "invalid key code!".
6. Enter the correct code again.

3.2.6.2 Checking Options

In the "Setup" menu, the R&S Spectrum Rider shows all options that are currently installed.

1. Press the SETUP key.
2. Select the "Installed Options" softkey.
   The R&S Spectrum Rider shows a list of all available options and the current status of the option:
   - "Installed": This means that the option is installed and working.
   - "Demo": This means that the option is for demo purposes and it has an expiry date.
   - "Removed:<option key>": This indicates that a portable license has been removed from the R&S Spectrum Rider and is ready to be transferred to another R&S Spectrum Rider.

3.2.6.3 Managing Options with R&S License Manager

If you are using the R&S Spectrum Rider in a local area network (LAN), you can manage the firmware options with a web browser (e.g. Microsoft Internet Explorer or Mozilla Firefox).

For more information on connecting the R&S Spectrum Rider to a LAN, see Chapter 3.2.8.1, "LAN Connection", on page 61.

After you have connected the R&S Spectrum Rider, open your web browser.

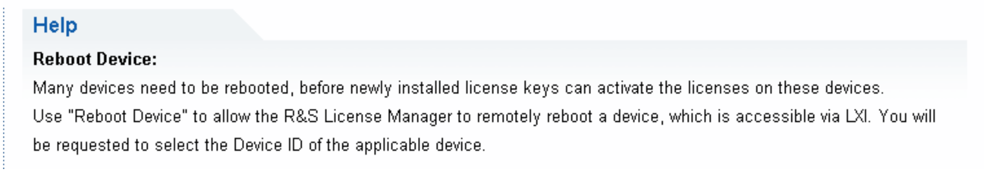
1. Enter the IP address of the R&S Spectrum Rider in the address bar of the web browser.

The browser will access the R&S License Manager. In this part of the R&S License Manager, you can install and activate licenses on the R&S Spectrum Rider.
This page features three areas:

- The first area shows the details of the connected device including the device ID and the IP address.

- The second area provides functionality to install and activate licenses.

  – **Install Registered License Keys and Activate Licenses**
    Follow this link if you have purchased a registered license. Registered licenses only work in combination with a specific device ID.
  – **Register Licenses, Install License Keys and Activate Licenses**
    Follow this link if you have purchased an unregistered license. Unregistered licenses are not connected to a specific device ID.
  – **Reboot Device**
    Follow this link to reboot the R&S Spectrum Rider.
  –
    Opens a detailed online help to the corresponding topic.
- The third area provides hints on using the license manager when you move the mouse over one of the options.



If you already have one or more R&S Spectrum Rider equipped with options, you can manage the licenses of these options on the license manager web page.

2. Select the Manage Licenses button.
The browser will access another part of the R&S License Manager. In this part of the license manager you can manage licenses already installed on your R&S Spectrum Rider.
This page features two areas:
   - The first area provides functionality to manage licenses already installed on a device.

     – **Register Licenses**
       Follow this link if you have purchased an unregistered license. Unregistered licenses only work in combination with a specific device ID.
     – **Unregister License**
       Follow this link if you have installed a portable license. Portable licenses work in combination with several device IDs. However, you have to unregister it on one device before you can use it on another.
     – **Move Portable License**
       Follow this link if you want to move a portable license. Moving a portable license is possible without unregistering the license.
     –
       Opens a detailed online help to the corresponding topic.
   - The second area provides hints on using the R&S License Manager when you move the mouse over one of the options.

After you have followed one of the links, follow the instructions displayed in the browser. If you encounter any problems during the licensing procedure, you can access the online help at any time with the icon . The online help contains an extensive description of all functionality that the license manager features.

3.2.7 Configuring the R&S Spectrum Rider

In the "Instrument Setup" dialog box, the R&S Spectrum Rider provides various general settings that are independent of the operating mode of the R&S Spectrum Rider.

1. Press SETUP key.
2. Select the "Instrument Setup" softkey.
A corresponding dialog box to configure instrument opens.

3. Select the item you want to modify.

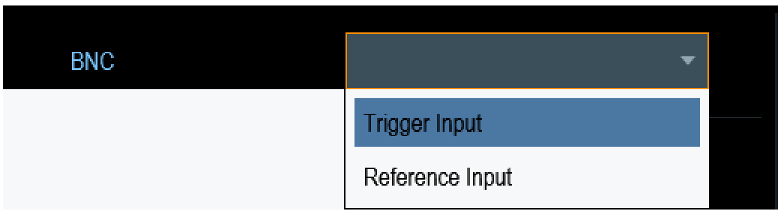
3.2.7.1 Configuring the Hardware

The hardware setting controls the setting of internal hardware.

Configuring the BNC connector

You can use the BNC connectors for various applications. For more information on the supported applications, see Chapter 3.2.2.2, "BNC Connector", on page 33.

1. In the "Instrument Setup" dialog box, select the "BNC" item.
   A drop-down menu to select the BNC connector application opens.



2. Select the required application.

3.2.7.2 Using the GPS receiver

The R&S Spectrum Rider can locate your exact position if you connect the R&S HA-Z340 GPS receiver (R&S order number 1321.1392.02) to the USB connector.

Location to secure GPS receiver

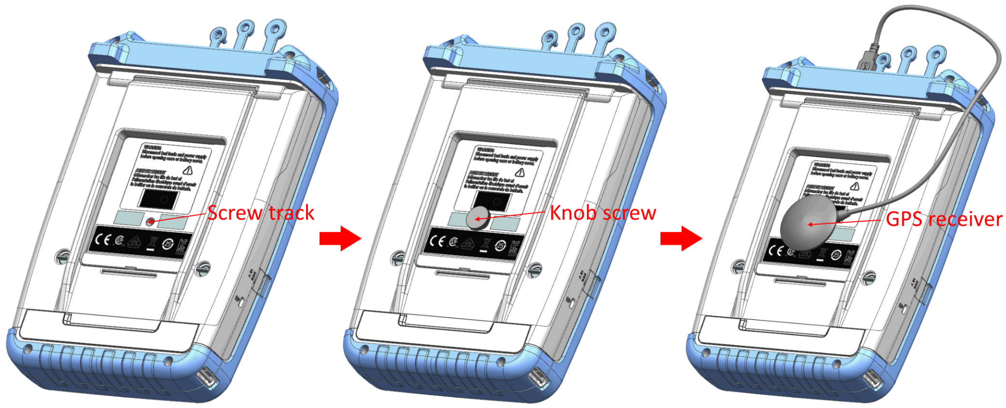


Figure 3-7: Location of GPS receiver

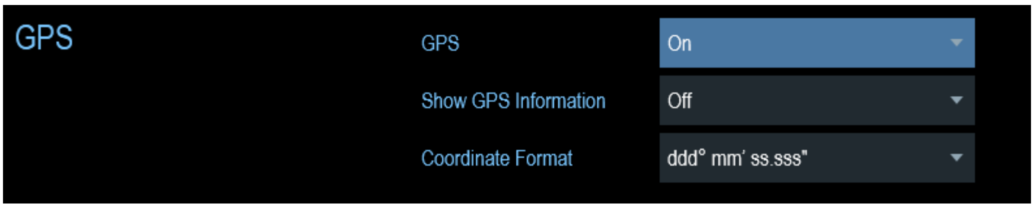
- Tighten the knob screw supplied with the GPS receiver (R&S order number 1321.1392.02) to the screw track located at the back of R&S Spectrum Rider.
- The GPS receiver can be conveniently attached to the knob screw as shown in Figure 3-7.

GPS reference frequency

The reference frequency is automatically adjusted as soon as the GPS receiver is enabled and a fix connection with enough satellites is established.

The "Instrument Setup" dialog box provides all settings necessary to configure the GPS receiver.

It also shows some information about the GPS connection like the number of tracked satellites and the signal quality.



Enabling the GPS receiver

1. In the "Instrument Setup" dialog box, select the "GPS" item.
   A drop-down menu opens to turn the GPS receiver on or off.
2. Turn the GPS receiver on or off as required.

When "GPS" item is set on, the R&S Spectrum Rider is ready to receive GPS data.

Displaying GPS information

1. In the "Instrument Setup" dialog box, select the "Show GPS Information" item.
   A drop-down menu opens to turn the display of the GPS coordinates on and off.
2. Turn the display of GPS coordinates on or off as required.

When the "Show GPS Information" item is set on, the R&S Spectrum Rider displays the GPS coordinates and number of satellites in the Measurement Result View when sufficient connection is established to the GPS satellites.

When the satellite connection is lost, the GPS coordinates and number of satellites are displayed with a white bar.

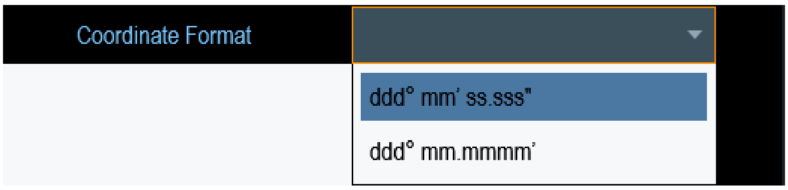
When the GPS receiver is not connected or enabled, a message "GPS Not Connected" is displayed in the Measurement Result View.

The state of the satellite lock is shown in the title bar.

- GPS in the title bar indicates that the GPS receiver is enabled and that there is a fix connection with enough satellites for the GPS receiver to provide the coordinates.
- GPS in the title bar indicates that the GPS receiver is enabled but that there is no fix connection to a satellite.
- ~~GPS~~ in the title bar indicates that the GPS receiver is enabled but that there is no GPS receiver connection.
- The title bar shows no symbol if the GPS receiver is not enabled

Selecting the coordinate format

1. In the "Instrument Setup" dialog box, select the "Coordinate Format" item.
   A drop-down menu opens to select the coordinate format.



2. Select the desired format from the drop-down menu.

3.2.7.3 Configuring Date and Time

The R&S Spectrum Rider has an internal clock that can apply a date and time stamp. In the "Instrument Setup" dialog box, you can set both date and time.

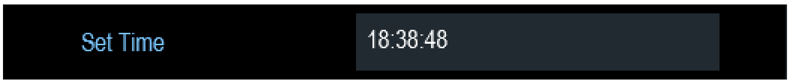
Setting the date

1. In the "Instrument Setup" dialog box, select the "Set Date" item.
2. Enter the date you want with the numeric keys. The sequence depends on the selected date format. See "Setting the date format" on page 55.

3. Confirm the entry with the rotary knob.

Setting the time

1. In the "Instrument Setup" dialog box, select the "Set Time" item.
2. Enter the time you want with the numeric keys.



3. Confirm the entry with the rotary knob.
   After you have entered the time, the R&S Spectrum Rider verifies the validity of the time. If it is not a valid time, it sets the next valid time.

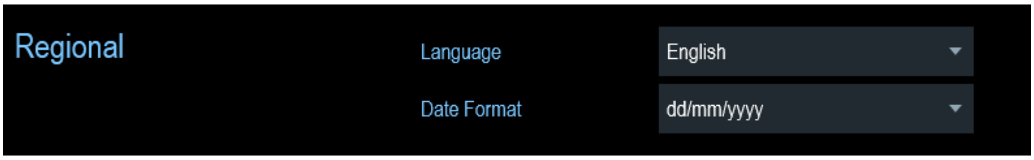
Selecting the time zone

1. In the "Instrument Setup" dialog box, select the "Time Zone" item.
2. Enter a positive or negative time offset relative to the system time with the numeric keys.

3. Confirm the entry with the rotary knob.
   After you have confirmed the time zone, the R&S Spectrum Rider adjusts the displayed time accordingly without changing the system time.

3.2.7.4 Selecting Regional Settings

The regional settings allow you to select a different language and date format.



Selecting the language

The R&S Spectrum Rider supports several languages for the user interface.

The following is a list of languages that the instrument supports:

English	Spanish	Japanese	Russian
French	Italian	Chinese	Hungarian
German	Portuguese	Korean	Traditional Chinese

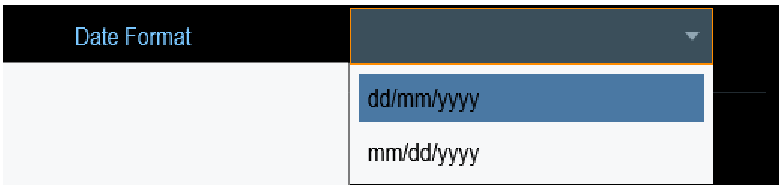
1. In the "Instrument Setup" dialog box, select the "Language" item.
   A drop-down menu opens to select the language.

2. Select one of the languages from the drop-down menu.
3. Reboot the device in order to activate the choice of selected language.

Setting the date format

The R&S Spectrum Rider provides 2 different formats to display the date.

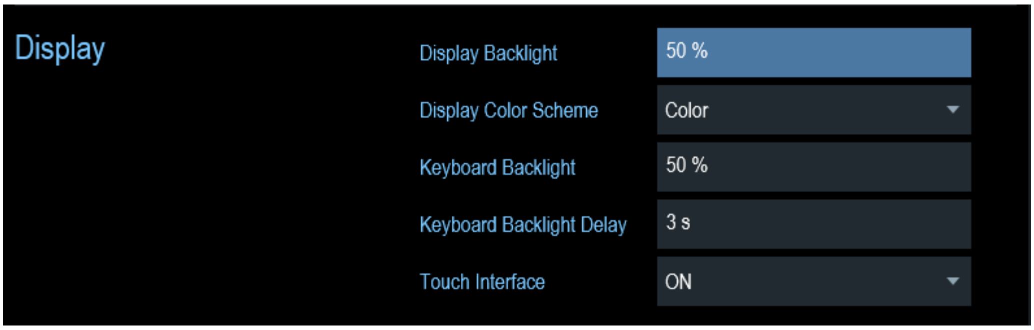
1. In the "Instrument Setup" dialog box, select the "Date Format" item.
   A drop- down menu opens to select the date format.



2. Select the required date format from the drop-down menu.

3.2.7.5 Configuring the Display

The display settings configure the display characteristics and the touch interface.



The display of the R&S Spectrum Rider is a TFT color LCD display.

The ideal brightness of the display depends on the intensity of the backlight. To strike a balance between battery operating time and screen display quality, set the backlight intensity to the minimum brightness needed.

To optimize the viewing angle, adjust the display color scheme settings. To achieve maximum contrast, the screen can be switched from color display to black-and-white display.

The intensity of the keyboard backlight is adjustable with a time delay setting to turn off the backlight. The keyboard backlight remains on until the time specified by the "Keyboard Backlight Delay" or a subsequent key is pressed.

Adjusting the display backlight

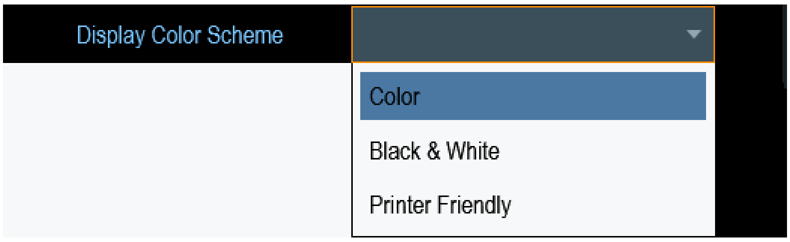
1. In the "Instrument Setup" dialog box, select the "Display Backlight" item.
2. Enter the backlight intensity you want with the numeric keys.

   The backlight intensity is a percentage from 0% to 100% with 100% being the brightest.
3. Confirm the entry with the rotary knob.

Adjusting the display color scheme

1. In the "Instrument Setup" dialog box, select the "Display Color Scheme" item.
   A drop- down menu opens to select the display color scheme.



2. Select the desire color scheme from the drop-down menu.
   a) "Color" selects a color display.
   b) "Black & White" selects monochrome display.
   c) "Printer Friendly" inverts the colors.

Adjusting the keyboard backlight

1. In the "Instrument Setup" dialog box, select the "Keyboard Backlight" item.
2. Enter the backlight intensity you want with the numeric keys.

   The backlight intensity is a percentage from 0% to 100% with 100% being the brightest.
3. Confirm the entry with the rotary knob.

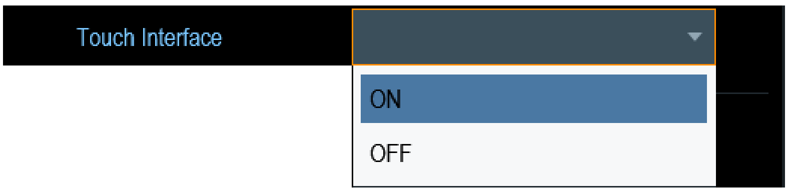
Adjusting the keyboard backlight delay

1. In the "Instrument Setup" dialog box, select the "Display Backlight" item.
2. Enter the time you want to turn off the keyboard backlight with the numeric keys.

   The time delay has a range of 1s to 10s.
3. Confirm the entry with the rotary knob.

Activating the touchscreen interface

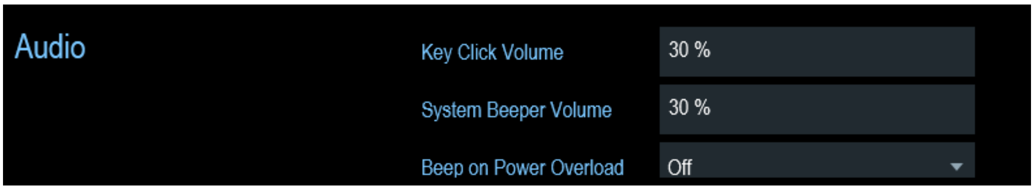
1. In the "Instrument Setup" dialog box, select the "Touch Interface" item.
2. Select "ON" to activate the touchscreen interface with R&S Spectrum Rider.



3. Select "OFF" to deactivate the touchscreen interface.
   Note: If the touch interface is not activated, the On-screen keyboard will be disabled.

3.2.7.6 Configuring the Audio Output

The audio settings control the audio output of the system.



Setting the key click volume

The key click volume sets the volume of the sound that the R&S Spectrum Rider produces when you press a key or select a softkey.

1. In the "Instrument Setup" dialog box, select the "Key Click Volume" item.
2. Enter the volume you want with the numeric keys.

   The key click volume is a percentage from 0% to 100% with 100% being the loudest.
3. Confirm the entry with the rotary knob.

Setting the system beeper volume

The system beeper volume sets the volume of the system beeper of the R&S Spectrum Rider used, i.e. if a message box pops up.

1. In the "Instrument Setup" dialog box, select the "System Beeper Volume" item.
2. Enter the volume you want with the numeric keys.

   The system beeper volume is a percentage from 0% to 100% with 100% being the loudest.
3. Confirm the entry with the rotary knob.

Activating/Deactivating audio alert in case of a power overload on and off

In case the R&S Spectrum Rider detects an overload at one of its inputs, you can configure it to make a sound.

1. In the "Instrument Setup" dialog box, select the "Beep on Power Overload" item.
2. Select "Beep on Power Overload" to "On".
   When this beeper is turned on, the R&S Spectrum Rider will make a sound every time it detects an overload.

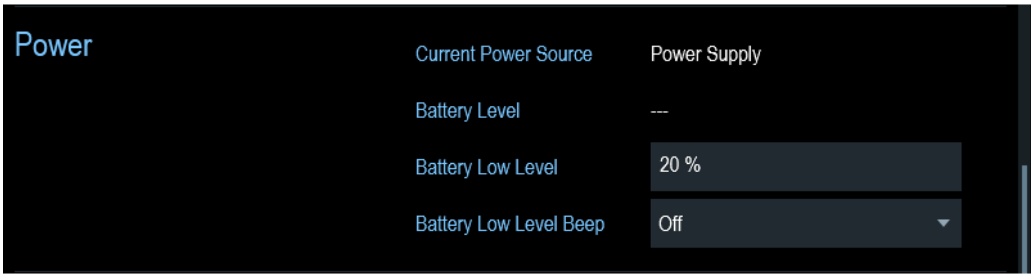
   

3.2.7.7 Configuring Power Supply

The "Current Power Source" shows the source the R&S Spectrum Rider is currently powered by.

When you are using the battery to supply the R&S Spectrum Rider with power, the remaining "Battery Level" is displayed as a percentage with 100 % representing a full charge.

The power sets the low power indicator on the power supply of the R&S Spectrum Rider.



Setting the battery low level

The battery low level is a reminder that the remaining battery charge might be used up soon.

When the battery low level is reached, the battery symbol in the "Title bar" turns red and starts blinking. See Chapter 3.1.1.5, "Battery Operation", on page 24 and Chapter 3.2.3.1, "Title Bar", on page 38.

1. In the "Instrument Setup" dialog box, select the "Battery Low Level" item.
2. Enter the charge level in percent of a fully charged battery with the numeric keys.

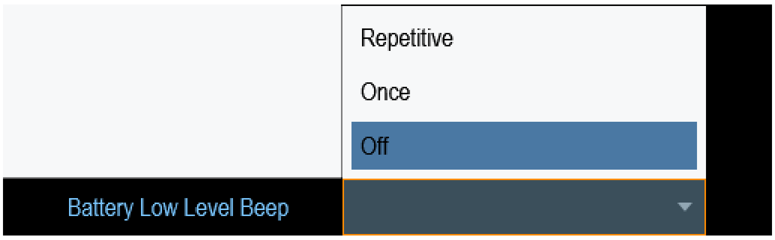
   

3. Confirm the entry with the rotary knob.

Activating/Deactivating audio alert in case of battery low level state on and off

The R&S Spectrum Rider also allows you to turn on an audio signal that indicates that the battery has reached its low level state.

1. In the "Instrument Setup" dialog box, select the "Battery Low Level Beep" item.



2. Select either "Repetitive" or "Once" to turn the audio signal on.
   If you have selected "Once", the R&S Spectrum Rider will beep once if the battery runs out of power. For a continuous beep, select "Repetitive".
3. Select "Off" to turn off the beeper.

3.2.7.8 Resetting the R&S Spectrum Rider

You can either preset the R&S Spectrum Rider or reset it to factory settings.

Presetting the R&S Spectrum Rider

The PRESET key resets the R&S Spectrum Rider to the default setup of the currently active operating mode.

This allows you to define the instrument with a new configuration based on a defined measurement parameters without using parameters from a previous measurement unintentionally still being active.

► Press the PRESET key.

Resetting the R&S Spectrum Rider

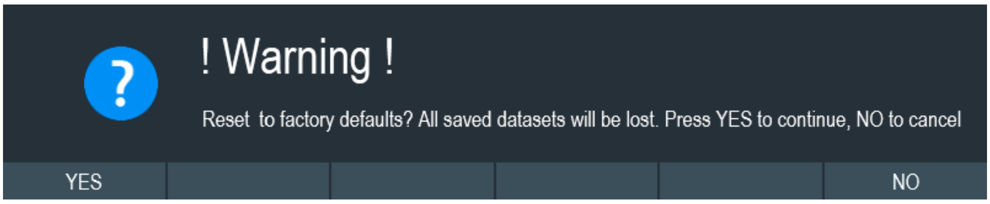
A "Reset to Factory Settings" resets the R&S Spectrum Rider to the factory defaults.

During a reset, the R&S Spectrum Rider restores the original configuration. It also deletes all customized datasets (limit lines, standards, channel tables, transducer tables etc.). Instead, it will reinstall all the datasets that have been available after delivery.

Risk of data loss
All datasets you have saved will be deleted during a factory reset.

1. In the "Instrument Setup" dialog box, select the "Reset to Factory Settings" item.
2. Confirm the entry with the rotary knob.

   The R&S Spectrum Rider initiates the reset procedure and shows a warning message box.



3. A corresponding dialog box opens for selection.
   Selecting "Yes" performs the reset. During the reboot, it shows a corresponding message.
   Selecting "No" cancels the reset.

3.2.8 Connecting the R&S Spectrum Rider to a PC

The R&S Spectrum Rider comes with the R&S Instrument View software package. This software package features several tools that allow you to document measurement results or create and edit limit lines or channel tables among other things.

The .NET Framework 2.0 (or higher) is required to run the software properly.

You can set up a connection between the R&S Spectrum Rider and R&S Instrument View either via its LAN port or its mini USB port. See Chapter 3.2.2.7, "Mini USB and LAN Port", on page 35.

You have to install the R&S Instrument View software on the PC before you are able to establish a connection.

1. Run the CD-ROM delivered with the R&S Spectrum Rider.
2. Navigate to the "Software" section and start the setup file.
3. Follow the instructions on the screen.
   Alternatively, you can download the latest R&S Instrument View from the R&S Spectrum Rider product homepage.

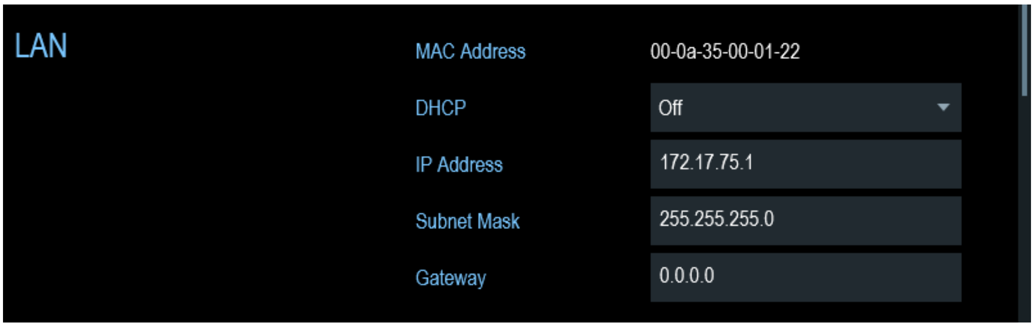
Firewall settings

If no connection can be established between the software and the R&S Spectrum Rider after successful configuration, check the firewall settings on your PC.

3.2.8.1 LAN Connection

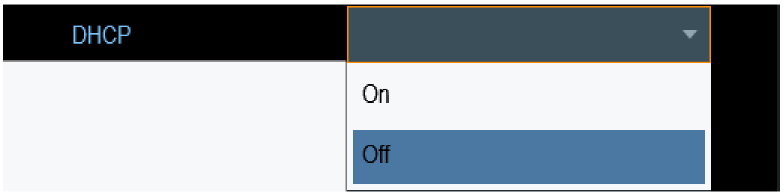
You can connect the R&S Spectrum Rider directly to the PC with a LAN cable. The LAN port is located on the right side of the R&S Spectrum Rider behind a protective cap. See Chapter 3.2.2.7, "Mini USB and LAN Port", on page 35.

You can set up the LAN connection in the "Instrument Settings" dialog box. See Chapter 3.2.7, "Configuring the R&S Spectrum Rider", on page 50.



For a direct connection between a PC and the R&S Spectrum Rider, DHCP (Dynamic Host Configuration Protocol) has to be turned off (which is the default state).

1. In the "Instrument Settings" dialog box, select the "DHCP" item.
   A drop-down menu opens to select the DHCP state.
2. Select "DHCP" to on or off as required.

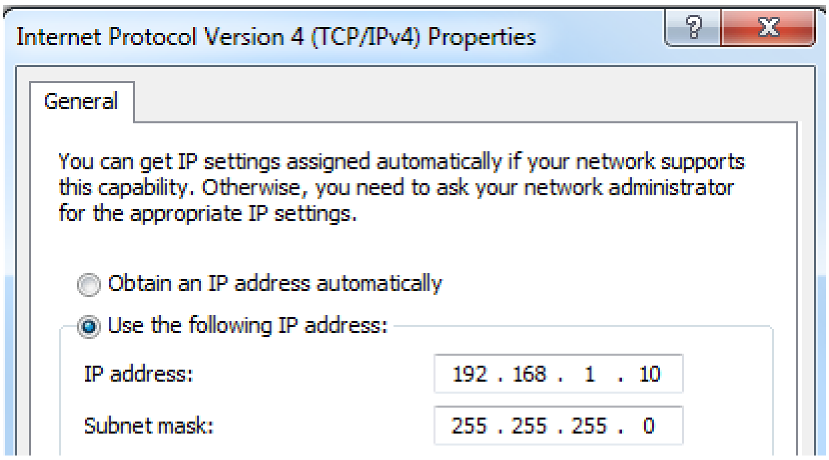


Setting an IP address and subnet mask

To establish a connection, the PC and the R&S Spectrum Rider have to be in the same subnet.

Subnet mask

1. Identify the subnet mask of your PC, i.e. in the Microsoft Windows "TCP/IP Properties".



2. In the "Instrument Settings" dialog box, select the "Subnet Mask" item.
3. Enter the subnet mask of the PC with the numeric keys.

After you have matched the subnet mask, you can define the IP address. When both devices are in the same subnet, the first three digits of the IP address are usually the same. See example below:

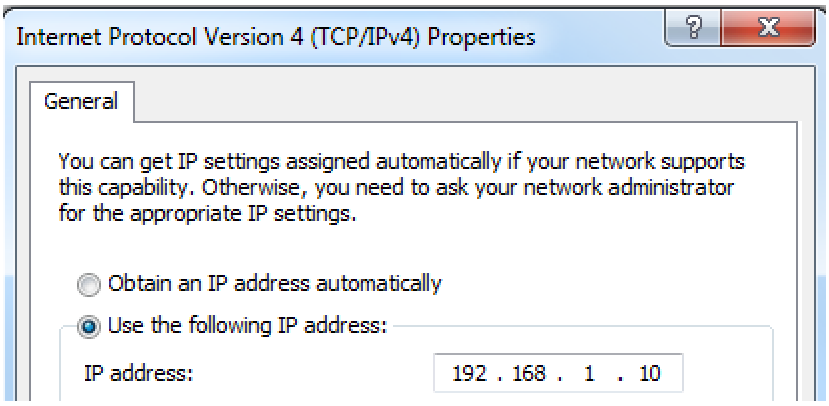
Example:

IP address PC: 192.168.1.10

IP address R&S Spectrum Rider: 192.168.1.20

IP address

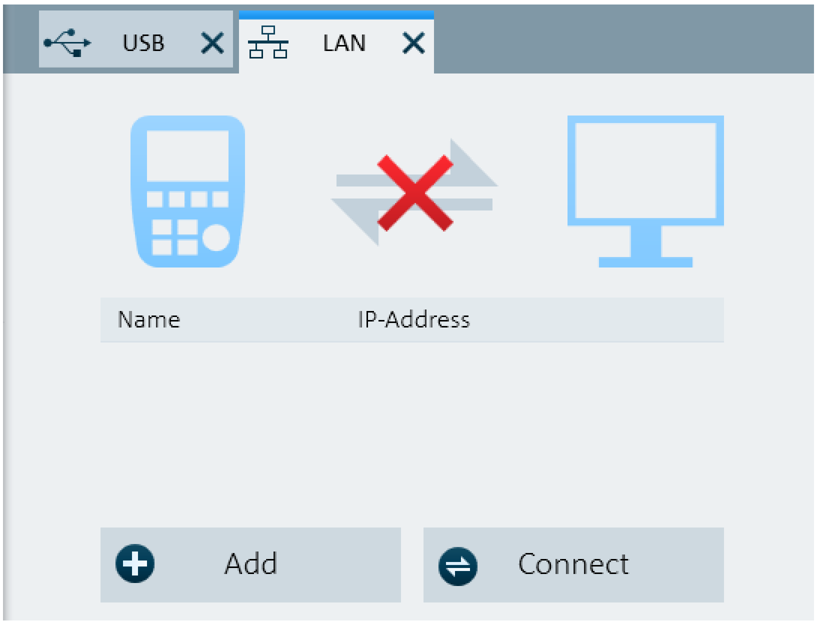
1. Identify the IP address of your PC, i.e. in the Microsoft Windows "TCP/IP Properties".



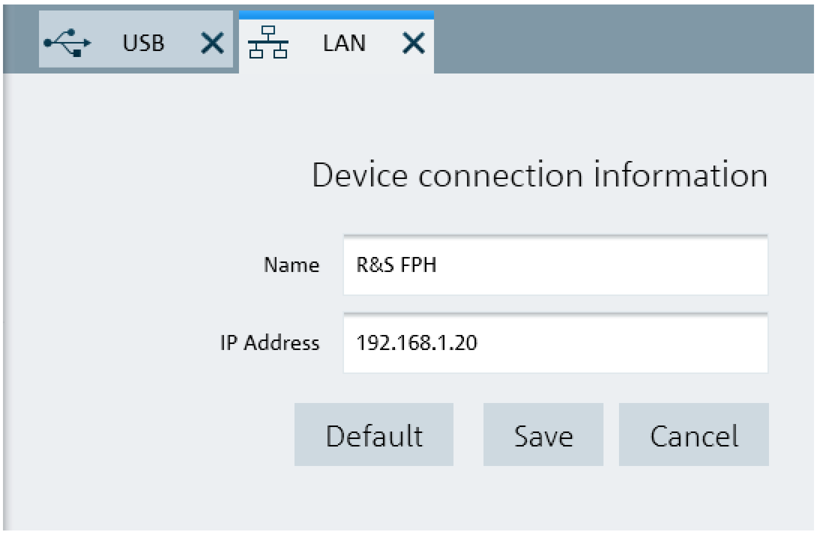
2. In the "Instrument Settings" dialog box, select the "IP Address" item.
3. Confirm the entry with the rotary knob.
4. Enter the IP address of the PC with the numeric keys.

Configuring the R&S Instrument View software

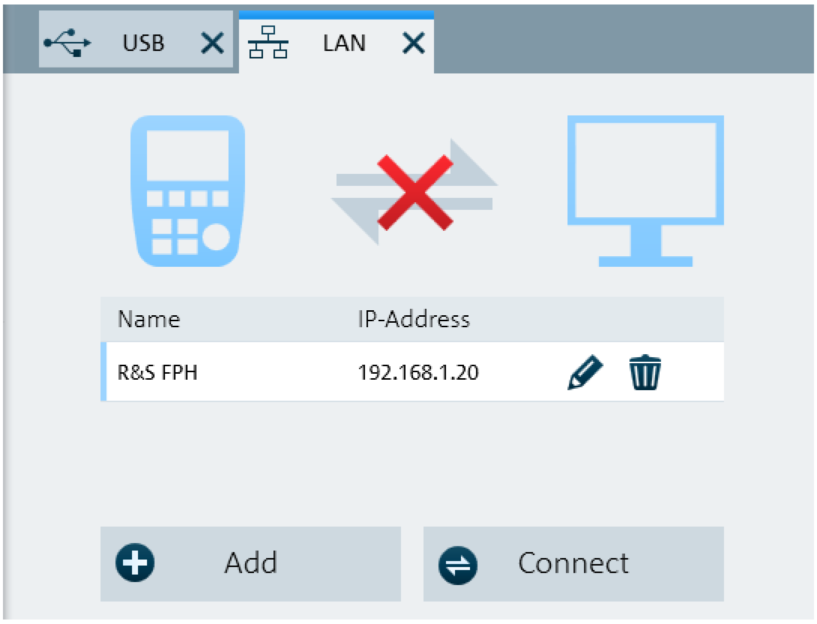
1. Start R&S Instrument View .
2. Select the "LAN" tab in the screen layout.



3. Select the "Add" button to create a new network connection.



4. Specify a name for the new network connection, e.g. R&S Spectrum Rider.
5. Enter the IP address for the R&S Spectrum Rider (in this case 192.168.1.20).
6. Confirm the entry with the "Save" button.
   The connection is now created and configured.



7. Select the new connection labeled R&S Spectrum Rider.
8. Select the "Connect" button to establish the connection.

Connecting the R&S Spectrum Rider in an existing LAN

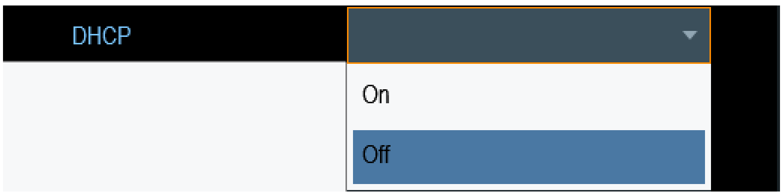
You can either draw the R&S Spectrum Rider IP address automatically from the DHCP server or manually assign a fixed address. With manual allocation, a fixed IP address and subnet mask must be assigned to the R&S Spectrum Rider as described in Chapter 3.2.8.1, "LAN Connection", on page 61. Then the R&S Instrument View software has to be configured as described in "Configuring the R&S Instrument View software" on page 63 with the assigned IP address.

Free IP address
Contact your IT system manager to get a free IP address.

In networks with a DHCP server, DHCP permits automatic allocation of the network configuration to the R&S Spectrum Rider connected via LAN cable. For this purpose, DHCP has to be active on the R&S Spectrum Rider.

DHCP is off by default. Turn it on like this:

1. In the "Instrument Setup" dialog box, select the "DHCP" item.
2. Select "DHCP" to "On" to activate DHCP.



The R&S Spectrum Rider is now allocated an IP address and the subnet mask by the DHCP server. This can take several seconds.

The IP address and subnet mask are automatically set in the corresponding input fields and are no longer available for editing.

Configure the R&S Instrument View software with the IP address and subnet mask as defined by the DHCP server. For more information, see Chapter 3.2.8.1, "LAN Connection", on page 61.

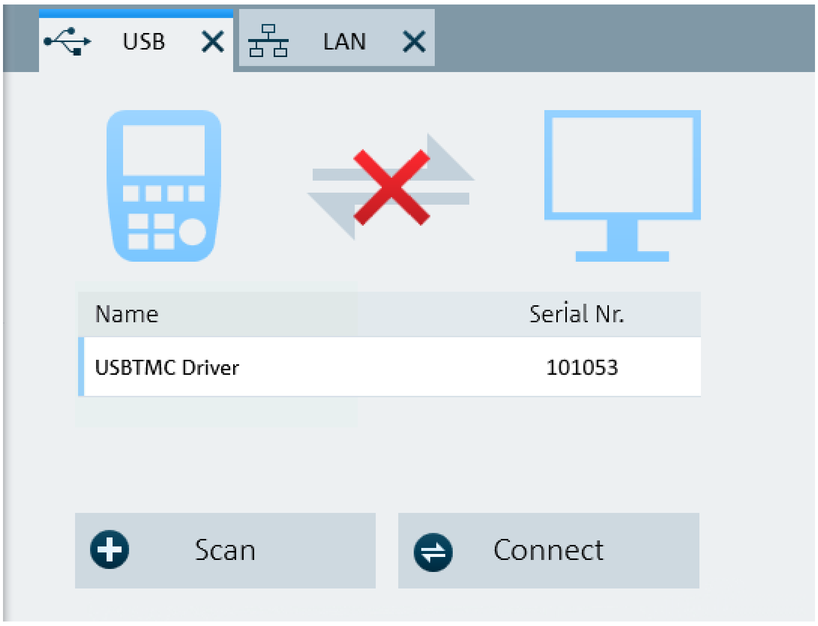
3.2.8.2 USB Connection

Alternatively, you can connect the R&S Spectrum Rider to the PC with a USB cable. The Mini USB interface is located on the right side of the R&S Spectrum Rider behind a protective cap. For more information, see Chapter 3.2.2.7, "Mini USB and LAN Port", on page 35.

When you connect the R&S Spectrum Rider to a computer for the first time, Windows tries to install the new hardware automatically. The required drivers are installed along with the R&S Instrument View software package.

When the drivers have been found on your system and the hardware has been successfully installed, Windows shows a corresponding message.

1. Connect the R&S Spectrum Rider via the Mini USB port to your computer.
2. Start R&S Instrument View on the PC.
3. Select the "USB" tab in the screen layout.



4. Select the "Scan" button to identify the R&S Spectrum Rider.
5. Confirm the selection with the "Connect" button.

3.3 Trying Out the Instrument

This chapter provides a short overview of the first steps of the measurements you can perform with the R&S Spectrum Rider.

3.3.1 Using the Spectrum Analyzer

This chapter provides a short overview of the first steps of the measurements you can perform with the R&S Spectrum Rider.

3.3.1.1 Attenuating the Signal

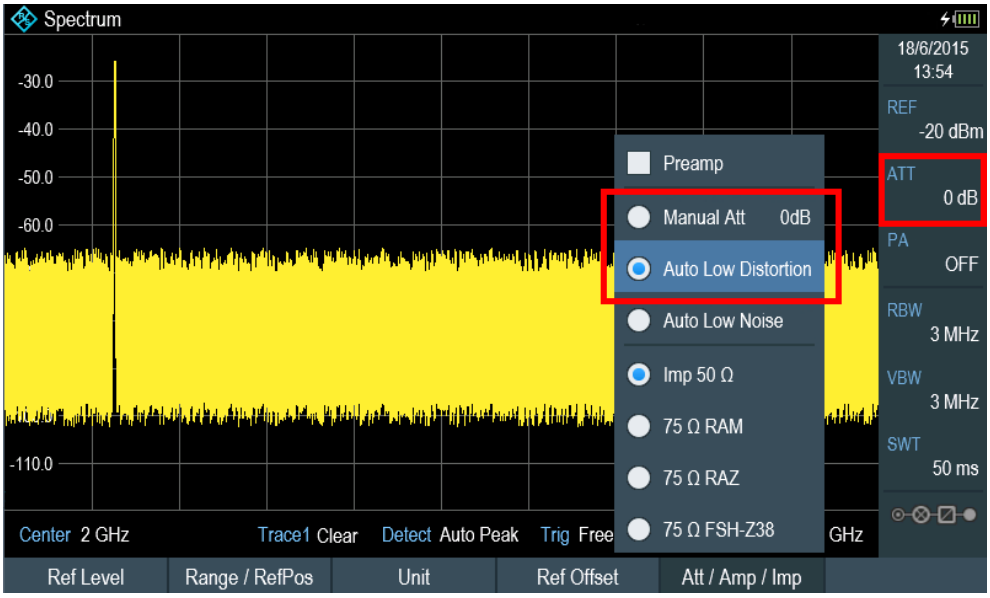
You can attenuate the signal to a suitable level either manually or automatically.

In case of automatic attenuation, the level of attenuation at the RF input depends on the current reference level. The R&S Spectrum Rider provides two ways of automatic attenuation.

For the highest possible sensitivity, it provides the "Auto Low Noise" attenuation mode. For the lowest possible intermodulation, it provides the "Auto Low Distortion" mode.

The main difference between the two modes is that the attenuation level is 5 to 10 dB higher in case of "Auto Low Distortion" than it is for "Auto Low Noise". In the default state, "Auto Low Distortion" is active.

1. Press the AMPT key.
2. Select the "Att/Amp/Imp" softkey.
3. Select either the "Auto Low Noise" or "Auto Low Distortion" menu item.
   The R&S Spectrum Rider shows the current attenuation level in the "Parameter view". The currently active menu item has a blue background and the selected parameters is indicated with a blue dot in the menu item.



You can also set the attenuation manually. TheR&S Spectrum Rider provides attenuation in the range from 0 to 40 dB in 5 dB steps.

4. Press the AMPT key.
5. Select the "Att/Amp/Imp" softkey.
6. Select the "Manual Att" menu item.
   The R&S Spectrum Rider opens an entry box to define the attenuation. Two methods are provided to fill in the input fields:
   - Directly with the number keys
   - Using rotary knob

   While you can enter any number you want with the number keys, using the rotary knob is coupled to a certain step size in most cases.
   If you use the rotary knob to change the attenuation, i.e. the step size is 5 dB.
7. Enter the attenuation you need.
   The R&S Spectrum Rider shows the current attenuation level in the "Parameter View".

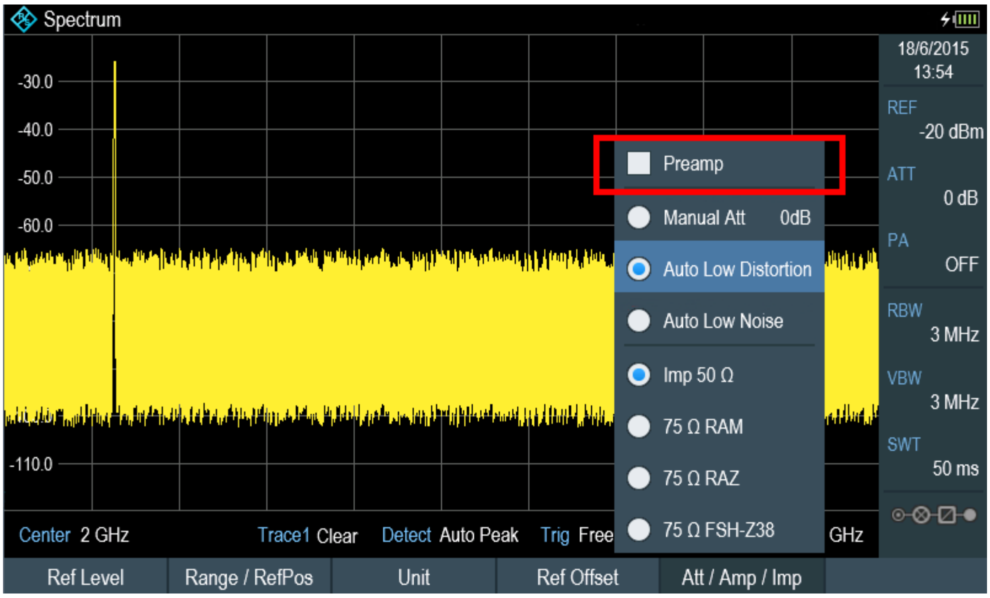
3.3.1.2 Using the Preamplifier

The R&S Spectrum Rider has an optional preamplifier (R&S FPH-B22, order number 1321.0680.02) to increase sensitivity. Depending on the frequency, the gain of the amplifier is in the range from 15 to 20 dB and increases the sensitivity by 10 to 15 dB.

In the signal path, the preamplifier comes after the input protection circuit and before the RF attenuator of the R&S Spectrum Rider to provide excellent sensitivity when the preamplifier is switched on.

1. Press the AMPT key.

2. Select the "Att/Amp/Imp" softkey.
3. Enable or disable the "Preamp" checkbox to turn on or off the preamplifier of the R&S Spectrum Rider.



The magnitude of amplification depends on the reference level. This coupling to the reference level makes sure that the dynamic range is at an optimum.

3.3.1.3 Measuring CW Signals

A basic task for spectrum analyzers is to measure the level and frequency of sinewave signals. The following examples illustrate an effective way of performing these measurements.

A signal generator, e.g. R&S SMBV provides the signal source.

Test setup

Connect the RF output of the signal generator to the RF input of the R&S Spectrum Rider.

Signal generator settings:

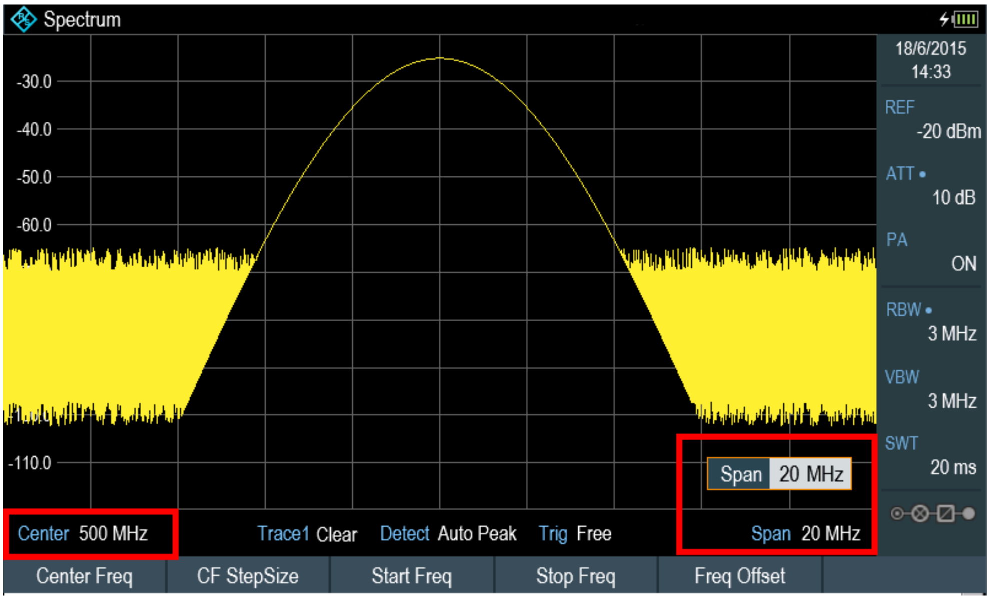
- Frequency: 500 MHz
- Level: -25 dBm

Measuring the level

1. Press the PRESET key.
   The R&S Spectrum Rider is reset to its default state.
   After the preset, the R&S Spectrum Rider displays the frequency spectrum over its full frequency span.

At 500 MHz, the generator signal is displayed as a vertical line. To analyze the generator signal at 500 MHz in more detail, reduce the frequency span.

2. Press the "Center" softkey at the "Parameter view".
   The R&S Spectrum Rider opens an entry box to define the center frequency.
3. Enter a center frequency of 500 MHz.
   The signal is now in the center of the display.
4. Press the "Span" softkey at the "Parameter view".
   The R&S Spectrum Rider opens an entry box to specify the span.
5. Enter a span of 20 MHz.
   The R&S Spectrum Rider now displays the generator signal with a higher resolution.



Setting the reference level

The level at the top of the measurement diagram is called the reference level. To obtain the best dynamic range from the R&S Spectrum Rider, you should use its full level range. That means that the maximum level value should be at or close to the top of the measurement diagram (= reference level).

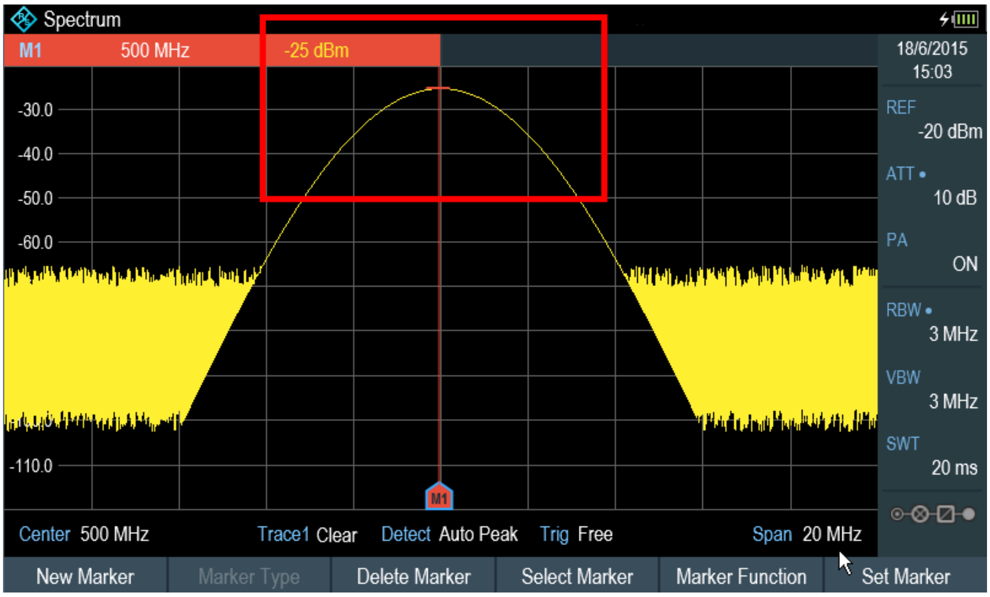
1. Press the "REF" softkey at the "Parameter view".
   The R&S Spectrum Rider opens an entry box to enter the reference level.
2. Enter a reference level of -25 dBm.
   The R&S Spectrum Rider reduces the reference level by 5 dB.

The maximum trace value is close to the maximum scale value of the measurement diagram. The increase in the displayed noise floor is minimal. The difference between the signal maximum and the displayed noise (i.e. the dynamic range) has, however, been increased.

Using Markers

The R&S Spectrum Rider has markers to read out signal levels and frequencies. Markers are always positioned on the trace. Both the level and frequency at their current positions are displayed on the screen.

► Press the MARKER key.
The R&S Spectrum Rider activates a marker and puts it on the maximum value on the trace. The coordinates of the marker is shown in a table above the measurement diagram.
A red vertical line represents the position of the marker on the horizontal axis (i.e. the frequency). A small red horizontal dash represents the marker position on the vertical axis (i.e. the level).



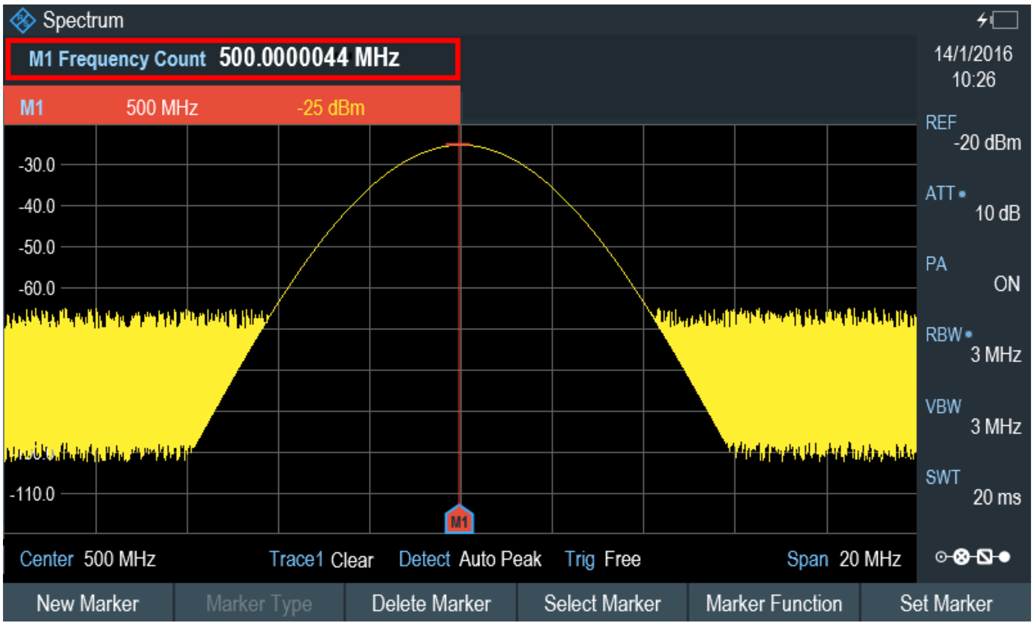
Measuring the frequency

The trace consists of 711 measurement points (frequency points). The marker is always positioned on one of these measurement points. The R&S Spectrum Rider calculates the marker frequency from the frequency of the measurement point, the center frequency and the frequency span that have been set. The measurement-point resolution, and consequently the accuracy of the marker frequency readout, therefore depend on the frequency span that has been selected.

The R&S Spectrum Rider has a frequency counter to increase the accuracy of the marker-frequency readout. It completes the sweep, then counts the frequency at the marker position.

1. Press the "Marker Function" softkey at the "Parameter view".
2. Select the "Frequency Count" from the menu item.

The measurement result of the frequency counter is displayed at the "Measurement result view". When the frequency counter is active, the resolution of the frequency readout is always 0.1 Hz, regardless of the span. The accuracy is determined by the internal reference frequency which is far more exact than that of the pixel-oriented marker readout.



3.3.1.4 Measuring Harmonics

A spectrum analyzer is ideal to measure harmonic levels or harmonic ratios, because it can resolve different signals in the frequency domain.

With marker functions, you can speed up measurement tasks like that.

A signal generator, e.g. R&S SMBV provides the signal source.

Test setup

Connect the RF output of the signal generator to the RF input of the R&S Spectrum Rider.

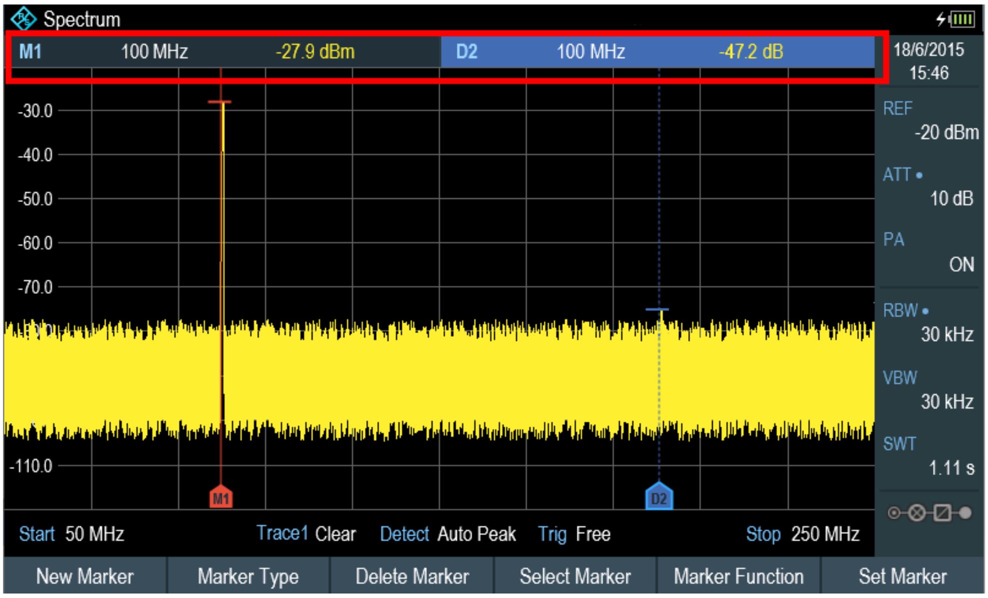
Signal generator settings:

- Frequency: 100 MHz
- Level: -20 dBm

Detecting harmonics

1. Press the PRESET key.
   The R&S Spectrum Rider is reset to its default state.
   After the preset, the R&S Spectrum Rider displays the frequency spectrum over its full frequency span.
   At 100 MHz, the generator signal is displayed as a vertical line. In addition, you can see the harmonics as smaller vertical lines at frequencies that are multiples of 100 MHz. To measure the second harmonic ratio, decrease the span.

2. Press the FREQ key.
3. Select the "Start" softkey at the "Measurement footer bar".
   The R&S Spectrum Rider opens an entry box to enter the start frequency.
4. Enter a start frequency of 50 MHz.
5. Confirm the entry with one of the unit keys.
6. Select the "Stop" softkey at the "Measurement footer bar".
   The R&S Spectrum Rider opens an entry box to enter the stop frequency.
7. Enter a stop frequency of 250 MHz.
8. Confirm the entry with one of the unit keys.
   The R&S Spectrum Rider displays the frequency spectrum in the range from 50 MHz to 250 MHz. This frequency range visualizes the signal itself at 100 MHz and the second harmonic at 200 MHz.



   To measure the harmonic ratio, set the marker on the signal and a delta marker on the second harmonic.

9. Press the MARKER key.
   The R&S Spectrum Rider sets a marker on the trace maximum. The trace maximum corresponds to the signal.
10. Select the "New Marker" softkey at the "Measurement footer bar".
    The R&S Spectrum Rider activates a delta marker and places it on the next trace maximum. This corresponds to the second harmonic.
    The harmonic ratio is the vertical distance of the marker and the delta marker. The R&S Spectrum Rider displays this value in the "Measurement result view".

3.3.2 Using a Power Sensor

For highly accurate power measurements, you can connect one of the power sensors that are supported by the R&S Spectrum Rider.

R&S Spectrum Rider option

R&S FPH-K9 (order number: 1321.0709.02) option is required to operate the R&S Spectrum Rider in power sensor mode.

For a list of R&S Spectrum Rider supported power sensor, refer to Chapter 7.1, "Using a Power Sensor", on page 149.

You can connect the power sensors available for R&S Spectrum Rider to the USB port of R&S Spectrum Rider. This connector allows you to control the power sensor and supplies it with power. For more information, see Chapter 3.2.2.4, "USB Port", on page 34.

3.3.2.1 Measuring the Power with a Power Sensor

For more information about the characteristics of the supported power sensors, refers to their datasheet.

NOTICE

Risk of damaging the power sensor

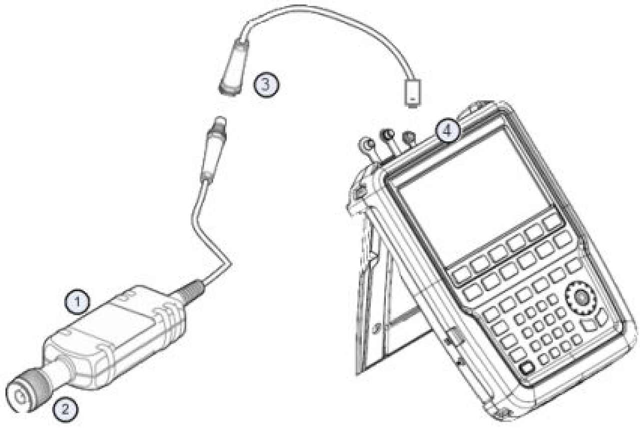
Because of high input power,

- The continuous power applied to the power sensor's input must not exceed 400 mW (26 dBm).
- Use an attenuator for measurements on high-power transmitters.

However, brief power peaks ≤ 10 µs up to 1 W (30 dBm) are permissible.

Test setup

Connect the power sensor cable to the USB port of R&S Spectrum Rider. If the power sensor is having the binder connector (i.e R&S FSH-Z1, R&S FSH-Z18), the FSH-Z144 adaptor cable is needed.



1 = Supported power sensor (e.g R&S FSH-Z1, R&S NRP-Z11)
2 = Power sensor connector (DUT)
3 = USB binder adaptor (R&S FSH-Z144)
4 = USB port connector (see Chapter 3.2.2.4, "USB Port", on page 34)

Measuring the power

1. Press the MODE key.
2. Press the "Power Meter" softkey.
   The R&S Spectrum Rider switches its operating mode. See "R&S Spectrum Rider option" on page 74.

If the R&S Spectrum Rider recognizes a power sensor, it sets up a connection via the interface and after a few seconds shows the measured power.

If no power sensor has been connected or is not connected appropriately, the R&S Spectrum Rider shows nothing.

If there are communication problems between the R&S Spectrum Rider and the power sensor, the R&S Spectrum Rider displays an error message that indicates a possible cause. For more information, see the R&S Spectrum Rider user manual.

Zeroing the power sensor

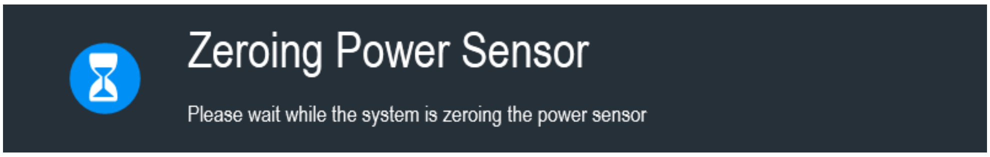
To compensate internal offsets of the power meter, it needs to be compensated for before starting the measurement.

1. Press the "Zero" softkey.
   Do not to apply any signals to the power sensor while zeroing is active.
   A popup message box is displayed to provide instructions during the zeroing of the power sensor.

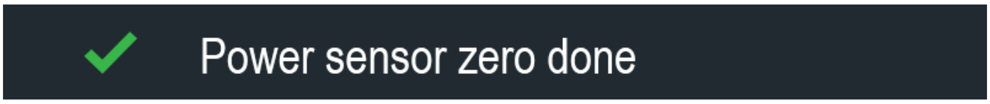
   

2. Disconnect the power sensor from any signal sources.

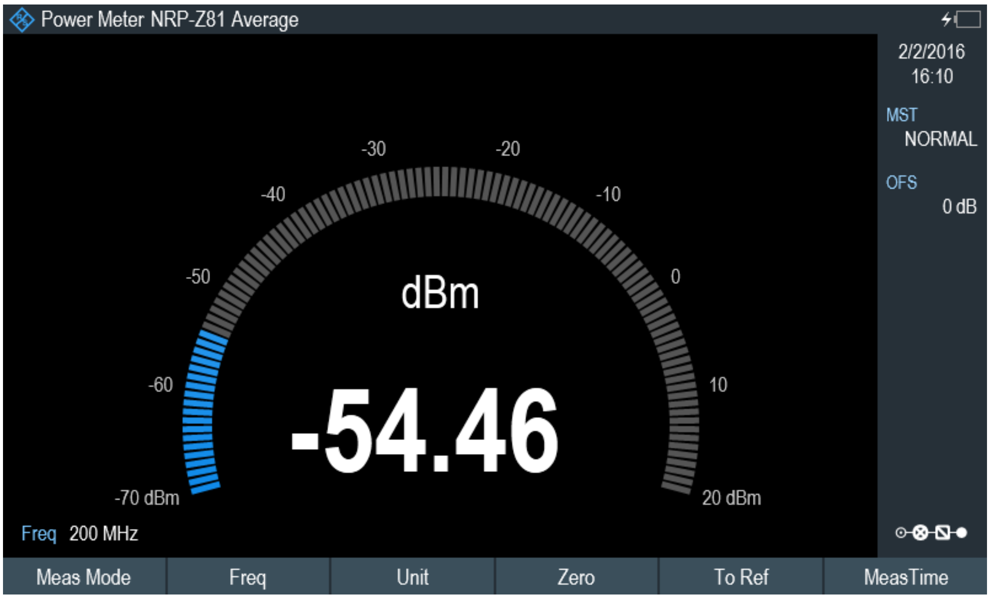
3. Press the "Continue" softkey to start zeroing.
   The R&S Spectrum Rider starts the zeroing process.



4. Wait for the zeroing process to finish.
   After zeroing is done, the R&S Spectrum Rider displays the message "Power sensor zero done" and again shows the power sensor softkey menu.



5. Connect the DUT to the power sensor.
   The R&S Spectrum Rider shows the measured power level in dBm.



Set the frequency

To get the best results, enter the frequency of the signal under test.

1. Press the "Freq" softkey.
   The R&S Spectrum Rider opens an entry box to enter the frequency.
2. Enter the frequency of the signal.
3. Confirm the entry with one of the unit keys.

The R&S Spectrum Rider transfers the new frequency to the power sensor which then corrects the measured power readings.

3.3.2.2 Measuring Power and Return Loss

With the directional power sensors R&S FSH-Z14 and R&S FSH-Z44, you can measure the power in both directions.

See "R&S Spectrum Rider option" on page 74.

When you connect the directional power sensor between the source and the load, the R&S Spectrum Rider measures the power from the source to load (forward power) and from the load to source (reverse power).

The ratio between the forward and reverse power is a measure of the load matching. The R&S Spectrum Rider displays it as the return loss or standing wave ratio.

The power sensors for the R&S Spectrum Rider have an asymmetrical design. Therefore, they have to be inserted into the test setup in such a way that the "Forward" arrow on the sensor points toward the load (in the direction of the power flux).

When measuring high powers, pay strict attention to the following instructions to avoid personal injury and to prevent the power sensor from being destroyed.

⚠ CAUTION

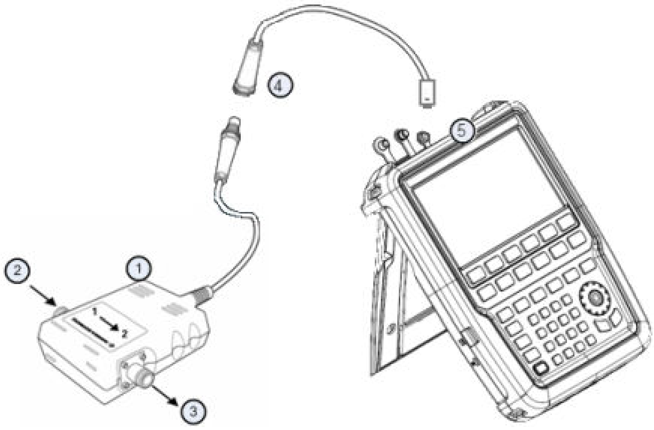
Danger of skin burns and damage to the instrument

- Never exceed the permissible continuous power.
- See diagram on the rear of the sensor for the permissible continuous power.
- Turn off the RF power to connect the sensor.
- Screw the RF connectors tightly.

Test setup

Connect the power sensor cable to the USB port of R&S Spectrum Rider. If the power sensor is having the binder connector (i.e R&S FSH-Z14, R&S FSH-Z44), the FSH-Z144 adaptor cable is needed. Insert the directional power sensor between the source and the load.

The power sensors for the R&S Spectrum Rider have an asymmetrical design. Hence, you have to insert them into the test setup in such a way that the "Forward" arrow (1→2) on the sensor points toward the load (= in the direction of the power flux).



1 = Directional power sensor R&S FSH-Z14 or Z44
2 = Source
3 = Load
4 = USB binder adaptor (R&S FSH-Z144)
5 = USB port connector (see Chapter 3.2.2.4, "USB Port", on page 34)

Measuring the power

1. Press the MODE key.
2. Press the "Power Meter" softkey.

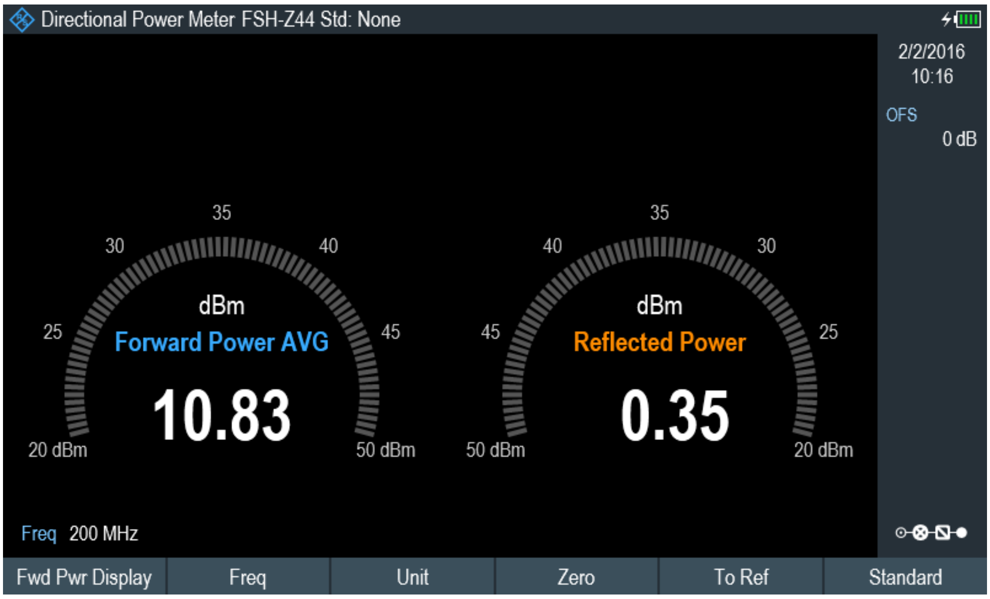
As soon as the R&S Spectrum Rider recognizes the power sensor, it shows the type of the directional power sensor that is connected in the "Title bar" (see Figure 3-6). After a few seconds it also shows the forward power and return loss currently measured at the load.

Zeroing the power sensor

Before performing the power measurement, you should zero the power sensor. For more information, see Chapter 3.3.2.1, "Measuring the Power with a Power Sensor", on page 74).

After zeroing is done, the R&S Spectrum Rider displays the message "Power sensor zero done" and again shows the power sensor softkey menu.

► Connect the R&S FSH-Z14 or R&S FSH-Z44 between the source and the load.
The R&S Spectrum Rider displays the measured forward power in dBm and the SWR of the load.



To get the best results, you should also define the frequency of the signal. For more information, see Chapter 3.3.2.1, "Measuring the Power with a Power Sensor", on page 74.

3.3.3 Saving and Recalling Results and Settings

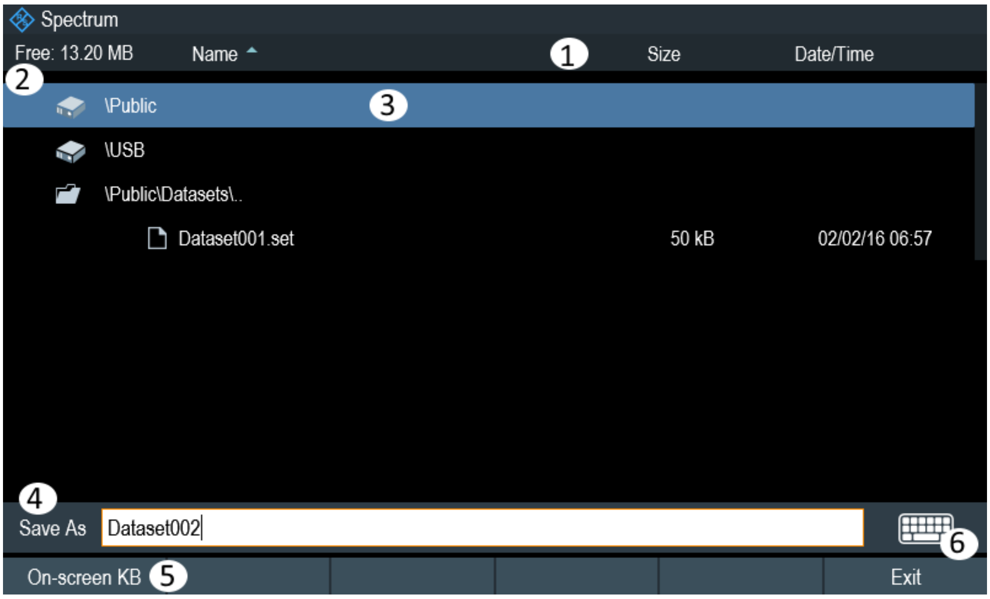
The R&S Spectrum Rider can store measurement results and settings in the internal memory, on a removable SD memory card or on a memory stick via the USB interface.

Results and settings are always stored together, allowing them to be interpreted in context when recalled. The R&S Spectrum Rider can store at least 100 data records in the internal memory which are differentiated by their names.

The R&S Spectrum Rider provides two USB ports and a SD card slot. For more information, see Chapter 3.2.2.4, "USB Port", on page 34 and Chapter 3.2.2.8, "SD Card Slot", on page 36.

3.3.3.1 Saving Measurement Results

1. Press the SAVE RECALL key.
2. Select the "Save" softkey.
   The R&S Spectrum Rider opens the file manager dialog box.
   The file manager provides file navigation function in the internal storage, SD card and USB.



1 = Header bar
2 = Remaining memory on selected data storage
3 = Selected data sets and folder structure
4 = Input field for dataset name
5 = On-screen Keyboard
6 = On-screen Keyboard icon

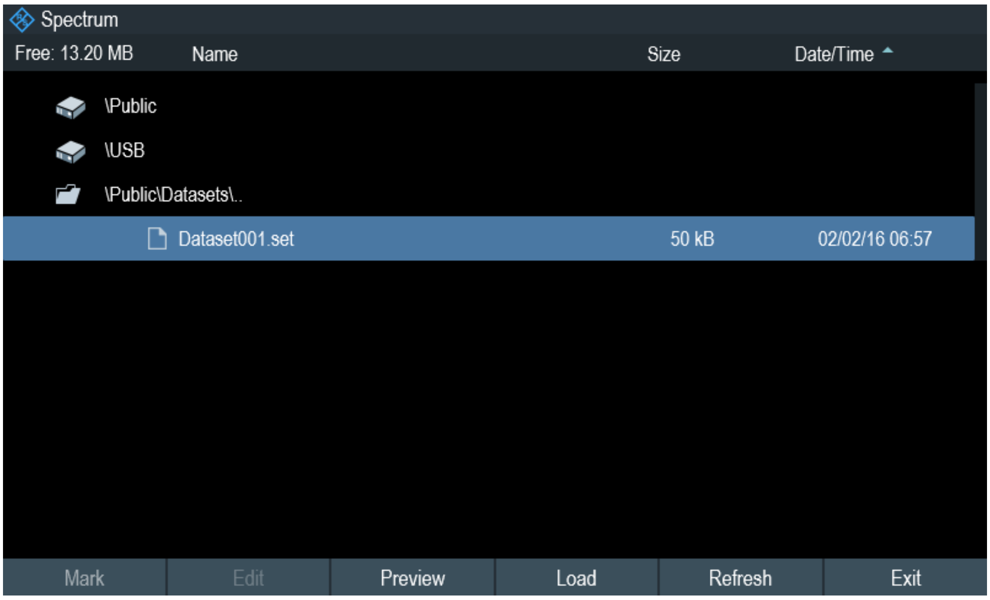
3. Specify a name for the data set in the input field of the dialog box with the on-screen keyboard.
   Note: If touch interface is not activated, the "On-screen KB" softkey is disabled.
   In addition, use the BACK key to delete a character and the CANCEL key to quit the entry. You can either:
   - Overwrite a data set that already exists by selecting it from the available data sets in the list.
   - Edit the name of an existing data set using the on-screen keyboard function.
   - Create a new data set by entering a new name with the on-screen keyboard function.
   - Sort the files by selecting the respective column of the "Header bar" and the list will be sorted according to the type (i.e. "Name", "Size", "Date/Time") selected.
4. Select the storage medium that you want to use.
5. Select the "Save" softkey.
   The R&S Spectrum Rider saves the data set.

3.3.3.2 Recalling Measurement Results

Use the R&S Spectrum Rider recall function to review previously saved measurement results and settings.

1. Press the SAVE RECALL key.
2. Select the "Recall" softkey.

A list of all saved data sets opens.
If you want to recall the results from the SD card or a USB stick, select "Preview" softkey to preview its contents.



3. Confirm your selection with the "Load" softkey.

4 Instrument Functions

This chapter provides information about the basic functionality and the user interface of the R&S Spectrum Rider.

4.1 Screen Layout and Elements

The following figure shows the screen layout in spectrum mode. It shows all elements that are the same for all operating modes of the R&S Spectrum Rider. Screen layouts that show specifics for each operating mode or measurement are provided in the corresponding sections of this manual.

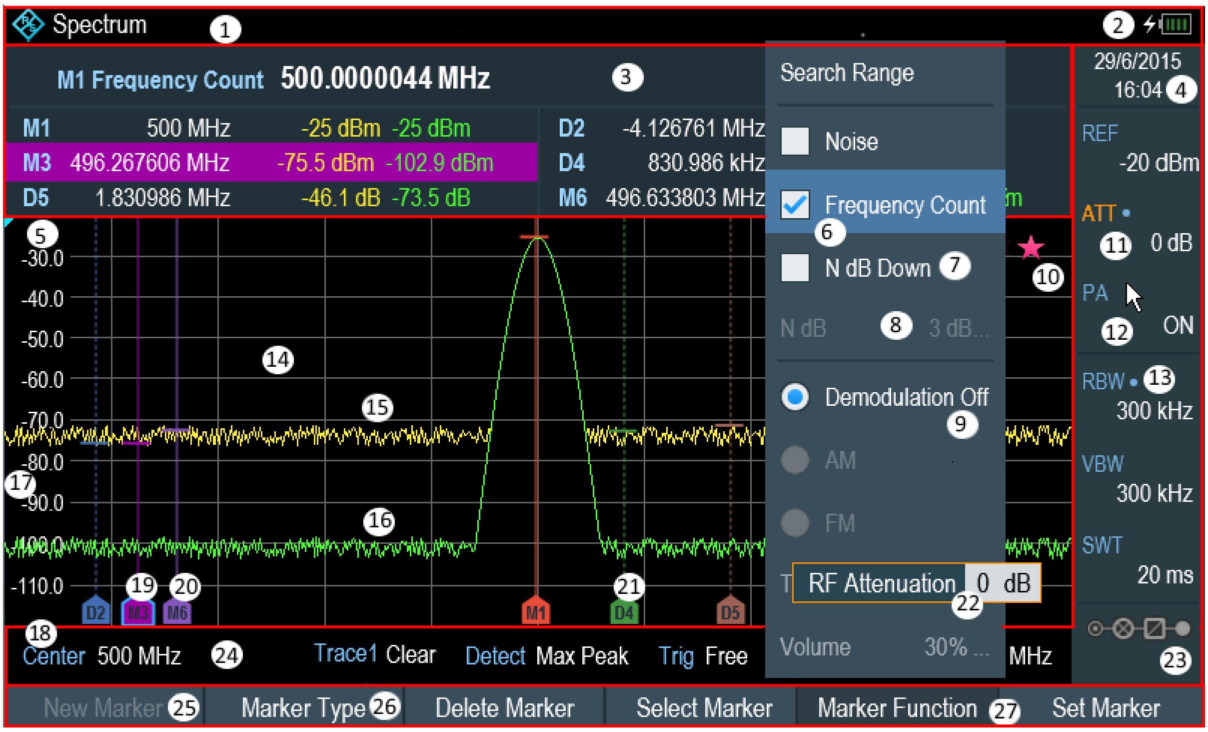
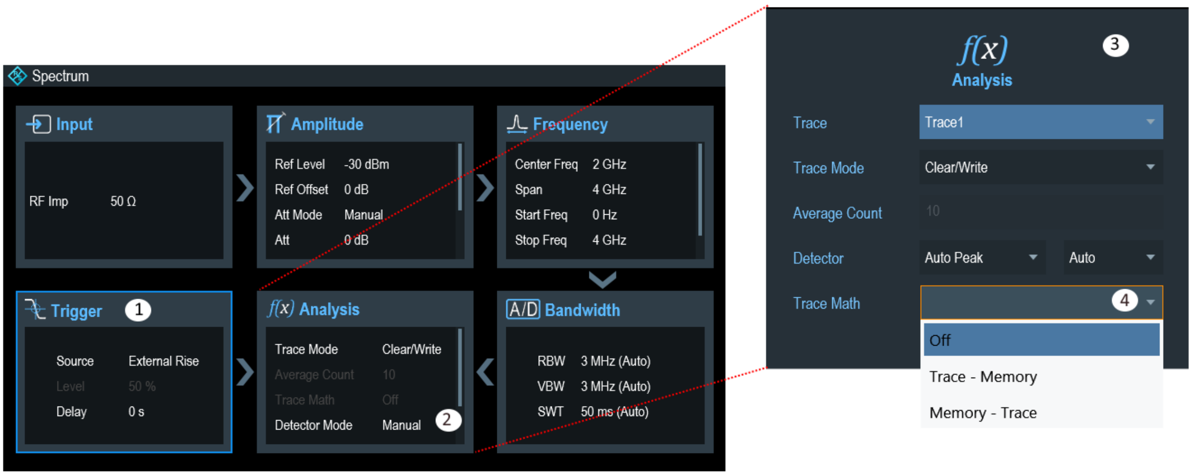


Figure 4-1: Screen layout and elements

1 = Title Bar
2 = Battery status
3 = Measurement Result View
4 = Date and time
5 = Reference position
6 = Currently selected menu item
7 = Available menu item
8 = Unavailable menu item
9 = Active menu item
10 = Invalid trace indicator and overload information
11 = Currently selected button
12 = Selectable toggle button
13 = Blue dot implies setting not coupled to another hardware setting
14 = Measurement Trace Window
15 = Trace 1
16 = Trace 2
17 = Horizontal axis labeling
18 = Vertical axis labeling
19 = Currently selected maker
20 = Marker
21 = Delta marker
22 = Entry box
23 = Configuration Overview
24 = Parameter View
25 = Unavailable softkey function
26 = Available softkey function
27 = Currently selected softkey function

4.1.1 Configuration Overview Screen Layout

The "Configuration Overview" is an operation mode dependable function. When selected, it opens the "Config Overview" window which consists of six configuration blocks to configure the relevant parameters at each stages of the measurement. The button is located at the bottom right corner of the display. The following illustrates the screen layout of the "Config Overview" window.



1 = Current selected block
2 = Scroll bar
3 = Associated block (see Table 3-3)
4 = Drop down list

When the block in the "Config Overview" window is selected, it displays a blue frame around the selected block. You can also used the rotary knob to select the block for configuration.

The parameters displayed in the block are current parameters applied to the spectrum measurement. To configure the parameters, select the desired block for configuration. Alternatively, press the rotary knob to select the block for configuration.

If there is an arrow on the block (see index 3), this indicates that there are more parameters available for configuration. Select the arrow to go to the next block for further configuration.

Depending on the mode selected for operation, blocks that are not available in the selected mode will be dimmed.

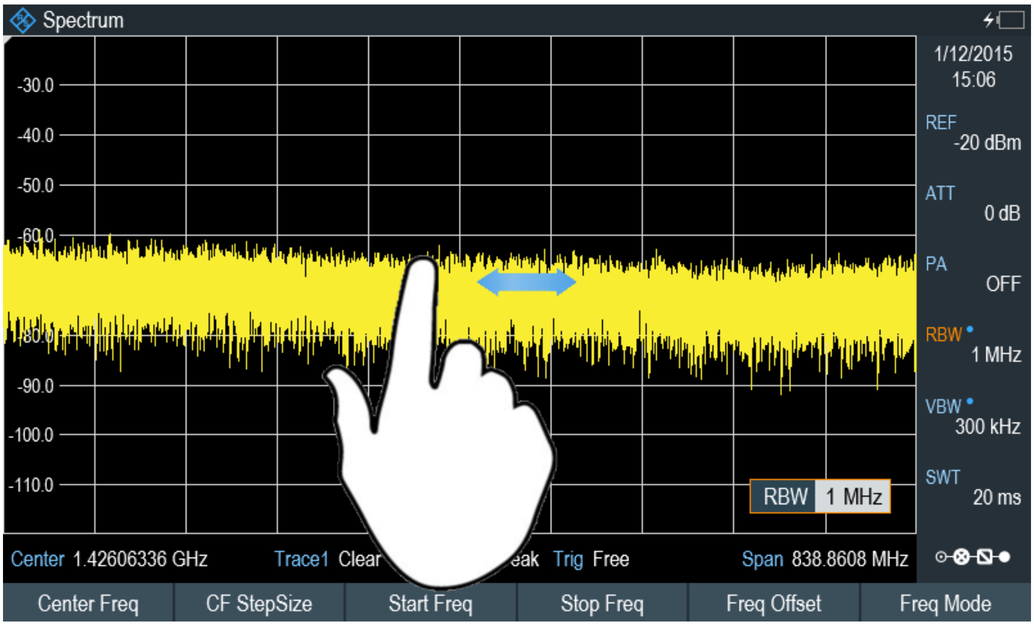
See details of each block configuration in "Configuration Overview" on page 41 for spectrum analyzing mode.

4.2 Touchscreen Gesture Element

To enhance greater flexibility and user experience in the user interaction with R&S Spectrum Rider, special touchscreen gestures are introduced. The following illustrated the list of special gestures that R&S Spectrum Rider provides.

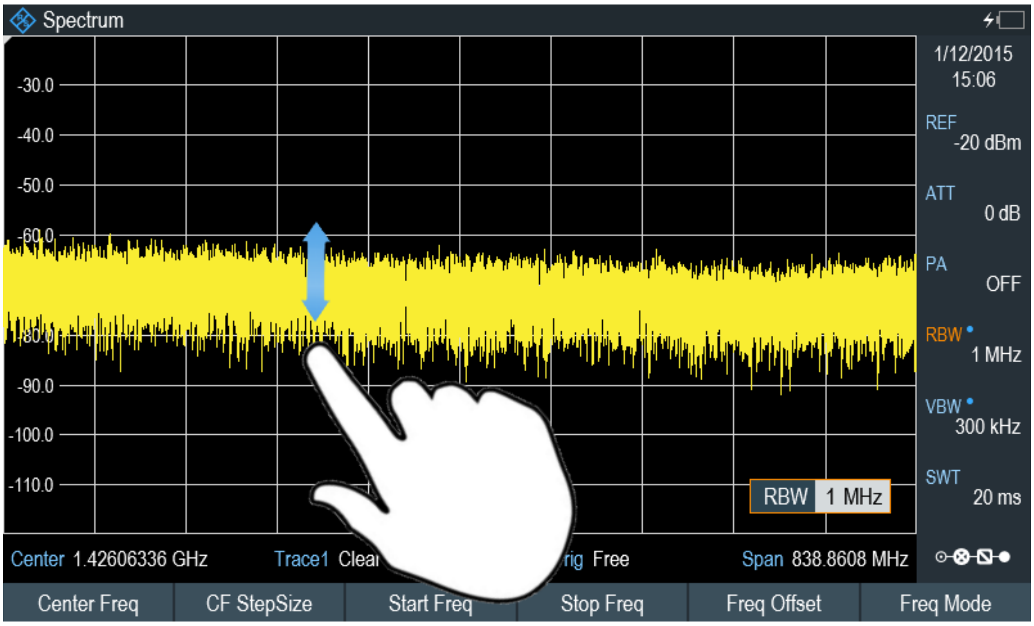
4.2.1 Change Center Frequency

Swipe left or right horizontally in the trace window to adjust the center frequency of the spectrum measurement. Alternatively, select the "Center" in the Parameter View to adjust the center frequency or press the FREQ key on the front panel to display the "Center Freq" softkey label for adjustment.



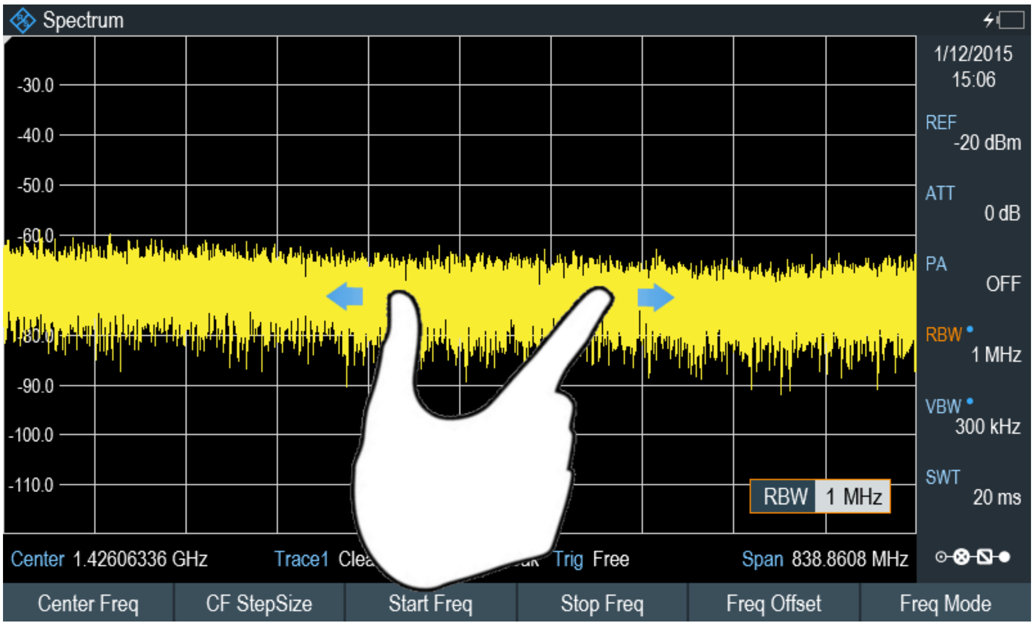
4.2.2 Change Reference Level

Swipe up or down vertically in the trace window to adjust the reference level of the spectrum measurement. Alternatively, select the "REF" button in the Parameter View to adjust the reference level or press the AMPT key on the front panel to display the "Ref Level" softkey label for adjustment.



4.2.3 Change Span

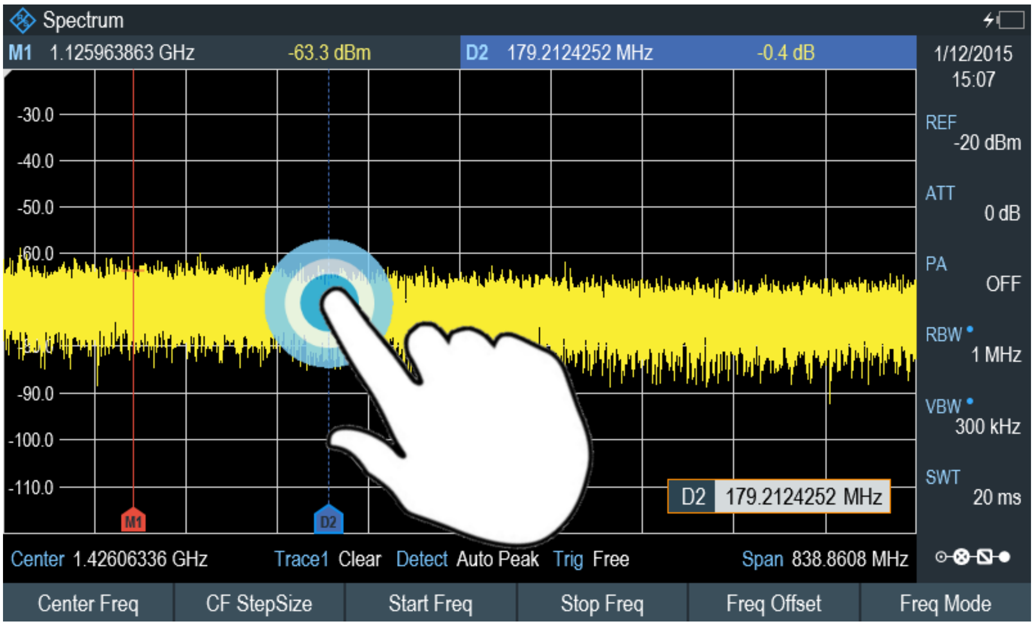
Pinch or stretch two fingers horizontally to adjust the span of the spectrum measurement. Alternatively, select the "Span" in the Parameter View to adjust the span of the spectrum measurement or press the SPAN key on the front panel and select the "Manual Span" softkey label for adjustment.



4.2.4 Add Marker

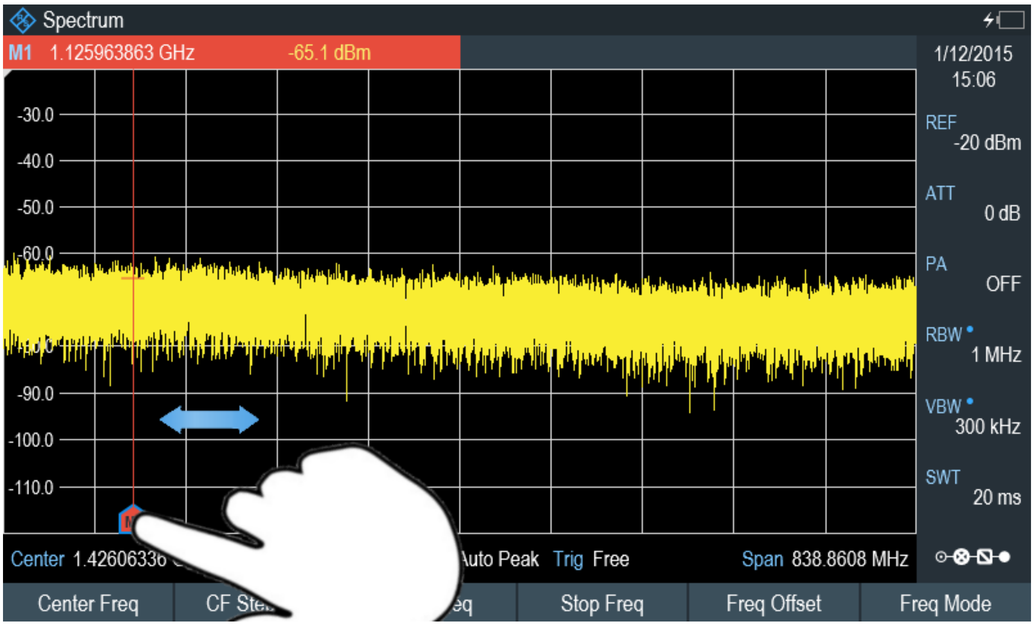
Double tap in the trace window to create a new marker on the spectrum measurement. The marker will be placed on the trace where the double tab gesture is performed.

Alternatively, press the MARKER key on the front panel and select the "New Marker" from the softkey label to create a new marker on the spectrum measurement.



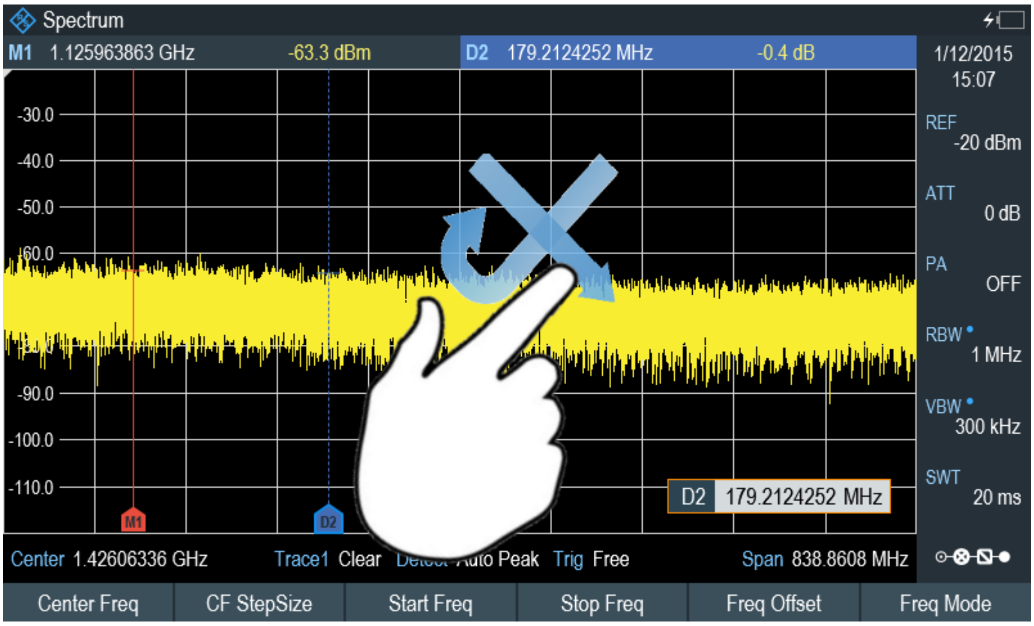
4.2.5 Move Marker

Tab and drag on the marker icon to change the marker position in the trace window. Alternatively, select the marker label in the Measurement Result View to adjust the marker position on the spectrum measurement or press the MARKER key on the front panel and select the "Select Marker" softkey label for adjustment.



4.2.6 Delete All Markers

Draw a "X" on the trace window to delete all markers from the spectrum measurement. Alternatively, press the MARKER key on the front panel and select the "Delete Marker" from the softkey label to delete all markers from the spectrum measurement.



4.3 Means of Input

The following sections describe several elements which provide additional ways to input data to R&S Spectrum Rider.

1. Alphanumeric keys
2. Unit keys
3. Rotary knob
4. BACK key
5. CANCEL key
6. Enter key

4.3.1 Using the Alphanumeric keys

Using the alphanumeric keys, you can enter numeric values or characters. The alphanumeric keys include the numbers from 0 to 9, the alphabet, a minus sign and a dot.

If you have to enter a numeric value, press the corresponding key. In case of numeric values, each key covers just the number that's printed on it.

You can enter negative values with the minus sign key and enter values that contain decimal places with the dot key.

If the R&S Spectrum Rider asks you to enter a character or you need to enter a character (e.g. file names), the key assignment changes. Each key covers one number and more than one character with the first choice being a character. If you need to enter a character, press the key several times until the character you require is selected. Alternatively, you can key in the characters using the on-screen keyboard icon which will be displayed along the entry box or press the "Virtual Keyboard" softkey to activate the on-screen keyboard function. See Chapter 3.2.4, "On-screen Keyboard", on page 43 of on-screen keyboard.

You can correct entries with the BACK key. The BACK key moves the cursor one position backwards and deletes the character that was in that place.

The following table shows an overview of character assignment.

Key	1.	2.	3.	4.	5.	6.	7.	8.	9.
1	1	␣							
2	a	b	c	2	A	B	C		
3	d	e	f	3	D	E	F		
4	g	h	i	4	G	H	I		
5	j	k	l	5	J	K	L		
6	m	n	o	6	M	N	O		
7	p	q	r	s	7	P	Q	R	S
8	t	u	v	8	T	U	V		
9	w	x	y	z	9	W	X	Y	Z
0	0								
-	-								
.	.								

4.3.2 Using the Rotary Knob

Using the rotary knob, you can do several things.

- The rotary knob works like a cursor key in dialog boxes or softkey submenus. In that case you can navigate to one of the items with the rotary knob. If the dialog box covers more than one screen page, it also scrolls through the dialog box. Turning it to the right corresponds to a downward movement. Moving it to the left to an upward movement.
- The rotary knob increases or decreases any kind of numeric value if an input field is active. Turning it to the right corresponds to an increase, turning it to the left to a decrease of a numeric value.
  In most cases, the rotary knob changes numeric values with a fixed step size.
- The rotary knob moves markers around.
  Again the step size is fixed.
- Pressing the rotary knob to confirm an entry or selection.

4.3.3 Confirming and Cancelling Entries

Depending on the input you have made, there are several ways to confirm entries.

- Values without unit or values that have a fixed unit that you enter in an input field can be confirmed by pressing the center of the rotary knob.
- Values that have flexible units, like frequency or time, can be confirmed with one of the unit keys. If you confirm such a value with the rotary knob, the R&S Spectrum Rider always uses the last used unit.
- If you have opened a submenu or input field by accident, you can close it without making any changes with the CANCEL key.

4.3.4 Remote Operation

Remote operation is a way to control the R&S Spectrum Rider from another device like a PC. To use the R&S Spectrum Rider this way, you have to establish a connection between both devices via the LAN or USB interfaces of the R&S Spectrum Rider.

The product range of the R&S Spectrum Rider provides several tools for remote operation.

Remote commands

Using remote commands that are compatible to SCPI standard to control the R&S Spectrum Rider.

See Chapter 11.6, "Remote Control - Commands", on page 195 for details of remote commands to control R&S Spectrum Rider.

Remote display with R&S Instrument View

The remote display is an application provided by the R&S Instrument View software. You can use it to access and control the R&S Spectrum Rider in the R&S Instrument View environment.

While the R&S Spectrum Rider is running and connected to the control computer, the screen contents and control elements (keys, softkeys etc.) are displayed. Thus, you can operate the R&S Spectrum Rider just like the hardware itself.

1. Connect the R&S Spectrum Rider to the control computer.
2. Start the R&S Instrument View software.
3. Press the "Remote Display" button in the user interface.

The software opens the remote display to operate the R&S Spectrum Rider remotely.

See Chapter 3.2.8, "Connecting the R&S Spectrum Rider to a PC", on page 61.

4.4 Presetting the R&S Spectrum Rider

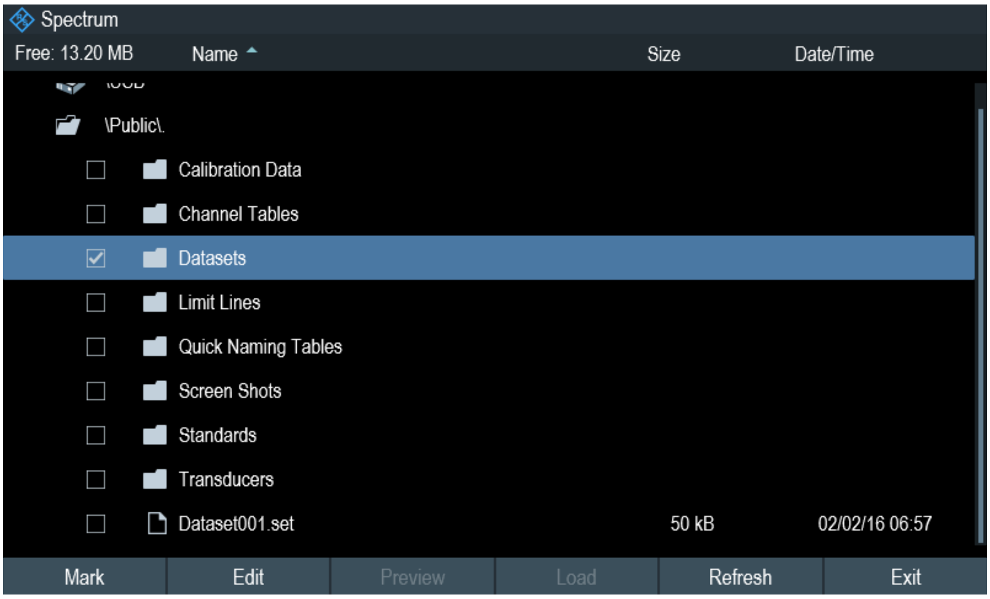
Before you prepare a measurement, it is recommended to preset the R&S Spectrum Rider. During a preset, the R&S Spectrum Rider resets all settings to their default state. Restoring the default configuration has the advantage that old settings do not affect measurements.

The default setup is specific to the operating mode.

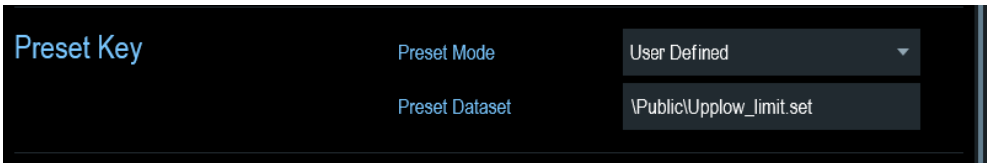
► Press the PRESET key.
The R&S Spectrum Rider restores its default setup.

You can also define your own default settings via a dataset. These are then loaded after pressing the PRESET key instead of the factory default.

1. Press the SETUP key.
2. Press the "User Preference" softkey.
3. In the "User Preferences" dialog box, select the "Preset Dataset" item.
   The R&S Spectrum Rider displays the File Manager dialog box to select the data-set that contains the settings you would like to have as the preset settings.



4. Select the dataset with the settings you want and press "Load" softkey.
5. In the "User Preferences" dialog box, select the "Preset Mode" item.
   A drop-down menu opens to select the preset mode.
6. Select the "User Defined" to load the dataset defined in the "Preset Dataset".
   The R&S Spectrum Rider now loads the settings of the dataset after you press PRESET.



4.5 Configuring Measurements

The "Config Overview" dialog box provides an overview of the current configuration of the R&S Spectrum Rider. In addition, you can also change the configuration in this dialog box.

1. Press the SETUP key.
2. Press the "Config Overview" softkey.

3. Select one of the dialog box and change the settings as you like.

Note that the contents of the "Config Overview" dialog box are customized for each operating mode of the R&S Spectrum Rider. Therefore, the order and number of displayed settings is different in each mode.

4.6 Working Directory

Using the Working Directory, you can customise the folder directory to save the screenshots and datasets captured during spectrum measurement.

1. Press the SETUP key.
2. Press the "User Preference" softkey.
3. In the "User Preferences" dialog box, select the "Using working directory" item.
4. Select "On" to activate the cusotmize folder directory or "Off" to use the default storage device in the R&S Spectrum Rider. See Data storage devices.
5. Define the folder name in the "Working directory" item.

4.7 Taking Screenshots

You can take and store a screenshot of the current screen anytime with the screenshot key.

► Press the key.
The R&S Spectrum Rider takes the screenshot.

If available, the R&S Spectrum Rider stores the screenshot on an external storage device (USB memory stick or SD card). If both are connected, the R&S Spectrum Rider uses the SD card.

If no external device is available, the R&S Spectrum Rider stores the screenshot in its internal memory until the internal memory is full. In that case you can transfer the screenshots with the R&S Instrument View software to your computer.

Saving screenshot and dataset at the same time

Depending on the "Capture" settings available in the "User Preference" menu, using the key also saves a dataset in addition to the screenshot.

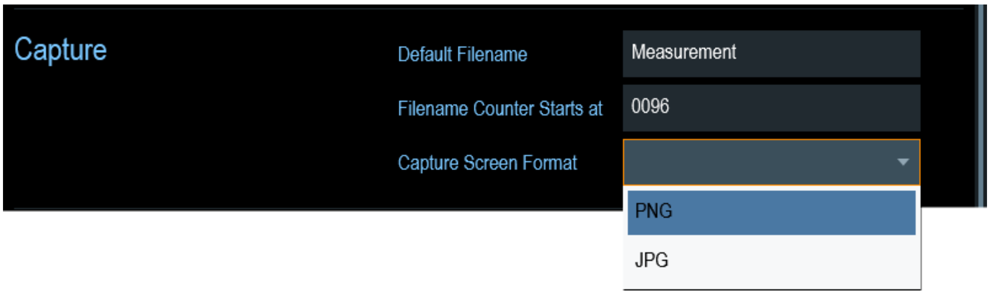
For more information see Chapter 4.8, "Managing Datasets", on page 96.

Screenshot file name and file format

All screenshots get a default filename "Screenshot####". The files also get numbers (####) in ascending order, beginning with 0000. You can select a default filename and a starting number in the "User Preference" menu.

The file format of screenshots is either *.png or *.jpg, depending on your configuration in the "User Preference" menu.

1. Press the SETUP key.
2. Press the "User Preference" softkey.
3. Select the "Default Filename" and "Filename Counter Starts At" items and assign a filename and number as you wish.
4. Select the "Capture Screen Format" items to select the screenshot file format.



Previewing screenshots

The R&S Spectrum Rider provides functionality to preview screenshot.

1. Press the SAVE/RECALL key.
2. Press the "File Manager" softkey.
   The R&S Spectrum Rider opens the file manager dialog to select a screenshot for the preview.
3. Select the screenshot for preview.
4. Press the "Preview" softkey to preview the screenshot.
5. Press the "Prev" or "Next" softkey to preview the screenshots available in the selected folder.
   The filename of the previewed screenshot is diaplayed at the Title Bar.
   See also Chapter 4.8.2.1, "Previewing a Dataset", on page 101.

6. Press the "Exit" softkey to return to the "File Manager" dialog box.

4.8 Managing Datasets

The R&S Spectrum Rider provides functionality to manage (save, restore etc.) datasets available in its internal memory or an external storage device

Datasets

The R&S Spectrum Rider supports various types of datasets. The instructions below primarily describe managing datasets that you create on the R&S Spectrum Rider during measurements, for example measurement results and configurations. Note that these datasets have the file extension `.set`.

Datasets with the file extension .set are an image of measurement results and configurations. Thus, you can subsequently reproduce the context of the measurement.

You can use datasets for documentation, for example, or use them for a more detailed analysis later on (for example with the R&S Instrument View software). Note that datasets also contain calibration data if calibration has been performed.

Templates

The R&S Spectrum Rider also supports various other types of datasets (or templates). Such templates mainly contain additional requirements for a particular measurement, like limit lines or channel tables.

Creating and editing these templates is only possible with the functionality provided by the R&S Instrument View software package. Note that the file extension depends on the application of the template. For example, a template containing a channel table has the extension .chntab.

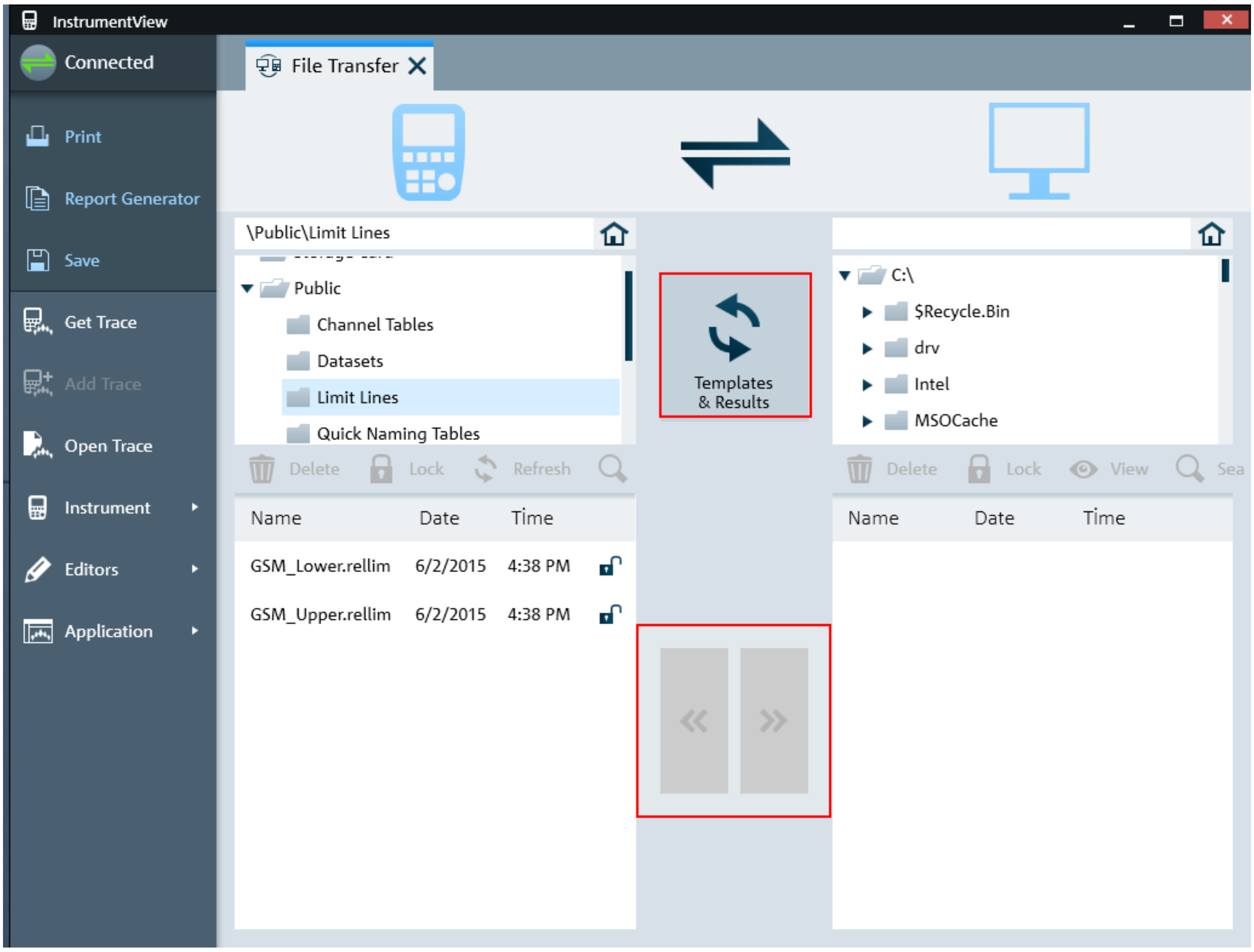
For more information on working with templates refer to the documentation of the R&S Instrument View software package.

Data synchronization

The R&S Instrument View features a data synchronization that matches the data available on the R&S Spectrum Rider and that on the computer with the R&S Instrument View installation.

1. Select "File Transfer" from the "Instrument" menu.
   The software opens the "File Transfer" dialog box.
2. Select the "Template & Result" synchronization button to process data synchronization between the computer and the instrument.
   This updates all files that have been created or edited with the R&S Instrument View software package to the instrument and vice versa. (Note that template can only be created and edited in the PC, see "Templates" on page 96).

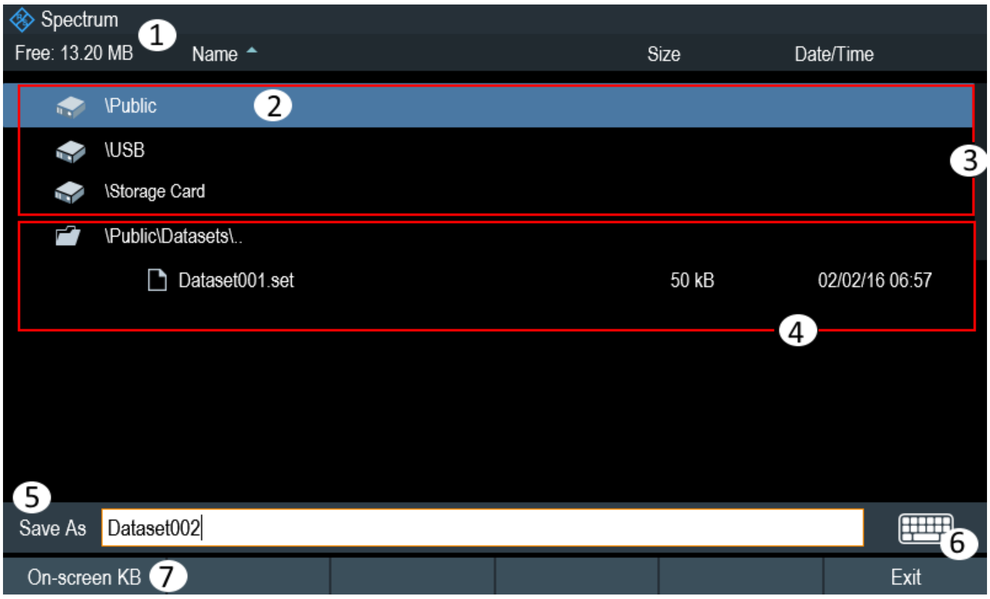
3. Alternatively, data can be transferred in a single direction using the direction button between the PC to instrument and vice versa.



4.8.1 Saving datasets

The R&S Spectrum Rider allows you to save the data that is currently analyzed at any time.

1. Press the SAVE/RECALL key.
2. Press the "Save Dataset" softkey.
   The R&S Spectrum Rider opens the "Save Dataset" dialog box.



1 = Currently selected data storage
2 = Remaining memory on selected data storage device
3 = Available data storage
4 = Currently folder structure of the selected data storage
5 = Dataset name input field
6 = On-screen Keyboard
7 = File manager softkey menu

Data storage devices

The folder structure shows all the available data storage devices. Possible storage devices are the internal memory of the R&S Spectrum Rider, an SD card or a memory stick.

The default storage device depends on which devices are connected to the R&S Spectrum Rider

- If an SD card is connected, datasets are always stored there first.
- If a memory stick is connected, datasets are stored there only if no SD card is connected.
- The internal memory is used only if neither SD card or memory stick are connected.

The internal memory provides approximately 20 MB of data, therefore the number of datasets you save on the R&S Spectrum Rider is limited. Each dataset needs about 100 kB of memory, but this value can vary.

If you are using an external storage device, the number of datasets you can save is limited only by the size of the storage device.

R&S Spectrum Rider shows the remaining memory on the storage device in the dialog box.

1. Select the storage device you want to save the data.
2. Select the folder you want to save the data.

3. Enter a filename in the corresponding input field.
   The default filename for datasets is `Dataset###.set` with a new number in ascending order for each new dataset. The file extension for datasets is `.set`.
   If you enter another name, the R&S Spectrum Rider uses that name and assigns a new number to the filename if you save the data set the next time. This function allows you to assign consecutive dataset file names without entering a new name every time you want to save a dataset.
   You can define the dataset filename at the "User Preference" dialog box. Select the "Default Dataset Name" and enter the filename in the entry box. Once the "Default Dataset Name" item is selected, the virtual keyboard is loaded for entry. Alternatively, you can enter the filename with the alphanumeric keypad, see Chapter 4.3.1, "Using the Alphanumeric keys", on page 90.
4. Press the rotary knob to confirm the entry.
   The R&S Spectrum Rider saves the dataset.

4.8.1.1 Alternative Ways to Save Datasets

The R&S Spectrum Rider provides alternative and more convenient ways to save datasets.

Using the screenshot key

You can configure the screenshot key to take a screenshot as well as saving a dataset.

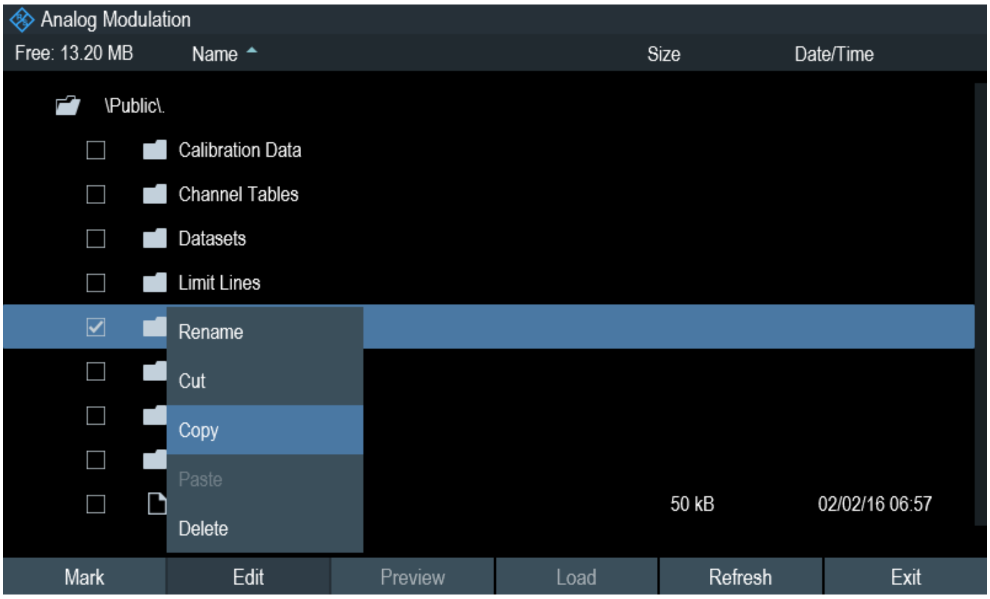
1. Press the SETUP key.
2. Press the "User Preference" softkey.
3. Configure the "Default Filename", "Filename Counter Starts at" and "Capture Screen Format" menu items.
   Pressing the key saves the selected data of the current measurement based on the filename syntax defined in the "Default Filename""Filename Counter Starts at"."Capture Screen Format".

4.8.1.2 Renaming File Names

If necessary, you can rename files or file directories directly on the R&S Spectrum Rider.

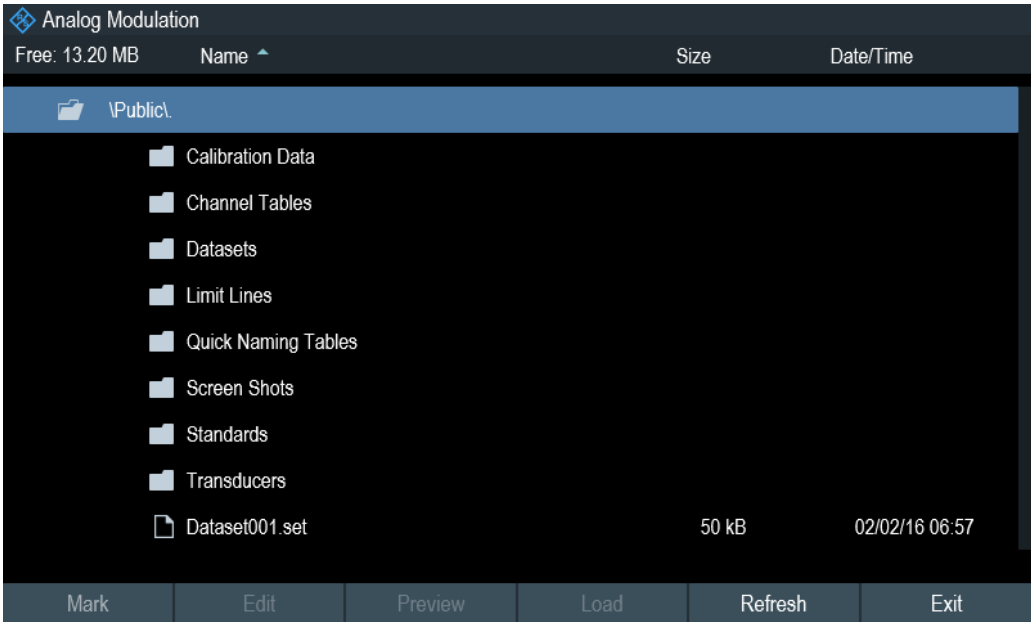
1. Press the SAVE/RECALL key.
2. Press the "File Manager" softkey.
   The R&S Spectrum Rider opens the file manager.
3. "Mark" the selected files or file directories in the "File Manager" dialog

4. Press "Edit" softkey.
   A list of "Edit" menu is displayed for selection.
5. Select "Rename" to rename the files or file directories.
   The R&S Spectrum Rider opens an input field to change the name of the file.



4.8.2 Restoring Datasets

You can preview and load previously saved measurement results with the recall function of the R&S Spectrum Rider. This function also provides easy access to previous measurement settings so that you do not have to set up the R&S Spectrum Rider again.



1. Press the SAVE/RECALL key.
2. Press the "Recall Dataset" softkey.
   The R&S Spectrum Rider opens the "Recall Dataset" dialog box.
3. Select the storage device and the folder directory you want to load the dataset.
   The R&S Spectrum Rider restores the configuration that the dataset contains.

By default, the most recently saved dataset is highlighted. If you need another dataset, navigate to the folder or storage device that contains the dataset you need.

4.8.2.1 Previewing a Dataset

The R&S Spectrum Rider provides the function to preview datasets. The preview function allows you to take a quick look at that measurement and its settings. The R&S Spectrum Rider does not yet activate the measurement settings of that dataset.

1. Browse through the available datasets and select the one you want.
2. Press the "Preview" softkey.
   The R&S Spectrum Rider shows a preview of the measurement contained in the selected dataset. The preview shows the measurement results as well as the measurement settings.
3. Press the "Prev" or "Next" softkey to preview the datasets available in the selected folder.
   The filename of the previewed dataset is diaplayed at the Title Bar. See Figure 4-2.

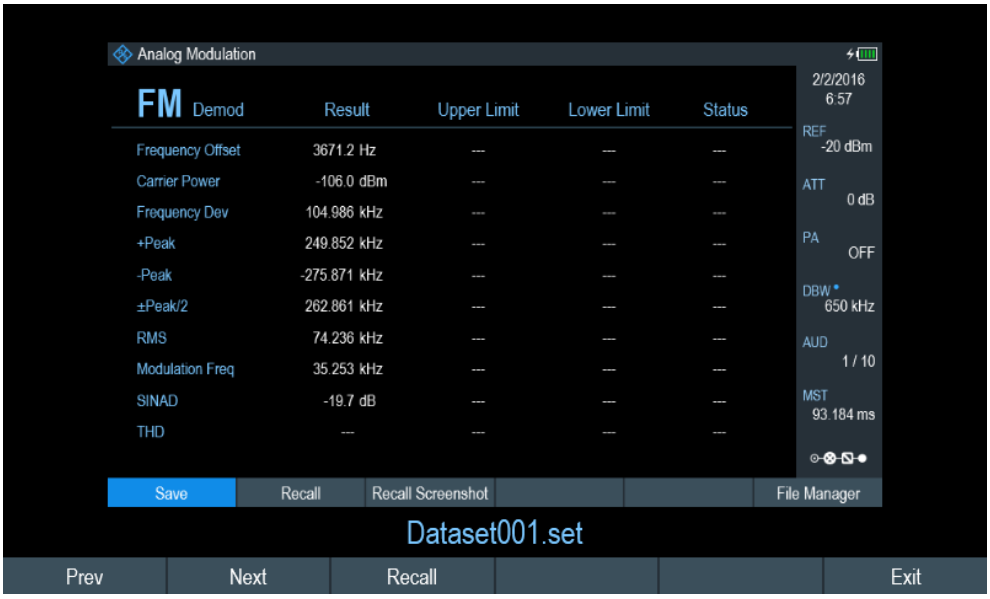


Figure 4-2: Preview Database

4. Press the "Exit" softkey to return to the "Recall Dataset" dialog box or select the "Recall" softkey to load the dataset.

4.8.2.2 Loading a Dataset

If you find a dataset whose settings you need for your current measurement task, you can load it.

► Press the "Load" softkey.
The R&S Spectrum Rider loads the dataset in question and adjusts its measurement settings to those of the dataset.
See also Chapter 4.8.2.1, "Previewing a Dataset", on page 101.

4.8.3 Deleting Datasets

If you have to delete a dataset, you can do so with the file manager.

1. Press the SAVE/RECALL key.
2. Press the "File Manager" softkey.
   The R&S Spectrum Rider opens the file manager.
3. "Mark" the selected files or file directories in the "File Manager" dialog
4. Press "Edit" softkey.
   A list of "Edit" menu is displayed for selection.
5. Select "Delete" to delete the files or file directories.
   Before deleting the dataset, the R&S Spectrum Rider shows a warning message that you need to confirm. After confirming the deletion process the R&S Spectrum Rider deletes the selected dataset from its memory.

4.9 Updating the Firmware

You can download new firmware versions from the R&S Spectrum Rider website.

http://www.rohde-schwarz.com/product/fph.html

The website also provides release notes for each new firmware version. The release notes include instructions on how to perform a firmware update.

4.10 Installing Firmware Options

You can equip the R&S Spectrum Rider with several firmware options to enable additional operating modes or special measurements.

For more information see the "Getting_Started" manual.

5 Working with the Measurement Wizard

When testing antennas and making measurement which involves complex signals, it is often necessary to perform a sequence of standardized and recurring measurements, often in an environment that is not easily accessible. To make sure that measurements are performed as required and to avoid a constant adjustment of parameters, the R&S Spectrum Rider features a measurement wizard.

The measurement wizard allows you to combine several individual measurement configurations to a sequence of measurements (or measurement set). As all relevant parameters have been set prior to the actual measurement and cannot be changed once the measurement procedure has begun, the wizard is a good way to avoid mistakes and save time when setting up measurements.

Note that it is necessary to install and use the R&S Instrument View software package if you want to configure the measurement steps and parameters in the measurement wizard.

This chapter describes the functionality of the measurement wizard. You can use the wizard for measurements in all the operating modes.

For details on the individual measurements you can perform with the wizard, refer to the corresponding chapters.

- Chapter 6, "Spectrum Analyzer Mode", on page 111
- Chapter 7, "Power Meter (R&S FPH-K9)", on page 149
- Chapter 10, "Analog Modulation (R&S FPH-K7)", on page 169

5.1 Performing and Configuring Measurements

Before you can use the measurement wizard, you have to define a measurement set using the "Wizard Set Editor" in the R&S Instrument View software package. The R&S Instrument View software package is delivered with the R&S Spectrum Rider. The latest version is also available for download on the R&S Spectrum Rider website at http://www.rohde-schwarz.com/product/fph.html.

After creating the measurement wizard set using the R&S Instrument View software package, transfer the file to the R&S Spectrum Rider.

For more information of the "Wizard Set Editor", see R&S Instrument View manual.

Load the Measurement Wizard

Now that the measurement set is available on the R&S Spectrum Rider, you can start performing the measurement wizard.

1. Press the WIZARD key.
   The R&S Spectrum Rider opens the Wizard dialog box. See Figure 5-1.

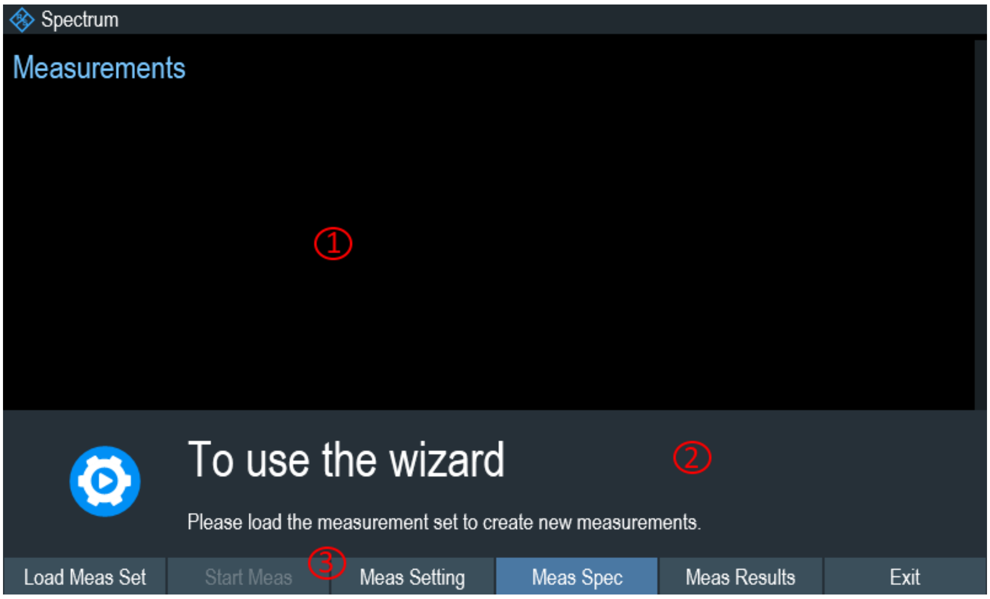


Figure 5-1: Wizard dialog box

1 = Measurement wizard dialog box
2 = Measurement wizard message box
3 = Chapter 3.2.5.3, "Softkey", on page 44 menu of measurement wizard application

2. Select the "Load Meas Set" softkey.
   The R&S Spectrum Rider opens the file manager to select the measurement wizard set.
3. Select the required measurement wizard set from the file manager.
4. Press the "Load" softkey to confirm the selection.
   The R&S Spectrum Rider loads the measurement wizard set.

Measurement Setting

The parameters highlighted in the measurement setting dialog are configurable during the start of the measurement. See Figure 5-2.

1. Select the "Meas Setting" softkey.
   The R&S Spectrum Rider opens the "Meas Setting" dialog.
2. Select the desired menu item in the "Meas Setting" dialog.
   Note some of the parameters are read-only information. See Table 5-1.

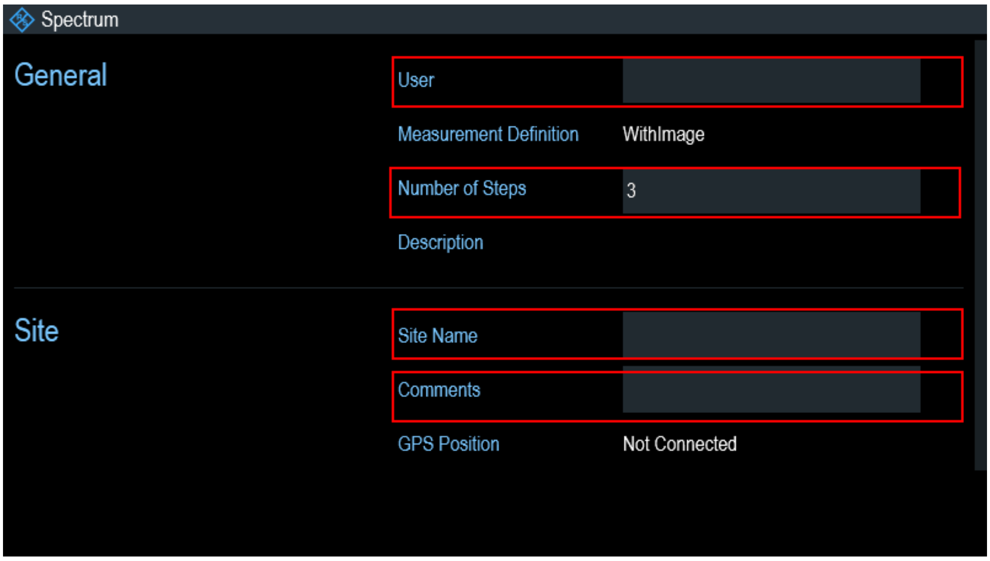


Figure 5-2: Measurement setting dialog

Table 5-1: Measurement setting parameters

Measurement parameters		Descriptions
General	User	Name of the person that performs the measurement.
	Measurement Definition	Name of the measurement wizard set. This is a read only field that shows the measurement name as defined with the R&S Instrument View software package..
	Number of Steps	Number of individual measurements in the measurement sequence as defined with the R&S Instrument View software package.. The field allows you to reduce the number of individual measurements and perform only those measurements that are really necessary. If you reduce the number of measurements, the R&S Spectrum Rider omits the last measurement in the sequence.
	Descriptions	Short description of the measurement task. This is a read only field that shows the description as defined with the R&S Instrument View software package.
Site	Site Name	Location of the measurement.
	Comments	Comments about the measurement, e.g. the external conditions during the measurement..
	GPS Position	Displays the GPS information. See Chapter 3.2.7.2, "Using the GPS receiver", on page 51.

Measurement Specification

The measurement specification dialog box displays the measurement step sequence and the individual performed measurement status. See Figure 5-3.

► Select the "Meas Spec" softkey.
The R&S Spectrum Rider opens the "Meas Spec" dialog.

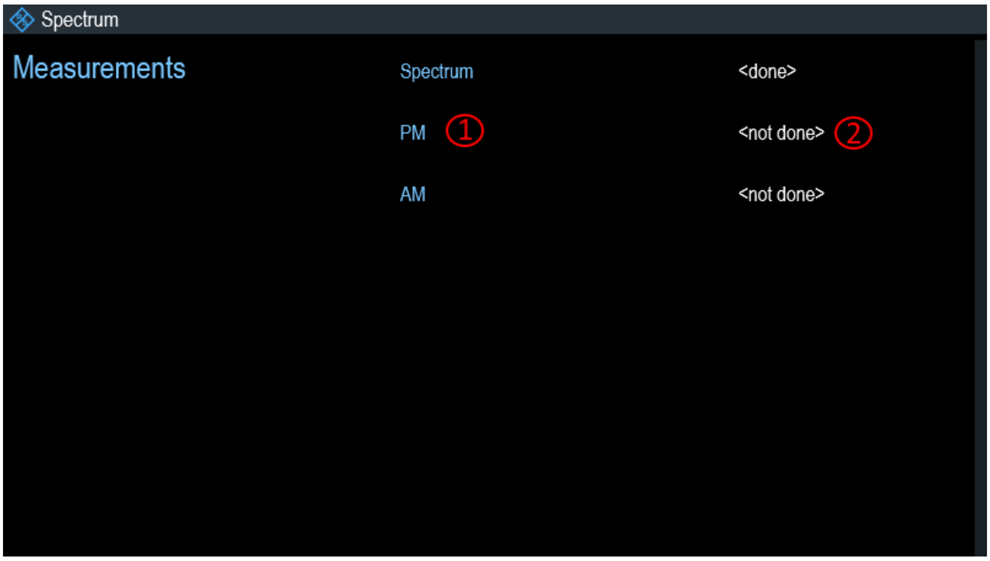


Figure 5-3: Measurement specification dialog box

1 = Measurement step in a wizard set
2 = Individual measurement step status

Performing a Sequence of Measurements

Now that you have updated all parameters concerning the measurement task, you can start the measurement procedure.

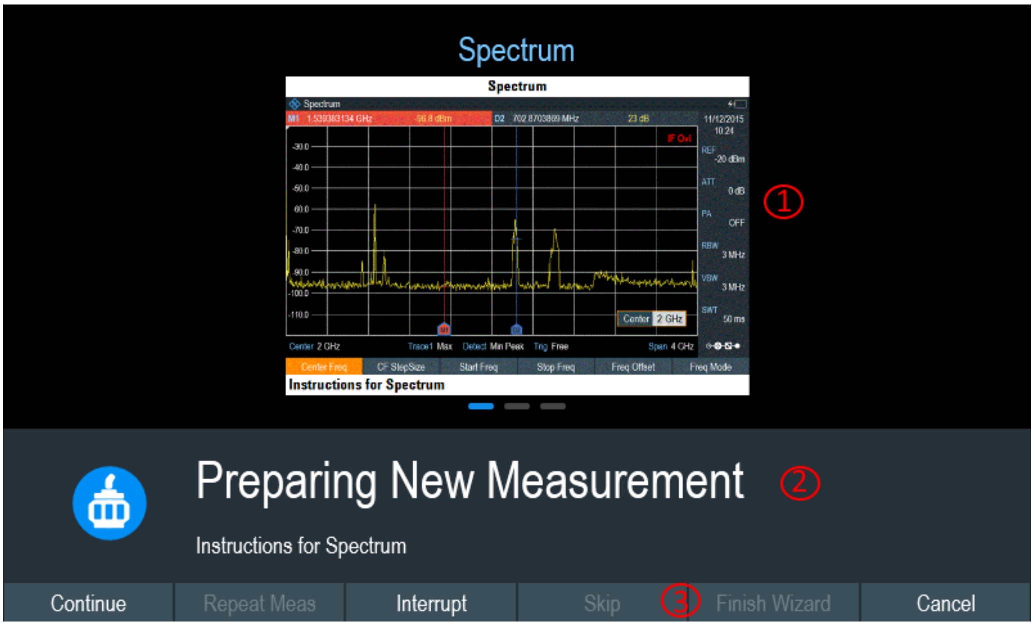


Figure 5-4: Performing wizard measurement

1 = Image of a measurement step defined in the R&S Instrument View software package.
2 = Wizard message box
3 = See Table 5-2

1. Select the "Start Meas" softkey.

The R&S Spectrum Rider starts to go through the measurements that are part of the measurement wizard set. The sequence of the measurements is defined in the R&S Instrument View software package.
Before the start of each measurement, the R&S Spectrum Rider displays a massage "Preparing New Measurement" in the wizard message box.
The message box contains information and instructions on how to prepare and perform the measurement that you have defined in the R&S Instrument View software package.

2. At each measurement step, you have several options:
   - Select the "Continue" softkey.
     The R&S Spectrum Rider finishes the current measurement and opens the measurement wizard dialog box. See Figure 5-5

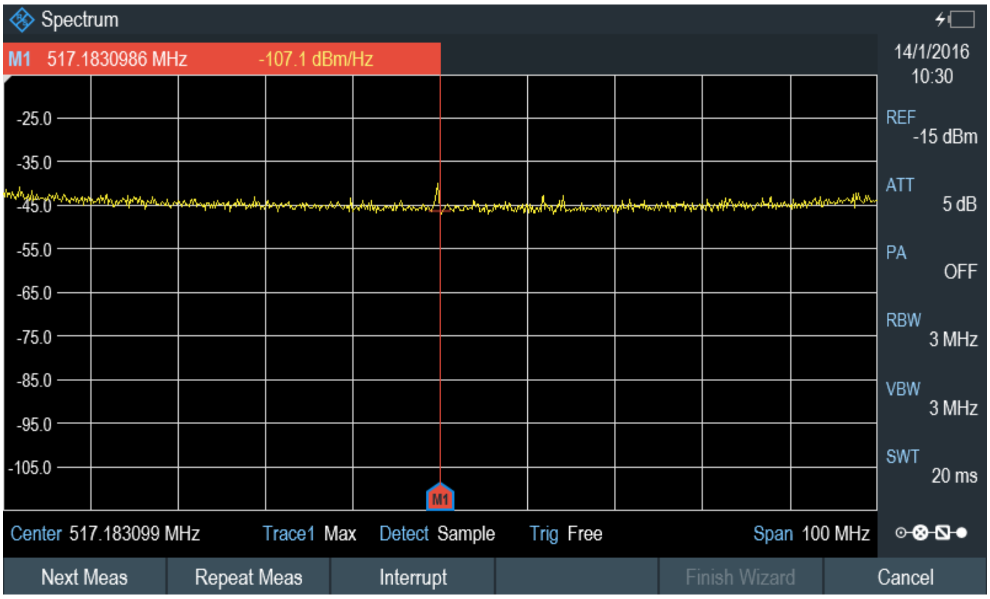
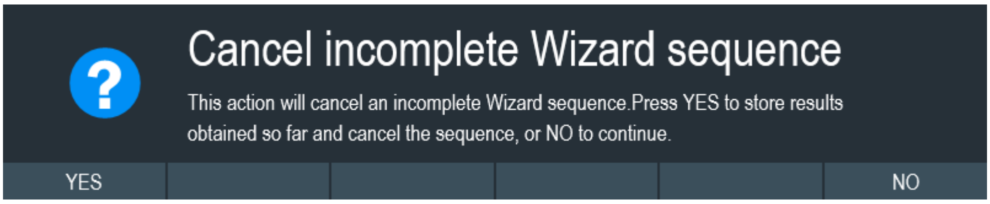


Figure 5-5: Measurement wizard dialog box

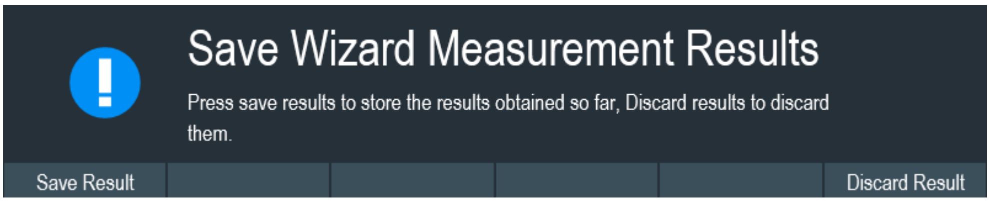
     – Select the "Next Meas" softkey to proceed to the next measurement step in the measurement sequence.
     – Select the "Repeat Meas" softkey if the result does not match your expectation and you want to validate the result again.
     – Select the "Interrupt" softkey if the result does not match your expectation and you want to find the origin of the problem by using a different settings or measurement than those defined in the wizard.
     – Select the "Finish Wizard" softkey to end the measurement sequence.
     – Select the "Cancel" softkey if at any time the result does not match your expectation and you want to abort the measurement.
       The R&S Spectrum Rider prompt you to save measurement result and exit the wizard measurement.
   - Select the "Interrupt" softkey.
     The R&S Spectrum Rider opens the wizard interrupt dialog box.
     There are three selections in the wizard interrupt dialog box, you can either:

– Select the "Leave Menu" softkey to proceed and perform the necessary reconfiguring of the measurement. The R&S Spectrum Rider go to the current measurement environment which you can analyze the measurement settings and make the necessary reconfiguration on the measurements. After you have completed the reconfiguration on the measurement, press WIZARD key to return back to the wizard interrupt dialog box
– Select the "Resume Sequence" softkey to resume back to the measurement.
– Select the "Cancel" softkey to abort the wizard measurement.

- Select the "Skip" softkey.
  The R&S Spectrum Rider skips a single measurement step and continue the subsequent measurement step.
- Select the "Cancel" softkey.
  The R&S Spectrum Rider displays a message "Cancel Incomplete Wizard Sequence" in the wizard message box.
  Select "YES" to abort the wizard measurement or "NO" to continue.

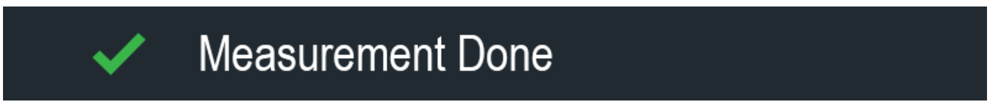


  This is follows with a message prompt to save measurement result. The R&S Spectrum Rider displays a message "Save Wizard Measurement Results" in the wizard message box.



  Select "Save Result" to save the measurement results or "Discard Result" to discard the measurement results.

3. After each measurement is completed, the R&S Spectrum Rider displays a message "Measurement Done" in the wizard message box.
   Select the "Continue" softkey to proceed to the next measurement step (if any).



4. After all the measurements are completed, the R&S Spectrum Rider displays a message "All Measurements Done" in the wizard message box.
   Select the "Continue" softkey. The R&S Spectrum Rider prompt you if you want to save the measurement results.
   Select the "Save Result" softkey to save the results on the selected storage device or "Discard Result" softkey to discard all the measurement results.

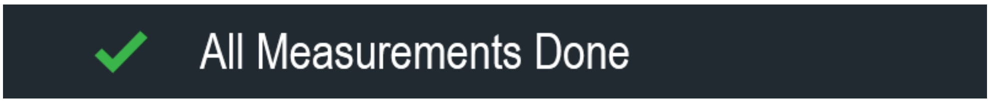


Table 5-2: Softkey in the measurement wizard

Softkey	Description
Next Meas	The R&S Spectrum Rider proceed to perform the measurement.
Continue	The R&S Spectrum Rider finishes the current measurement and begins with the next measurement by showing the necessary preparation instruction.
Repeat Meas	Repeat the current measurement
Interrupt	If you interrupt the measurement sequence, you can change the different settings or measurements as if wizard is not in used. The R&S Spectrum Rider keeps the results of measurement you have already performed. When you finished reconfigured the measurement, you can resume back to the measurement sequence.
Skip	Skip a single measurement step and continue the subsequent measurement step Skipping individual measurements is possible when you turn on "Allow to skip measurements and finish wizard sequence" in the "Wizard Set Editor" of the R&S Instrument View software package.
Cancel	Abort wizard measurement. The R&S Spectrum Rider displays a message "Cancel Immediate Wizard Sequence" in the message box. If wizard measurement is aborted, the R&S Spectrum Rider displays a message "Save Wizard Measurement Results" in the message box. If wizard measurement result is saved, the R&S Spectrum Rider returns to the last saved measurement result trace window. If the result is discarded, the R&S Spectrum Rider returns to the measurement dialog box.
Exit	Exit wizard measurement.
Finish Wizard	Ends the measurement sequence and returns to the "Measurement Wizard" dialog box. The results of the measurements you have already finished are kept in the memory of the R&S Spectrum Rider. Ending the sequence is possible when you turn on "Allow to skip measurements and finish wizard sequence" in the "Wizard Set Editor" of the R&S Instrument View software package.
Save Result	Save result of the measurements performed in the wizard set. See "Measurements Result" on page 110
Discard Result	Discard measurement results.

Measurements Result

Limited internal memory

If you have to store the results on the internal memory, make sure there is enough space left to store them or else the results might get lost. If the space is not enough, you can delete old data with the file manager.

For more information, see Deleting Datasets.

Measurement wizard results

All the measurement wizard results are stored in the wizard result folder during the process of the measurement wizards. These stored results will not be saved until you do a Save Result at the end of the wizard measurement.

The results for a measurement set consist of a number of files, each file corresponding to one of the performed measurements. For easy evaluation, the R&S Spectrum Rider includes the name of the measurement as defined in the wizard dialog or R&S Instrument View in the file name.

All result files that belong to a measurement set are stored in the same directory. The directory is named after the measurement name and site. The syntax is 'site-name_measurement_#'.

The R&S Spectrum Rider adds numbers in ascending order to files as well as directories if you perform a measurement or measurement set more than once.

6 Spectrum Analyzer Mode

The default operating mode of the R&S Spectrum Rider is the spectrum analyzer. The spectrum analyzer provides the functionality to perform measurements in the frequency domain, e.g. to identify the power of signals.

6.1 Common Measurement Settings

Basic measurement settings that are common to many measurement tasks, regardless of the application or operating mode, are described here. If you are performing a specific measurement task, using an operating mode other than Signal and Spectrum Analyzer mode, or an application other than the Spectrum application, be sure to check the specific application or mode description for settings that may deviate from these common settings.

6.1.1 Configuration Overview

The "Configuration Overview" provides an overview on the most important currently defined settings for the spectrum measurement. See "Configuration Overview" on page 41. It is displayed when you select the "Config Overview" icon, which is available at the bottom of "Parameter View". See Chapter 3.2.3.4, "Parameter View", on page 40.

The "Configuration Overview" provides quick access and allows easy configuration on the parameters that affect the spectrum measurement from input to signal processing to output and signal analysis by stepping through each of the following dialog boxes:

- "Input"
  See Chapter 6.1.3.7, "Setting the Input Impedance", on page 120.
- "Amplitude"
  See Chapter 6.1.3, "Configuring the Vertical Axis", on page 116.
- "Frequency"
  See Chapter 6.1.2, "Configuring the Horizontal Axis", on page 112.
- "Bandwidth"
  See Chapter 6.1.4, "Setting Bandwidths", on page 120.
- "Analysis"
  See Chapter 6.1.6, "Working with Traces", on page 126.
- "Trigger"
  See Chapter 6.1.5.3, "Working with Trigger Functionality", on page 125

To configure settings

► Select any of the six configuration dialog boxes to open the corresponding dialog box. See Table 3-3.

6.1.2 Configuring the Horizontal Axis

The FREQ key contains all necessary functions to configure the horizontal axis for spectrum measurements.

The contents of the menu depend on the currently selected measurement.

Usually, the horizontal axis contains frequency information in spectrum mode. You can specify the frequency in terms of the center frequency or by defining a start and stop frequency for a particular span.

If you know the frequency of the signal you are measuring, it is best to match the center frequency to the signal's frequency. If you are investigating signals, e.g. harmonics, that are within a particular frequency range, the best option is to enter a start and stop frequency to define the span.

6.1.2.1 Defining the Center Frequency

The center frequency represents the frequency at the center of the horizontal axis in the diagram area.

1. Press the FREQ key.
2. Press the "Center Freq" softkey.
   The R&S Spectrum Rider opens an input field to define the center frequency.
3. Enter the center frequency you need.
   The frequency you have entered becomes the new center frequency.

Special touchscreen gesture

Alternatively, define the center frequency by swiping horizontally across the touchscreen to change the center frequency.

See Chapter 4.2.1, "Change Center Frequency", on page 85.

While adjusting the center frequency, you may obtain a value that is outside the R&S Spectrum Rider maximum span. If this happens, the R&S Spectrum Rider automatically reduces the span.

6.1.2.2 Defining a Frequency Step Size

If you set the center frequency with the rotary knob, the distance of each step that you take depends on the span. With the rotary knob, the smallest possible step is a pixel. As the trace consists of 711 pixels, each step is equal to 1/711 of the span.

You can set another step size.

1. Press the FREQ key.
2. Press the "CF Step Size" softkey.
   The R&S Spectrum Rider opens a submenu that contains possible step sizes.
   - "0.1 x Span"
     The step size equals 10 % of the span or 1 division of the horizontal axis.
   - "step = Center"
     The step size equals the center frequency.

  This step size is ideal for measurements on harmonics. When you increase or decrease the center frequency, the center frequency automatically moves to the next harmonic.
- "Manual"
  An entry box is displayed to define the value.
  This step size makes it easy to investigate a spectrum with frequencies at constant intervals.

3. Select the step size you need from the menu.
   The R&S Spectrum Rider adjusts the step size accordingly.

If you set the step size to 10 % of the span or to the center frequency, the R&S Spectrum Rider sets the step size internally. Manually defining the step size opens an input field to define the step size.

6.1.2.3 Setting a Frequency Offset

For measurements on frequency converters such as satellite downconverters, it is often convenient to reference the results to the frequency prior to conversion. For this purpose, the R&S Spectrum Rider offers a frequency offset that arithmetically shifts the center frequency to higher or lower frequencies. Thus, the R&S Spectrum Rider displays the input frequency of the DUT.

Positive frequency offset is possible in the range from 1 Hz to 100 GHz, in steps of 1 Hz. The maximum negative frequency offset depends on the start frequency you have set. The start frequency, taking into account the frequency offset, is always ≥ 0 Hz.

1. Press the FREQ key.
2. Press the "Freq Offset" softkey.
   The R&S Spectrum Rider opens an input field to set the frequency offset.
3. Enter the frequency offset you need.
   The R&S Spectrum Rider adds the frequency offset to the center frequency you have set. A blue dot at the center frequency display indicates that a frequency offset has been set.

6.1.2.4 Defining a Start and Stop Frequency

Defining a start an stop frequency is best suited for example for measurements on harmonics or signals whose exact frequency is unknown.

1. Press the FREQ key.
2. Press the "Start Freq" softkey.
   The R&S Spectrum Rider opens an input field to define the start frequency.
3. Enter the start frequency you need.
4. Set a stop frequency with the "Stop Freq" softkey.

The R&S Spectrum Rider adjusts the horizontal axis according to your input, beginning with the start frequency and ending with the stop frequency.
If you have entered a stop frequency that is outside the maximum frequency range, the R&S Spectrum Rider sets the stop frequency to the possible maximum.
The softkey label of the "Parameter View" changes from "Center" and "Span" to "Start" and "Stop".

6.1.2.5 Setting the Span

SPAN

The span is the frequency range around the center frequency that a spectrum analyzer displays on the screen. The span you should select depends on the signal and the measurement that you are performing. A rule of thumb is that it should be at least twice the bandwidth occupied by the signal.

The available span for frequency domain measurements depends on the instrument model.

- R&S Spectrum Rider: 5 kHz to 2.0 GHz
- R&S Spectrum Rider with R&S FPH-B3: 5 kHz to 3.0 GHz
- R&S Spectrum Rider with R&S FPH-B4: 5 kHz to 4.0 GHz

If you set a span of 0 Hz (zero span), the R&S Spectrum Rider performs measurements in the time domain.

1. Press the "Span" softkey on the "Parameter view" to define the span.
   Alternatively, press the SPAN key.
   The R&S Spectrum Rider opens an input field to define the span.
2. Enter the span you need.
   The R&S Spectrum Rider adjusts the span of the horizontal axis.

Special touchscreen gesture

Alternatively, pinch and stretch on the touchscreen to change the span parameter.
See Chapter 4.2.3, "Change Span ", on page 87.

If you have to switch between full span and a smaller span, you can do so without having to enter the numeric values.

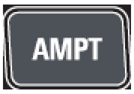
1. Press the SPAN key.
2. Press the "Full Span" softkey.
   The R&S Spectrum Rider displays the spectrum over its entire frequency range.
3. Press the "Last Span" softkey.
   The R&S Spectrum Rider restores the span that you have set just before displaying the entire frequency range.

Time domain measurements

You can also activate time domain measurements without having to enter the value manually. When measuring in the time domain, the span is 0 Hz. In that state, the R&S Spectrum Rider measures the signal at the current center frequency only. Instead of displaying the spectrum, the R&S Spectrum Rider shows the signal power over a certain time period. The horizontal axis becomes the time axis. The display always starts at 0 s and stops after the currently set sweep time.

1. Press the SPAN key.
2. Press the "Zero Span" softkey.
   The R&S Spectrum Rider sets a span of 0 Hz and performs the measurement in the time domain.

6.1.3 Configuring the Vertical Axis



All relevant settings to configure the vertical axis are available in the amplitude menu. You can access it via the AMPT key.

6.1.3.1 Setting the Reference Level

The reference level is represented graphically by the grid line at the top of the diagram.

The reference level sets the input signal gain up to the display stage. If the reference level is low, the gain is high. That means that even weak signals are displayed clearly.

If you are measuring strong signals, you have to set a high reference level in order to prevent an overload of the signal path of the analyzer and to keep the signal within the display range. If you are measuring the spectrum of a composite signal, make sure that the reference level is high enough to cover all signals and that all signals are within the measurement diagram.

1. Press the AMPT key.
2. Press the "Ref Level" softkey.
   The R&S Spectrum Rider opens an input field to define the reference level.
3. Enter the reference level you require.
   If you change the reference level, the R&S Spectrum Rider adjusts the position of the trace as you make the changes.

Special touchscreen gesture

Alternatively, define the reference level by swiping vertically across the touchscreen to change the reference level

See Chapter 4.2.2, "Change Reference Level", on page 86.

By default, the reference level corresponds to the grid line at the top of the diagram. You can also change the position of the reference level to another grid line if you have a signal that would otherwise overlap with the top of the diagram area. The R&S Spectrum Rider indicates the current reference level position with a triangle at the corresponding grid line on the vertical axis. See index 5 on Figure 4-1.

1. Press the AMPT key.
2. Press the "Range / Ref Pos" softkey.
   The R&S Spectrum Rider opens a submenu.
3. Select the "Ref Position 10…" menu item.
   The R&S Spectrum Rider opens an input field to define the reference position.
4. Enter the number of the grid line you want the reference level to position at.
   The range is from 0 to 10. "0" corresponds to the lowest grid line, "10" corresponds to highest grid line.

6.1.3.2 Setting a Display Range

The display range determines the scaling or resolution of the vertical axis. In the default state, the display range is a logarithmic scaling over a 100 dB. This corresponds to 10 dB per grid division. The R&S Spectrum Rider provides other display ranges that either increase or decrease the resolution of the vertical axis.

However, increasing resolution does not increase the accuracy of, for example, the marker level readout, but only makes it easier to read values off the trace.

You can also select a linear scale for the vertical axis. In that case, the power levels are expressed as a percentage of the reference level. Linear scaling is useful to display AM modulated carriers in the time domain, for example.

1. Press the AMPT key.
2. Press the "Range / Ref Pos" softkey.
   The R&S Spectrum Rider opens a submenu to select the display range.
3. Select the display range you need.
   The R&S Spectrum Rider adjusts the vertical axis accordingly.

6.1.3.3 Selecting the Display Unit

By default, the vertical axis (and therefore the reference level) is scaled in dBm. However, the units dBmV, dBV, Watt and Volt are also available. Selecting the right unit is relevant for the marker level display because the unit of the marker level is the same as that of the reference level.

1. Press the AMPT key.
2. Press the "Unit" softkey.
   The R&S Spectrum Rider opens a submenu to select the display unit.
3. Select one of the available units.
   The R&S Spectrum Rider adjusts the vertical axis accordingly.

6.1.3.4 Setting a Reference Offset

You can define a reference offset for the reference level. With a reference offset, you can increase the reference level by a certain amount. This is useful, for example, if an attenuator or amplifier has been inserted before the RF input. The R&S Spectrum Rider automatically takes the loss or gain into account when the level is displayed and no manual calculations are necessary. A loss introduced at the RF input must be entered as a positive number and a gain as a negative number.

1. Press the AMPT key.
2. Press the "Ref Offset"" softkey.
   The R&S Spectrum Rider open an entry box to define input field.
3. Enter the offset you need.
   The R&S Spectrum Rider includes the offset in puts in the measurement.
   To indicate an offset other than 0, the R&S Spectrum Rider puts a blue dot at the "REF" field displays in the "Parameter View".

6.1.3.5 Setting the RF Attenuation

RF attenuation adjusts the input range inside the analyzer. It is coupled directly to the reference level. If you have set a high reference level, RF attenuation is turned on in 10 dB steps according to the table below so that the input mixer always remains in the linear range.

The R&S Spectrum Rider provides three attenuation modes.

- Auto Low Distortion
  If this mode is active, the R&S Spectrum Rider sets the RF attenuation 10 dB higher according to the table below, making the stress of the input mixer 10 dB less at the specified reference level. If the spectrum is densely occupied with signals, e.g. in a television cable network, the input mixer reduces the R&S Spectrum Rider inherent spurious products. However, the inherent noise display of the R&S Spectrum Rider increases due to the increased attenuation in front of the input mixer.
- Auto Low Noise
  If this mode is active, the R&S Spectrum Rider sets the RF attenuation 10 dB lower. This increases the sensitivity of the R&S Spectrum Rider, which means that the inherent noise display decreases due to the lower attenuation in front of the input mixer.

- Manual
  Manual selection of the attenuation.

You can check the status of the RF attenuation and the preamplifier in the "Configuration Overview" dialog and in the Parameter View area.

Reference Level	**Preamplifier OFF RF Attenuation**		**Preamplifier ON RF Attenuation**	
	Low Noise	Low Distortion	Low Noise	Low Distortion
<=-40 dBm	0 dB	0 dB	0 dB	0 dB
-39 dm to -35 dBm	0 dB	0 dB	0 dB	5 dB
-34 dm to -30 dBm	0 dB	0 dB	0 dB	10 dB
-29 dBm to -25 dBm	0 dB	0 dB	0 dB	15 dB
-24 dBm to -20 dBm	0 dB	0 dB	0 dB	20 dB
-19 dBm to -15 dBm	0 dB	5 dB	5 dB	25 dB
-14 dBm to -10 dBm	0 dB	10 dB	10 dB	30 dB
-9 dBm to -5 dBm	5 dB	15 dB	15 dB	35 dB
-4 dBm to 0 dBm	10 dB	20 dB	20 dB	40 dB
1 dBm to 5 dBm	15 dB	25 dB	25 dB	40 dB
6 dBm to 10 dBm	20 dB	30 dB	30 dB	40 dB
11 dBm to 15 dBm	25 dB	35 dB	35 dB	40 dB
16 dBm to 20 dBm	30 dB	40 dB	40 dB	40 dB
21 dBm to 25 dBm	35 dB	40 dB	40 dB	40 dB
26 dBm to 30 dBm	40 dB	40 dB	40 dB	40 dB

1. Press the AMPT key.
2. Press the "Att / Amp / Imp" softkey.
3. Select either the "Auto Low Distortion" or the "Auto Low Noise" menu item.
   The R&S Spectrum Rider sets the attenuation according to the table above.
4. Select the "Manual Att" for manual entry of the RF attenuation.
   Alternatively, you can select the "ATT" softkey on the "Parameter View" to enter manually for the RF attenuation.
   The R&S Spectrum Rider opens an entry box to set the RF attenuation. You can set the attenuation from 0 dB to 40 dB in 5 dB steps.
   To indicate a manual attenuation, the R&S Spectrum Rider puts a blue dot at the "ATT" displays on the "Parameter View".

6.1.3.6 Using the Preamplifier (R&S FPH-B22)

To increase the input sensitivity, the R&S Spectrum Rider provides an integrated 20 dB preamplifier after the input mixer.

In the default state of the R&S Spectrum Rider, the preamplifier is turned off. If you want to measure signals with low powers, you can turn it on.

1. Press the AMPT key.
2. Press the "Att / Amp / Imp" softkey.
3. Enable or disable the checkbox to turn on or off the "Preamp" menu item.
   The R&S Spectrum Rider turns the preamplifier on and off.

6.1.3.7 Setting the Input Impedance

In the default state, the input impedance is 50 Ω.

The R&S Spectrum Rider can also handle 75 Ω systems. The R&S Spectrum Rider does not select a 75 Ω RF input. Instead it selects a 75 Ω matching pad connected at the RF input. The 50/75 Ω matching pad R&S RAZ is recommended for 75 Ω matching (see recommended accessories). The R&S Spectrum Rider automatically considers the conversion factor when a value of 75 Ω is set.

1. Press the AMPT key.
2. Press the "Att / Amp / Imp" softkey.
3. Select the impedance you need.
   You can also use other matching pads (e.g. R&S RAM or R&S FSH-Z38) by activating transducer factors.

6.1.3.8 Using Transducer Factors

For more information see Chapter 6.3, "Using Transducer Factors", on page 145.

6.1.4 Setting Bandwidths

The bandwidth menu contains all settings to set up filter bandwidths available in the R&S Spectrum Rider. You can access it with the BW key.

6.1.4.1 Setting the Resolution Bandwidth

The resolution bandwidth in a spectrum analyzer determines the frequency resolution for frequency domain measurements and therefore determines how well it can separate adjacent frequencies. The measurement results observed depends on the pass-band of a resolution filter.

The resolution bandwidth (RBW) has several effects on measurements.

- To be able to display two or more signals whose frequencies are close together separately, you need a (resolution) filter whose bandwidth is small enough. The frequency difference between two sinusoidal carriers can not be less than the selected resolution bandwidth if the carriers are to be resolved, for example.
- The bandwidth of the resolution filter also affects the noise that is displayed by the R&S Spectrum Rider. The smaller the bandwidth, the less noisy the results are. The rule is, that if you increase or decrease the bandwidth by a factor of 3, the noise goes down or up by 5 dB. If you change the bandwidth by a factor of 10, the displayed noise changes by 10 dB.
- The resolution bandwidth affects the speed of the measurement. If you want to display the true spectrum, the resolution filters have to settle at all frequencies that are of interest. Narrow bandfilters have a longer settling time compared to wide ones. Therefore the sweep time increases the smaller the resolution bandwidth gets. The rule is, that if you reduce the bandwidth by a factor of 3, the sweep time goes up by a factor of 9. If you reduce the bandwidth by a factor of 10, the sweep time goes up by a factor of 100.

The R&S Spectrum Rider has resolution bandwidths from 1 Hz to 3 MHz in a 1-3-10 sequence.

In the R&S Spectrum Rider's default state, the resolution bandwidth is coupled to the span, i.e. if you change the span, the R&S Spectrum Rider adjusts the resolution bandwidth. Therefore, you do not have to set the resolution bandwidth manually in many cases, because the R&S Spectrum Rider automatically sets the resolution bandwidth if you change the span.

1. Press the BW key.
   By default, the resolution bandwidth is coupled to the span.
2. Press the "Manual RBW" softkey.
   The R&S Spectrum Rider opens an input field to define the resolution bandwidth.
3. Enter the resolution bandwidth you need.
   The R&S Spectrum Rider uses the resolution bandwidth you have entered for the measurement.
   If the resolution bandwidth is no longer coupled to the span, the R&S Spectrum Rider puts a blue dot at the "RBW" displays on the "Parameter View".
4. Press the "Auto RBW" softkey to again couple the resolution bandwidth to the span.

Automatic adjustment of the sweep time

In its default mode, the R&S Spectrum Rider automatically adjusts the sweep time as soon as you change the resolution bandwidth. This is to make sure that the settling time required for the selected resolution filter is properly taken into account. The maximum allowed sweep time is 1000 s. For narrow resolution filters this value would be exceeded for large spans. In order to avoid this, the R&S Spectrum Rider adjusts the span automatically as soon as the maximum sweep time is reached.

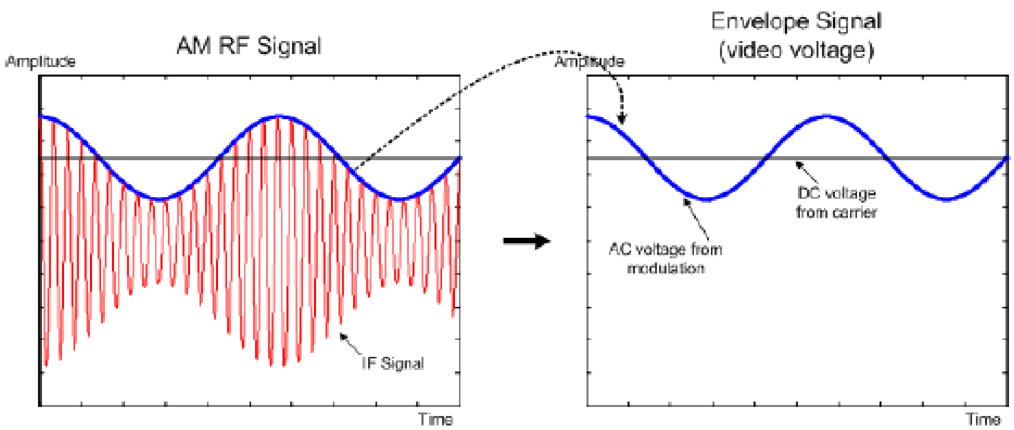
6.1.4.2 Setting the Video Bandwidth

The video bandwidth (VBW) basically smoothes the trace by reducing the noise and therefore making power levels easier to see.

The noise reduction is a result of the video filter. This lowpass filter defines the video bandwidth and filters the higher frequency parts of the voltage from the signal. Video voltage is the (DC) voltage that results from the IF signal passing through the envelope detector which removes the IF components and outputs the envelope only. This output is also known as the video signal.

The figure below shows that process on an AM modulated signal in the time domain.

In case of an AM modulated signal, the envelope (or video) signal contains a DC component that corresponds to the level of the carrier. The video signal also contains an AC component whose frequency is the same as the AM frequency.



If the bandwidth of the video filter is less than the frequency of the AC component, it is suppressed depending on its maximum frequency. If the AM component should be displayed truly, the cutoff frequency of the filter has to be greater than the modulation frequency.

If there is noise on the sine signal, the modulation signal can be thought of as noise. If the video bandwidth is reduced, the high-frequency noise components above the cutoff frequency of the video filter will be rejected. The smaller the video bandwidth, the smaller the noise amplitude at the video filter output.

The R&S Spectrum Rider provides video bandwidths from 1 Hz to 3 MHz in a 1-3-10 sequence. In its default state, the video bandwidth is coupled to the resolution bandwidth and is the same as the resolution bandwidth. If you change the resolution bandwidth, the R&S Spectrum Rider adjusts the video bandwidth accordingly.

The effects of the video bandwidth on measurements are as follows.

- if you are performing measurements on modulated signals, the video bandwidth must be sufficiently large so that significant modulation components are not rejected (≥ RBW)
- if you want to keep signals free of noise, you should select the smallest video bandwidth possible (≤ 0.1 x RBW)
- if you are performing measurements on pulsed signals, the video bandwidth should be at least three times greater than the resolution bandwidth so that the pulse edges are not distorted

Like the resolution bandwidth, the video bandwidth has an effect on sweep speed. Before each measurement, the video filter has to settle.

1. Press the BW key.
2. Press the "Manual VBW" softkey.
   The R&S Spectrum Rider opens an input field to define the video bandwidth.
3. Enter the video bandwidth you need.
   The R&S Spectrum Rider uses the video bandwidth you have entered for the measurement. If the video bandwidth is no longer coupled to the resolution bandwidth, the R&S Spectrum Rider puts a blue dot at the "VBW" displays on the "Parameter View".
4. Press the "Auto VBW" softkey again to couple the video bandwidth to the RBW.

6.1.5 Configuring and Triggering the Sweep

You can find all necessary settings to configure the sweep itself in the sweep menu. To access it, press the SWEEP key.

6.1.5.1 Setting the Sweep Time

The sweep time is the time it takes the R&S Spectrum Rider to get the results that are contained in one trace.

In the frequency domain (span > 0), the sweep time is the time it takes the R&S Spectrum Rider to measure the spectrum in the specified span. To avoid the display of spurs in the spectrum, the sweep time has to meet some conditions.

- The sweep time depends on the resolution bandwidth. If the sweep time is too short, the resolution filter has no time to settle. In that case, the displayed levels will be too low. For more information, see Chapter 6.1.4.1, "Setting the Resolution Bandwidth", on page 120.

- The sweep depends on the span. If you increase the span, you also have to increase the sweep time.

In its default state, the R&S Spectrum Rider couples the sweep time to the span and the resolution bandwidth to avoid invalid settings. If the coupling is active, the R&S Spectrum Rider always sets the shortest possible sweep time to make sure that the display of the spectrum is correct and valid.

The R&S Spectrum Rider requires a minimum sweep time of 20 ms for every 600 MHz of span. If you increase the span, the R&S Spectrum Rider will also increase the sweep time.

In the time domain (span = 0), the R&S Spectrum Rider shows the video voltage over time. The horizontal axis becomes a time axis that starts at 0 s and ends at the sweep time that you selected. The range of the sweep time in the time domain is from 34 us to 1000 s.

1. Press the SWEEP key.
   In the default state, "Auto SWT" is active.
2. Press the "Manual SWT" softkey.
   The R&S Spectrum Rider opens an input field to set the sweep time.
3. Enter the sweep time you need.
   If the video bandwidth is no longer coupled to the span or the resolution bandwidth, the R&S Spectrum Rider puts a blue dot at the "SWT" displays on the "Parameter View".

6.1.5.2 Selecting the Sweep Mode

The sweep mode is the way the R&S Spectrum Rider performs the measurement.

In its default state, the R&S Spectrum Rider measures continuously. In this mode, the R&S Spectrum Rider automatically repeats the sweep in the defined range of the horizontal axis (frequency or time) and updates the trace accordingly after it has finished with one sweep.

In some cases, it may be sufficient to get the results over a single sweep only, e.g. if a particular trigger condition is met. In single sweep mode, the R&S Spectrum Rider performs the sweep a certain number of times (depending on the number of averages you have set) over the defined range of the horizontal axis (frequency or time) and then stops measuring. It performs another sweep only after you tell it to. For more information on setting the number of sweeps included in a single sweep, see Chapter 6.1.6.1, "Selecting the Trace Mode", on page 126.

1. Press the SWEEP key.
2. Press the "Single Sweep" softkey.
   The R&S Spectrum Rider activates single sweep mode.
3. Press the "Cont Sweep" softkey.
   The R&S Spectrum Rider again starts to measure continuously.

6.1.5.3 Working with Trigger Functionality

If you have to perform measurements according to certain signal conditions, you can use a trigger. A trigger responds to certain events. If a trigger is active, the R&S Spectrum Rider starts to measure if the trigger conditions are met. The trigger can be generated either externally or internally. The R&S Spectrum Rider provides the following trigger functions

Selecting the trigger source

1. Press the SWEEP key.
2. Press the "Trigger" softkey.
   The R&S Spectrum Rider opens a submenu to select the trigger source.
3. Select the trigger source you need.
   The R&S Spectrum Rider activates the trigger.

The R&S Spectrum Rider provides the following trigger functions.

- **Free Run**
  A new sweep starts on completion of the previous sweep. This is the default state of the R&S Spectrum Rider.
- **Video Trigger**
  A sweep starts when the video voltage exceeds a particular level. The video trigger is available only in the time domain (span = 0).
  In the frequency domain, the R&S Spectrum Rider would never start a measurement with the video trigger because there is no guarantee that there is a signal that generates video voltage present at the start frequency.
- **External Trigger** (rising or falling slope)
  A sweep starts on the rising edge (RISE) or on the falling edge (FALL) of an external trigger signal. The external trigger signal is fed in via the BNC connector "Ext Trigger". See details of connector in Chapter 3.2.2.2, "BNC Connector", on page 33. The switching threshold is 1.4 V, i.e. a TTL signal level.

Including a Delay Time

When you are using a video trigger in the time domain or an external trigger, you can delay the start of the measurement with respect to the trigger event by entering a delay time. In this way, you can include time differences between the trigger event and the measurement.

The range of the trigger delay is from 0 s to 100 s. The resolution depends on the subrange.

Trigger Delay	Resolution
0 to 1 ms	10µ
1 ms to 10 ms	100 µ
10 ms to 100 ms	1 ms

Trigger Delay	Resolution
100 ms to 1 s	10 ms
1s to 10s	100 ms
10s to 100s	1 s

1. Press the SWEEP key.
2. Press the "Trigger" softkey.
3. Select the "Trigger Delay" menu item.
   The R&S Spectrum Rider opens an input field to define the trigger delay.
4. Enter the delay time you need.

Defining the Trigger Level

When you are using the video trigger, you have to define a trigger level. The trigger level is a percentage of the reference level. A trigger level of 100 % is the same as the reference level. A trigger level of, e.g. 50 % corresponds to the middle of the vertical axis. The R&S Spectrum Rider indicates the video trigger level with a triangle.

1. Press the SWEEP key.
2. Press the "Trigger" softkey.
3. Select the "Video" menu item.
   The R&S Spectrum Rider opens an input field to define the trigger level.
4. Enter the trigger level.
   The R&S Spectrum Rider shows the trigger level by adding a horizontal line to the diagram area.

6.1.6 Working with Traces

The trace menu contains all functions available to customize the trace display.

6.1.6.1 Selecting the Trace Mode

The R&S Spectrum Rider provides several trace modes. The trace mode defines the way the R&S Spectrum Rider writes the trace.

1. Press the TRACE key.
2. Press the "Trace Mode" softkey to set the trace mode.

3. Select the trace mode you want to work with.
   If you have selected the average trace mode ("Average: 10" menu item), the R&S Spectrum Rider opens an input field to set the number of sweeps the R&S Spectrum Rider includes in the averaging.
4. Enter the number of sweeps to include in the averaging.
   In continuous sweep mode, the R&S Spectrum Rider now calculates the moving average over the number of sweeps you have specified. In single sweep mode, it stops the measurement after finishing the sweeps and averages the traces.

The R&S Spectrum Rider provides the following trace modes.

- **Clear/Write**
  In its default state, the R&S Spectrum Rider overwrites the trace after each sweep.
  You can apply all detectors in this mode.
- **Average**
  The trace is the result of the moving average over several sweeps.
  The R&S Spectrum Rider calculates the (moving) average of the power levels for each pixel over a particular number of sweeps in the range from 2 to 999.
  Averaging reduces the effects of noise, but has no effects on sine signals. Using the trace averaging therefore is a good way to detect signals in the vicinity of noise.
  You can apply all detectors in this mode.
- **Max Hold**
  The trace shows the maximum power levels that have been measured at each pixel.
  To overwrite a max hold trace, change a parameter in a way that the results can not be compared any more (e.g. the span). Using the max hold trace mode is a good way to detect intermittent signals or the maximum values of fluctuating signals, for example.
  Using the max hold trace mode automatically activates the max peak detector.
- **Min Hold**
  The trace shows the minimum power levels that have been measured at each pixel.
  To overwrite a min hold trace, change a parameter in a way that the results can not be compared any more (e.g. the span). Using the min hold trace mode is a good way to highlight signals within noise or suppress intermittent signals.
  Using the min hold trace mode automatically activates the min peak detector.
- **View**
  The view trace mode freezes the current trace and aborts the measurement.
  Using the view trace mode is a good way to evaluate the trace, for example with markers.

6.1.6.2 Selecting the Detector

The number of measurement results collected in a single sweep usually is very high, especially if the span is large. However, the display of the R&S Spectrum Rider can display only 711 results in horizontal direction, as it is limited by the number of pixels that are available on the display. Therefore, it has to combine measurement results to fit them on the display. In that case, one pixel represents a frequency range = span / 711.

The detector determines the way the R&S Spectrum Rider combines and displays the results for one pixel. The data base is the video voltage of the analyzer.

1. Press the TRACE key.
2. Press the "Detector" softkey.
   The R&S Spectrum Rider displays the submenu to select the trace detector.
3. Select the detector you want to use.
   If the "Auto Detector" selection is active, the selection of the trace detector will follow Table 6-1.

The R&S Spectrum Rider provides several types of detectors.

- **Auto Peak**
  If the auto peak detector is active, the R&S Spectrum Rider displays both the maximum and the minimum power levels that were measured in the frequency range covered by a pixel.
  Therefore, the auto peak detector loses no information. If a signal power level fluctuates (e.g. noise), the width of the trace depends on the magnitude of the signal fluctuation. The auto peak detector is the default detector.
- **Max Peak**
  If the max peak detector is active, the R&S Spectrum Rider displays only the maximum power levels that were measured in the frequency range covered by a pixel.
  The max peak detector is useful for measurements on pulse or FM signals, for example.
- **Min Peak**
  If the max peak detector is active, the R&S Spectrum Rider displays only the minimum power level that were measured in the frequency range covered by a pixel.
  The min peak detector displays sine signals with the correct level and suppresses noise. Therefore it is useful to find sine signals in the vicinity of noise.
- **Sample**
  If the sample detector is active, the R&S Spectrum Rider shows one random power level that was measured in the frequency range covered by a pixel.
  The sample detector is useful for measurements in the time domain (span = 0 Hz) as it provides the only way to represent the timing of the video signal correctly.
  In the frequency domain, the sample detector is a good way to measure noise power because noise usually has a uniform spectrum with a normal amplitude distribution.
  Signals may get lost if you are using the sample detector for measurements with a span that is greater than "RBW * 711".
- **RMS**
  If the RMS detector is active, the R&S Spectrum Rider measures the spectral power over one pixel. In case of power measurements, the RMS detector always shows the true power of a signal, regardless of the shape of the signal.
  The RMS detector is best for measurements on digitally modulated signals because it provides stable and true power readings. In combination with a high

sweep time you can increase the display stability even more because the measurement time for each pixel increases.
Noise measurements also provide stable results if you apply the RMS detector in combination with a high sweep time.
However, the bandwidth occupied by the signal to be measured should at least equal the frequency covered by a trace pixel or the selected resolution bandwidth (whichever is larger). Otherwise, the power the R&S Spectrum Rider shows is too low because there are spectral components within the frequency range covered by the pixel that do not originate from the signal you want to observe (e.g. noise).
To get the true power, the video bandwidth (VBW) should also be greater than the resolution bandwidth (RBW). Otherwise, an averaging effect caused by video bandlimiting comes into play before the RMS value is calculated.

The R&S Spectrum Rider provides automatic selection of the detector. In that case, the R&S Spectrum Rider selects the detector that is most suitable for the current trace mode.

Table 6-1: Auto selection of trace detector

Trace Mode	Detector
Clear/Write	Auto Peak
Average	Sample
Max Hold	Max Peak
Min Hold	Min Peak

If you select the detector manually, the detector is independent of the trace mode and will not change.

6.1.6.3 Working with a Second Trace

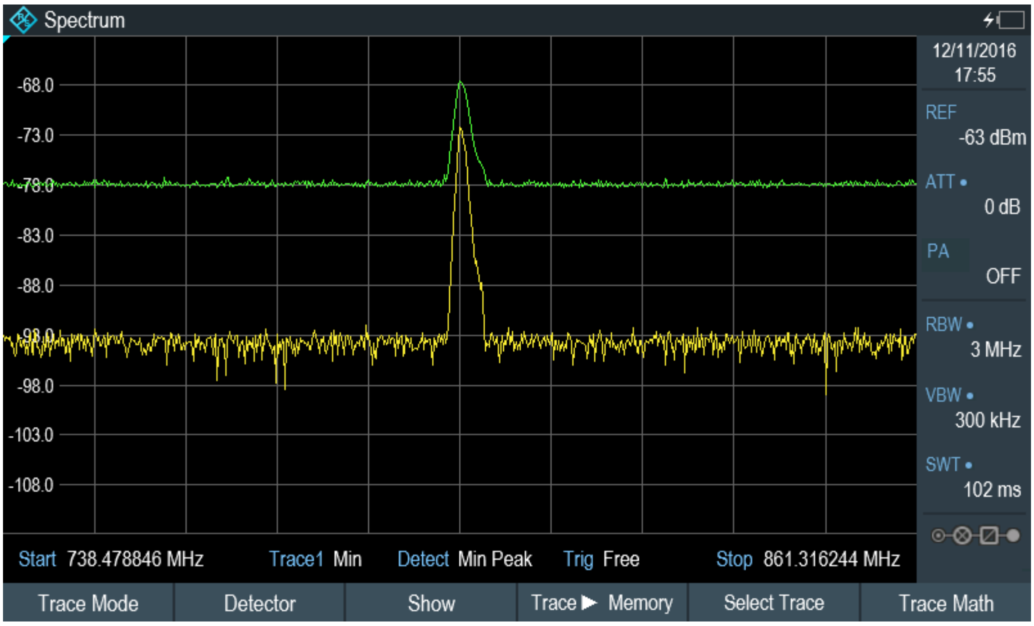
In spectrum mode, you can use up to two traces. All two traces are based on the same settings, except the trace settings like the trace mode or the detector. You can use the second trace to compare, for example, fout different detector settings.

In the default state, only trace 1 is active.

1. Press the TRACE key.
2. Press the "Show" softkey.
3. Select the "Enable Trace 2" menu item.
   The R&S Spectrum Rider shows the second trace. The second trace is in a different color. To show that the second trace is active, the R&S Spectrum Rider displayed the current active trace "Trace 1" or "Trace 2" on the "Parameter View".

After you have activated the second trace, the trace will becomes the active one. All actions (like changing the detector or trace mathematics) apply to the active trace.

4. Press the "Select Trace" softkey.
   Trace 1 becomes the active trace.



You can put both traces into the internal memory of the R&S Spectrum Rider and restore them later. Note that the memory trace 1 and memory trace 2 have the same color (i.e. white).

6.1.6.4 Working with Memory Traces

You can save the image of both traces to the memory of the R&S Spectrum Rider and later restore it and compare it to a live trace. The memory trace is always colored white to distinguish it from the live trace.

Measurement settings

Because the memory trace is just a bitmap, any modifications to measurement settings like span or reference level are nor reflected in the memory trace.

When you save a data set, the R&S Spectrum Rider also stores the associated trace in the trace memory. If you restore it at a later time, you can display the memory trace as if it is a normal memory trace.

1. Press the TRACE key.

2. Select the trace you want to store in the trace memory with the "Select Trace" softkey.

3. Press the "Trace▸Memory" softkey.
   The R&S Spectrum Rider saves the active trace.
4. Press the "Show" softkey.
5. Select the "Enable Memory 1 " menu item.
   The R&S Spectrum Rider shows the corresponding memory trace. If active, it labels the "Memory <x>" menu item with an active radio button.

6.1.6.5 Using Trace Mathematics

Trace mathematics subtract the memory trace from the live trace and vice versa and then display the results.

1. Press the TRACE key.
2. Press the "Trace▸Memory" softkey.
3. Press the "Show" softkey.
4. Press the "Trace Math" softkey.
5. Select the "Trace-Memory" or ""Memory-Trace"" menu item.
6. The R&S Spectrum Rider calculates and shows the resulting trace.
7. To turn off trace mathematics, select the "Off" menu item.

6.1.7 Using Markers

The spectrum analyzer mode provides marker and deltamarker functionality. In addition, you can use several marker functions.

6.1.7.1 Using Markers and Deltamarkers

The R&S Spectrum Rider has six markers, five of which can be used as either markers or delta markers.

The markers cannot leave the trace and indicate the horizontal and vertical coordinates of the point they are positioned on. The horizontal position of a marker is shown by a vertical line which extends from the top to the bottom of the measurement diagram. The marker list above the diagram area shows the exact coordinates of all markers in use.

The position of a delta marker is indicated by a dashed line to distinguish it from a normal marker. The delta marker level is always a relative to the main marker level and so the delta marker level unit is always dB. The delta marker frequency is always relative to the main marker – in other words, the delta marker frequency is the frequency difference between the frequency at the point marked by the main marker and the frequency at the point marked by the delta marker.

To measure complex signals, you can activate up to six markers. Marker 1 is always a normal marker and the reference of all delta markers. Markers 2 to 6 are either markers or delta markers depending on your set up.

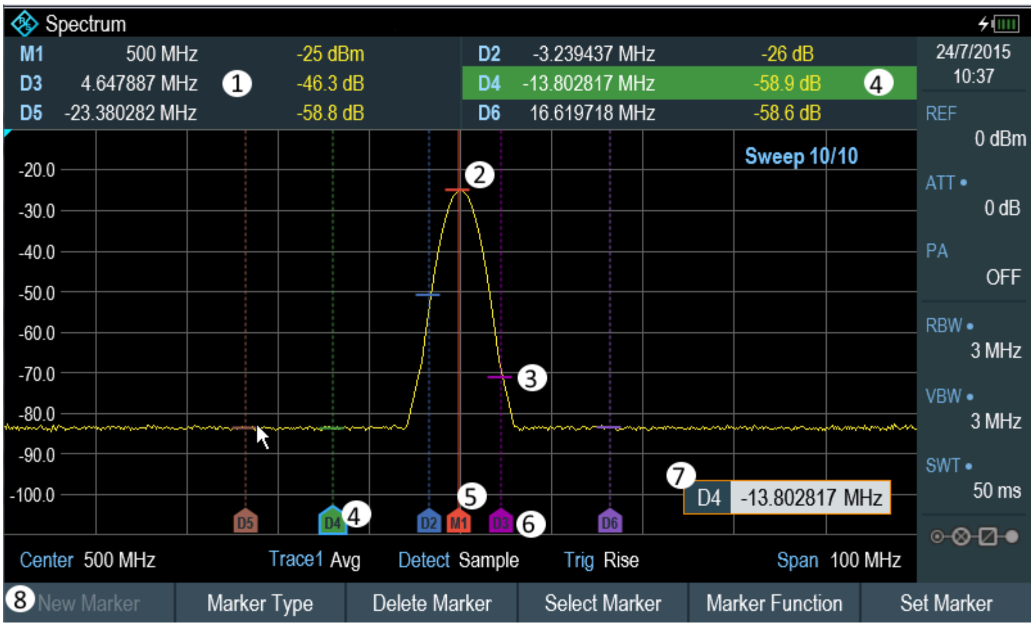


Figure 6-1: Screen Layout with Active Markers

1 = Measurement Result View
2 = Marker (solid line)
3 = Delta marker (dotted line)
4 = Active marker label (see highlighted line on the marker list as well as the marker label)
5 = Marker label: M(x)
6 = Delta marker label: D(x)
7 = Marker input field
8 = Marker menu

6.1.7.2 Positioning Markers

1. Press the MARKER key.
   The marker menu opens.
   If, as yet, no marker has been activated, the R&S Spectrum Rider automatically activates the main marker and positions it on the maximum level that has been measured. In addition, the marker frequency input field opens.
   You can perform the following actions:
   - Position the marker with the rotary knob

When positioning the marker with the rotary knob, the step size is one pixel.

- Enter a marker position with the number keys and confirm the entry with one of the unit keys.

2. Confirm the marker position by pressing the rotary knob.
   The Measurement Result View shows the horizontal position of all markers and the corresponding vertical value. You can select any marker in the Measurement Result View for further marker function using the marker softkey menu. You can also use rotary knob to select any of the marker displayed in the Measurement Result View.

Special touchscreen gesture

Alternatively, double tap on the touch screen to position the marker on the trace window. The first marker that is positioned on the trace window is the main marker, the following markers added on the trace window are the delta markers.

See Chapter 4.2.4, "Add Marker", on page 87.

6.1.7.3 Positioning a Delta Marker

When a normal marker is already in use, you can add delta markers.

1. Press the MARKER key.
   The marker menu opens.
2. Press the "New Marker" softkey.
   The R&S Spectrum Rider activates a delta marker and positions it on the next maximum level that has been measured. In addition, the delta marker input field opens. The R&S Spectrum Rider adds the delta marker to the marker list and shows the marker position relative to the normal marker (M1).
   You can perform the following actions:
   - Enter a delta marker position with the number keys and confirm the entry with one of the unit keys.
   - Change the delta marker position with the rotary knob.
3. Confirm the delta marker position by pressing the rotary knob.
   The delta marker input field closes.
4. To add more markers, press the "New Marker" softkey several times until you have the number of markers you want in the display.

Special touchscreen gesture

Alternatively, double tap on touch screen to position the delta marker on the trace window.

See Chapter 4.2.4, "Add Marker", on page 87.

6.1.7.4 Selecting the Marker Type

When you add new markers, they will be delta markers by default. Their coordinates are relative to the first marker (M1). You can turn delta markers into normal markers if you need absolute information about the marker position.

1. Select the delta marker you want to convert in the Measurement Result View.
   The selected marker will be highlighted in the Measurement Result View and its corresponding label in the trace window will turns focus with a blue frame around the marker label. The R&S Spectrum Rider opens a marker input field.
   Alternatively, you can press the MARKER key to select the delta marker you want to convert with the "Select Marker" softkey
2. Press the "Marker Type" softkey.
   The delta marker turns into a normal marker. Its label changes accordingly (e.g. D2 to M2) and its coordinates are now absolute values.

6.1.7.5 Automatic Positioning of Markers

The R&S Spectrum Rider offers functions that make setting the markers easier or allow to make instrument settings on the basis of the current marker position:

1. Press the MARKER key.
2. Press the "Set to Peak", "Set to Next Peak" or "Set to Minimum" softkey.
   The R&S Spectrum Rider positions the marker accordingly.

The R&S Spectrum Rider provides the following selections for automatic positioning of markers:

- "Set to Peak"
  The Peak function places the active marker or the delta marker on the highest level value of the trace.
- "Set to Next Peak"
  The Next Peak function places the active marker or delta marker on the next highest level value of the trace, relative to its current position.
- "Set to Minimum"
  The Minimum function places the active marker or delta marker on the lowest value of the trace.

6.1.7.6 Removing Markers

Remove markers any time you want from the trace window.

Removing selected markers

1. Select the marker you want to delete in the Measurement Result View.
   Alternatively, you can select the marker you want to delete with the "Select Marker" softkey

The selected marker will be highlighted in the Measurement Result View and its corresponding label in the trace window will turns focus with a blue frame around the marker label. The R&S Spectrum Rider opens a marker input field.

2. Press the "Delete Marker" softkey.
3. Select the "Delete Selected" menu item.
4. Confirm the selection by pressing the rotary knob.
   The R&S Spectrum Rider deletes the marker.

Deactivating markers

If you delete marker 1 (M1), all delta markers that are relative to that marker are also deleted.

Removing delta markers only

1. Select the delta marker you want to delete in the Measurement Result View.
   Alternatively, press the MARKER key.
2. Press the "Delete Marker" softkey.
3. Select the "Delete All Delta" menu item.
4. Confirm the selection by pressing the rotary knob.
   The R&S Spectrum Rider deletes all delta markers.

Removing all markers at the same time.

1. Press the MARKER key.
2. Press the "Delete Marker" softkey.
3. Select the "Delete All" menu item.
4. Confirm the selection by pressing the rotary knob.
   The R&S Spectrum Rider deletes all markers and delta markers.

Special touchscreen gesture

Alternatively, draw a "x" on the trace window to delete all markers and delta markers on the trace window.

See Chapter 4.2.6, "Delete All Markers", on page 89.

6.1.7.7 Using Marker Search Limits

The R&S Spectrum Rider allows you to use only a limited section of the trace for the "Set to Peak", "Set to Next Peak" and "Minimum" functions.

1. Press the MARKER key.

2. Press the "Set Marker" key.
3. Press the "Search Range" menu item.
   The R&S Spectrum Rider opens the marker search limits softkey menu.
4. Select the "Select Marker" to define the marker position.
   The R&S Spectrum Rider opens an input field to define the marker position.
5. Enter a desire marker position.
6. Confirm the entry with one of the unit keys
7. Select "Selected Marker" if you want to apply the marker search limit on the selected marker.
   The R&S Spectrum Rider display the the "Selected Marker" menu.
8. Select the "Search Range Off" menu item.
   The R&S Spectrum Rider activates the marker search limits for the selected marker.
   By default, the search limit range is over the whole span.
9. Select the "Lower Limit" menu item from "Search Range 1" section item.
   The R&S Spectrum Rider opens an input field to define the lower limit of the search range for "Search Range 1" section item.

10. Enter the lower limit.
11. Confirm the entry with one of the unit keys.
12. Define the upper search limit the same way for "Search Range 1" section item.
13. Define the lower and upper search limit the same way for "Search Range 2" section item.

Deactivating marker search limits

1. Press the "Selected Marker" softkey.
2. Select the "Search Range Off" menu item.
3. Confirm the selection by pressing the rotary knob.
   The R&S Spectrum Rider turn off the marker search limit function for the selected marker.
4. To turn off the marker search limits function for all markers, select "All Markers" softkey and repeat the above steps

6.1.7.8 Using Marker Functions

In addition to the frequency and level readout, the R&S Spectrum Rider provides several, more complex, marker functions in spectrum analyzer mode.

Marker function frequency

Marker functions are only applied to the marker position at center frequency.

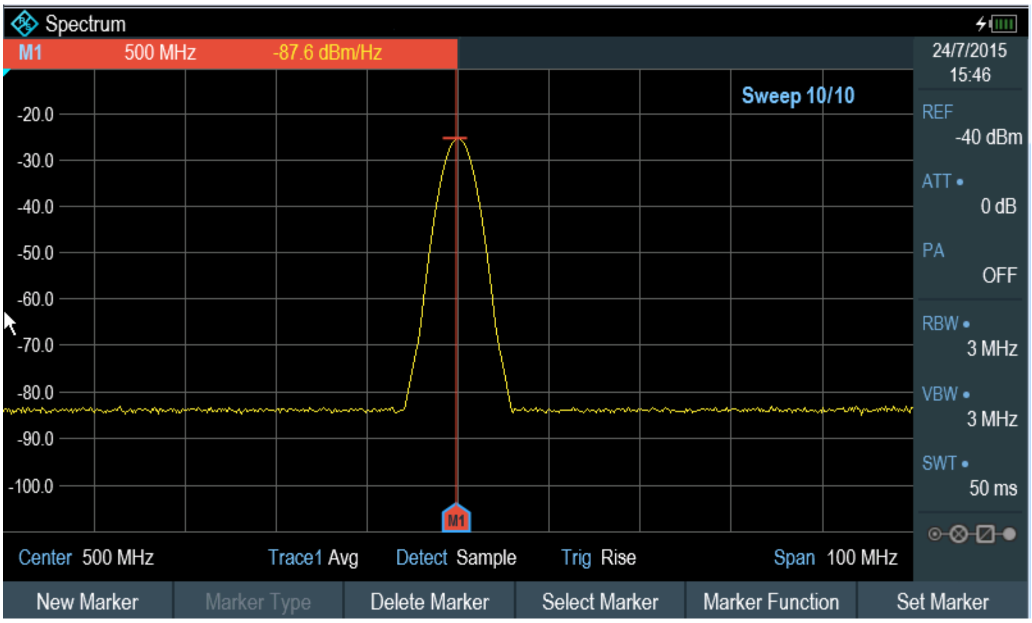
Deactivating marker functions

Selecting a marker function again while it is still active will turns that marker function off.

Measuring the Noise Power Density

The marker noise function calculates the noise power density at the marker position in dBm/Hz. The R&S Spectrum Rider includes several variables in the calculation of the noise power density, including the trace pixel values, the resolution bandwidth, the detector and the level display mode (absolute or relative). To stabilize the noise power display, the R&S Spectrum Rider uses the pixel the marker is on and four pixels to the right and four pixels to the left of the marker pixel.

Noise power density can provide useful information when you are measuring noise or digitally modulated signals. However, you will get valid results only if the spectrum in the vicinity of the marker has a flat frequency response. When measuring the noise power density on discrete signals, results are not valid.



1. Press the MARKER key
2. Press the "Marker Function" key
3. Enable the "Noise" checkbox menu item.
   The R&S Spectrum Rider shows the level at the marker frequency in dBm/Hz. If you are using a delta marker for the measurement, the results have the unit dBc/Hz with marker 1 being the reference.

Measuring the Frequency

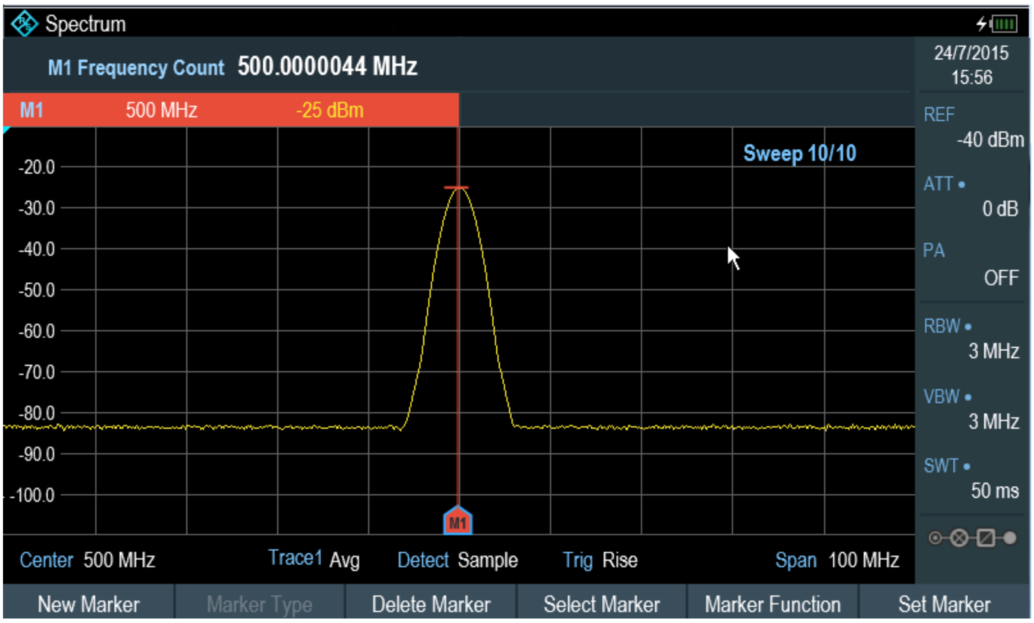
The R&S Spectrum Rider provides a frequency counter. The frequency counter accurately measures the frequency at the marker position.

When calculating the horizontal position of the marker, the R&S Spectrum Rider includes the current span, center frequency and the frequency of the pixel the marker is on. As the trace only has 711 pixels, the marker position is just an approximation, especially if the span is very wide.

With the frequency counter, however, you can get a more accurate result of the horizontal marker position. If the frequency counter is active, the R&S Spectrum Rider stops the measurement at the marker position for a short time and measures the frequency using the internal reference frequency.

The accuracy of the results therefore depends only on the accuracy of the internal reference frequency (TCXO). The frequency counter has a resolution of 0.1 Hz and therefore provides far more accurate results. Despite the accuracy, the measurement is still fast (because of a special algorithm for the I/Q baseband signal).

The frequency counter only gives completely accurate readings for sine signals that are at least 20 dB above the noise floor. If the S/N ratio is less, noise affects the results.



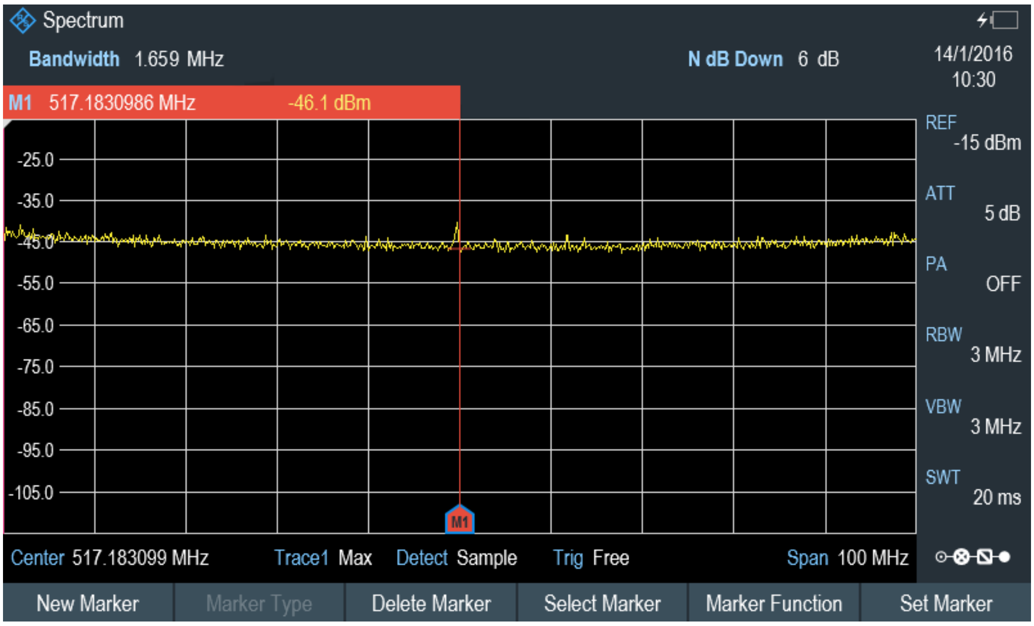
1. Press the MARKER key.
2. Press the "Marker Function" softkey.
3. Select the "Frequency Count" checkbox menu item.
   The R&S Spectrum Rider displays the counted marker frequency with a resolution of 0.1 Hz.

Measuring the Signal Bandwidth

The "n dB Down" marker function places two temporary markers to the left and to the right of the reference marker and measures the bandwidth between the two temporary markers. The function therefore is a good way to measure the bandwidth of a signal or the bandwidth of a filter, for example. The temporary markers are represented as two vertical lines.

The distance to the reference marker is by default 3 dB below the reference marker. You can also adjust this value manually. Entering a positive value sets the temporary markers below the reference marker. If it is, for any reason, not possible to calculate the frequency spacing, dashes are displayed instead of a value.

Upon entering a negative value, the function turns into a n dB up function. You can use a n dB up function, for example, for measurements on notch filters.



1. Press the MARKER key.
2. Press the "Marker Function" key.
3. Select the "n dB Down" menu item.
   The R&S Spectrum Rider displays two temporary markers on the left and on the right of the reference marker, "M1". It also shows the bandwidth between the n dB down markers. You can then adjust the distance of the temporary markers.
4. Press the "Marker Function" key.
5. Select the "n dB Down" menu item.
   The R&S Spectrum Rider opens an input field.
6. Enter a different distance of 6 dB.
   The R&S Spectrum Rider again shows the temporary markers, this time with a broader bandwidth.

Demodulating Signals

The R&S Spectrum Rider features an AM and FM demodulator to demodulate and monitor audio signals. It demodulates the signal at the marker frequency.

You can listen to the demodulated signal with the internal speaker or headphones that you can connect to the 3.5 mm headphone jack on the top of the R&S Spectrum Rider. See Chapter 3.2.2.3, "Headphone Jack", on page 34.

When demodulating an AM modulated signal, the R&S Spectrum Rider turns the video voltage into an audible sound. You should therefore set the reference level to about the level of the signal that you are demodulating.

If you perform measurements in the time domain, the R&S Spectrum Rider demodulates continuously. In the frequency domain, you can define a time period the R&S

Spectrum Rider demodulates the signal at the marker frequency. The frequency sweep then stops at the marker frequency for that time before finishing the sweep.

1. Press the MARKER key.
2. Press the "Marker Function" key.
3. Select the "AM" or "FM" demodulation scheme you require from the menu.
   The R&S Spectrum Rider starts to demodulate the signal.

Demodulating signals

If you turn on the demodulator, the R&S Spectrum Rider automatically turns off the noise marker or the frequency counter.

Defining the demodulation time period

1. Press the MARKER key.
2. Press the "Marker Function" softkey.
3. Select the "Time" menu item.
   The R&S Spectrum Rider opens an input field to define the demodulation time.
4. Enter the demodulation time you need.
   The range is from 100 ms to 500 s. In time domain the R&S Spectrum Rider demodulates continuously, i.e. the demodulation time is not relevant.

Controlling the volume

1. Press the MARKER key.
2. Press the "Marker Function" softkey.
3. Select the "Volume" menu item.
   The R&S Spectrum Rider opens an input field to define the demodulation volume.
4. Enter the volume you are comfortable with.
   The demodulation volume is a percentage (0 % to 100 %) with 100 % being full volume.
   For more information on general volume control see Chapter 3.2.7.6, "Configuring the Audio Output", on page 58.

Mute function

► Press the speaker icon to mute or unmute the volume.
   The speaker icon is located at the top right hand corner of the trace window. It appears only when "Marker Function" is set to "AM" or "FM" demodulation scheme.

6.1.8 Using Limit Lines

Limit lines help you to identify if a signal complies with certain level characteristics.

A limit line is made up out of two or more points that are connected to a line. Each of the points that define the shape of the limit line consists of two coordinates. One coordinate defines the horizontal position (e.g. frequency), the other one the vertical position. With the R&S Spectrum Rider you can build limit lines that consist of up to 1000 points.

Values that define the horizontal characteristics of the limit line can be either absolute values (e.g. frequency in MHz) or relative values whose reference is the center of the measurement trace (e.g. the center frequency). Relative values are of advantage if you, for example, measure modulated output signals and you change the center frequency but need the limit line to remain the same. Absolute limit lines have the file extension ".abslim" while relative limit lines have the file extension ".rellim"

Values that define the vertical characteristics are always level values in dB. If the scaling of the vertical axis is currently a linear one (units V or W), the R&S Spectrum Rider automatically switches to a logarithmic scaling after you turn on the limit line.

After turning on a limit line, the R&S Spectrum Rider checks if the signal violates the shape of the limit line. If one or more signal levels exceed the limit value, the R&S Spectrum Rider features several indicators that the limit check has failed.

- A general message in the diagram header that indicates if the signal violates the limit line, including the trace that violates the limit: 

- An audio signal that sounds every time a limit is violated

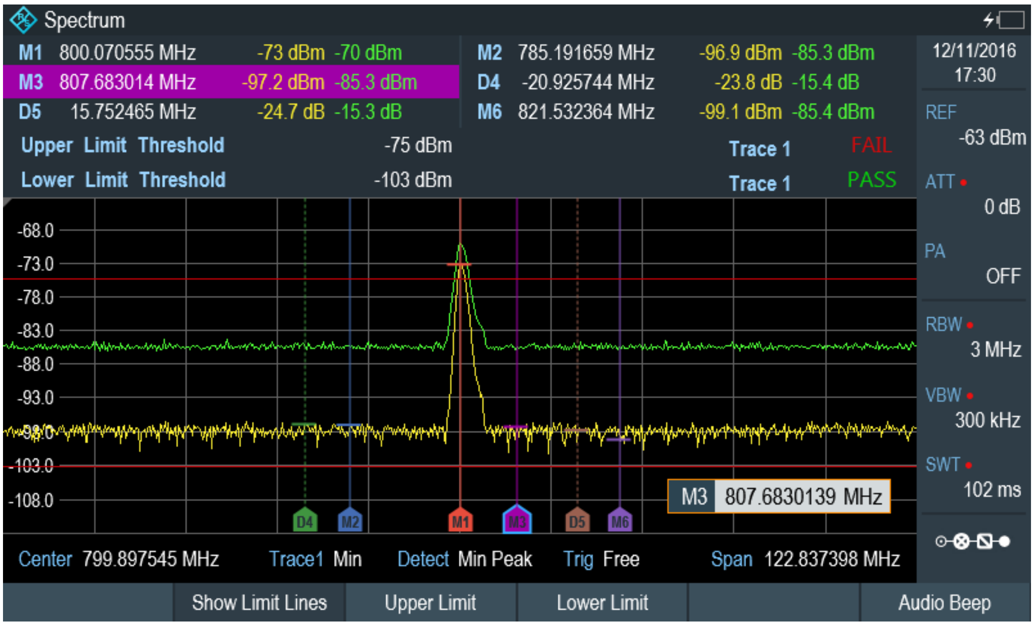


Figure 6-2: Upper and lower Limit Lines

You can create and edit limit lines with the R&S Instrument View software and then transfer them into the internal memory of the R&S Spectrum Rider. The number of limit lines you can store in the memory depends on other datasets available on the R&S Spectrum Rider or if you are using an external storage device (e.g. memory stick).

For more information on limit lines, see Chapter 4.8, "Managing Datasets", on page 96.

6.1.8.1 Selecting a Limit Line

Before selecting a limit line, you need to decide if you want to use it as an upper or lower limit line. In case of upper limit lines, the R&S Spectrum Rider checks if the signal is above the limit line. In case of lower limit lines, the R&S Spectrum Rider checks if the signal is below the limit line.

You also have to make sure that the limit line is compatible to the scale of the horizontal axis.

1. Press the LINES key.
2. Depending on the application, press the "Upper Limit" or "Lower Limit" softkey.
3. Select the "Load From File" menu item.
   The R&S Spectrum Rider opens the "File Manager" dialog to select the limit line.
4. Select one of the available limit lines.
5. Press the "Load" softkey.
   The R&S Spectrum Rider activates the limit line. In the diagram, the limit line is displayed as a red line. See Figure 6-2.
   If you have already selected a limit line, you can turn the limit line on and off with the "Show Limit Lines" softkey.

Alternatively, you can define a threshold that works like a limit line. A threshold is a simple horizontal limit line.

1. Press the "Upper Limit" or "Lower Limit" softkey.
2. Select the "Set Threshold" menu item.
   The R&S Spectrum Rider opens a input field to define the threshold.
3. Enter the threshold you need.
   The R&S Spectrum Rider displays the line and performs a limit check for that threshold.

The process of turning off a limit line completely is similar to that of selecting a line.

1. Press the "Show Limit Lines"
   The R&S Spectrum Rider hides the limit line.
2. To remove the limit lines, select the "Upper Limit" or "Lower Limit" softkey.
3. Select the "Remove" softkey.

The R&S Spectrum Rider removes the limit line.

6.1.8.2 Performing Limit Checks

If limit lines are active, the R&S Spectrum Rider automatically checks the trace for limit violations after each frequency sweep. As long as the signal does not violate the limit line, the R&S Spectrum Rider shows a "Pass" message in the measurement diagram. As soon as one single value (i.e. one pixel) is outside of the limits, the R&S Spectrum Rider displays a "Fail" message in the diagram area and, in addition, sounds a beep.

A limit checks relates only to the frequency range defined by the limit line, not the span.

Audio signal

You can turn the acoustic signal that sounds in case of a limit violation on and off.

► Select the "Audio Beep" menu item.
Once selected, the audio beep is active, the R&S Spectrum Rider beeps each time a limit is violated.

Limit violation
Note that a limit check fails only if the signal exceeds the limit line. If the signal level is the same as the limit value, the limit check passes.

6.2 Working with Channel Tables

Almost all transmission systems divide their assigned frequency ranges into channels. Each channel corresponds to a specific frequency. To keep the handling of such systems simple, you can use channel tables instead of entering frequencies manually.

The R&S Spectrum Rider already comes with an assortment of channel tables that you can use without doing anything. If you want to test transmission standards that are not listed, you can also build channel tables manually with the "Channel Table Editor" of the R&S Instrument View software package that is delivered with the R&S Spectrum Rider. To use one of those, you just have to copy the channel table to the R&S Spectrum Rider.

For more information on channel table, see Chapter 4.8, "Managing Datasets", on page 96.

Selecting a channel table

1. Press the FREQ key.
2. Press the "Frequency Mode" softkey.
3. Select the "Channel Downlink" or "Channel Uplink" menu item.

The R&S Spectrum Rider opens the "File Manager" dialog to select a channel table.

4. Select one of the available channel tables.
   After activating the channel table, the R&S Spectrum Rider is set up according to the information contained in the channel table. Instead of a center frequency, the R&S Spectrum Rider shows the currently active channel number including the name of the channel. The center frequency of a channel is defined in the channel table and is the frequency corresponding to the selected channel.

Selecting a channel

Entering a center, start or stop frequency is not possible anymore. Instead you select a channel. The R&S Spectrum Rider then adjusts the center, start and stop frequency according to the channel table.

1. Press the FREQ key.
2. Press the "Center Frequency" softkey.
   The R&S Spectrum Rider opens an input field to select the channel.
3. Enter the channel you want to perform measurements on.
   The R&S Spectrum Rider changes the channel according to the channel table.
   Channel numbers are assigned to frequencies as follows:
   - The first channel is assigned a channel number and a frequency.
   - All subsequent channels have ascending numbers.
   - The frequency spacing between channels is fixed. It can also be negative, i.e. the center frequency of the R&S Spectrum Rider decreases with ascending channel number.
   - In transmission systems containing gaps in the frequency range (as in the case of television, for example), a channel table can comprise multiple ranges.

6.3 Using Transducer Factors

The frequency-dependent transducer factor of transducers and antennas can be directly considered in the measurement result. A transducer factor consists of a numeric value and a unit. The R&S Spectrum Rider corrects the level values of the trace by the values of the transducer. At the same time, the unit of the transducer is assigned to the level axis. When field-strength measurements are performed with the aid of antennas, for instance, the electrical field strength is directly indicated in dBµV/m on the R&S Spectrum Rider. A transducer factor can also be used to correct a frequency-dependent attenuation, e.g. of a cable between DUT and RF input of the R&S Spectrum Rider.

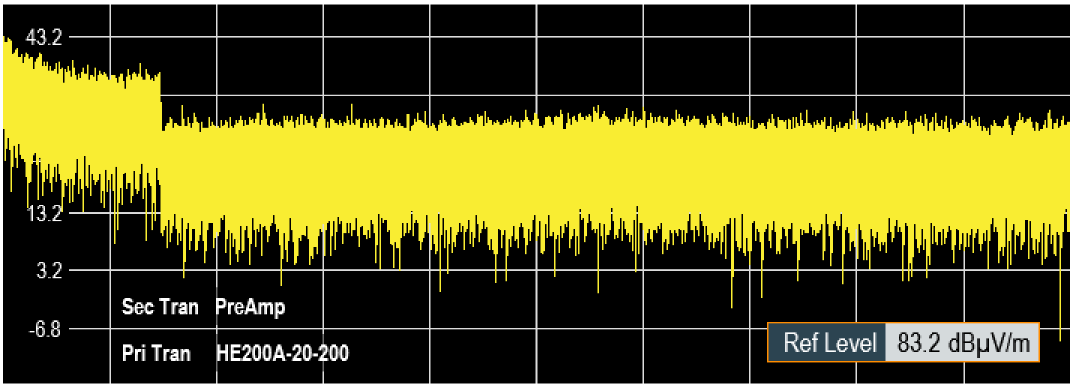


Figure 6-3: Transducer factors displayed

You can create and edit transducer factor with the R&S Instrument View software package and then transfer them into the internal memory of the R&S Spectrum Rider. Each transducer factor may consist of up to 1000 reference values.

For more information on transducer factors, see Chapter 4.8, "Managing Datasets", on page 96.

Interpolation between the values is performed with the aid of a modified spline algorithm. Even if only relatively few values such as maxima, minima and turning points are available, this algorithm can easily simulate the correction factors of common transducers. Two transducers can be switched on at a time. The second transducer must be assigned the unit dB. The R&S Spectrum Rider adds the two transducers to a total transducer.

Units supported for transducer factors:

- dB
- dBµV/m
- dBµA/m
- W/m2

The unit dB does not change the unit set on the R&S Spectrum Rider. It can be used, for instance, to compensate for frequency-dependent loss and gain at the input of the R&S Spectrum Rider. The units dBµV/m and dBµA/m convert the output power of an antenna into electric or magnetic field strength. The unit W/m2 is used to calculate and display the power flux density.

For example, to compensate for the cable loss between the transducer and the RF input, the R&S Spectrum Rider can use two transducers at the same time. One of them must have the unit dB, however, i.e. it must correspond to one loss or gain value.

1. Press the AMPT key.
2. Press the "Transducer" softkey.

Transducer factor availability

Transducer factors are not available for measurements with the Power Sensors. The "Transducer" softkey is therefore inactive.

You can select two transducer factors, a primary transducer and a secondary transducer. If a transducer factor is active, the checkbox next to the "Primary" or "Secondary" menu will be enabled.

1. Select the "Select Primary" menu item.
   The R&S Spectrum Rider opens the "File Manager" to select the transducer factor.
2. Select the transducer factor you need.
3. Confirm the selection with the "Load" softkey.
   The R&S Spectrum Rider shows the name of the active transducer on the display (e.g. "Sec Tran PreAmp, "Pri Tran HE200A-20-200").
   See Figure 6-3.

An example would be the transducer factor of the R&S HE200-A antenna that is defined between 200 MHz and 500 MHz. The R&S Spectrum Rider therefore displays the noise in this frequency range as a function of frequency incremented by the transducer factor. Outside the transducer range, the R&S Spectrum Rider sets the transducer factor at zero, i.e. measurements in this range do not yield conclusive results.

You can select a second transducer factor with the "Select Secondary" menu item. The secondary transducer factor in that case is added to the first. The unit of the second transducer factor must always be the relative unit dB as otherwise an addition would not be useful. When you select a secondary transducer factor, the dialog box shows only those transducer factors that have dB as their unit.

6.3.1 Unit for Measurements with Transducers

If the unit of the transducer is dB, the units dBm, dBmV or dBµV remain unchanged. The linear units Volt and Watt are not permissible. They are deactivated in the units menu.

If the unit of the transducer is dBµV/m or dBµA/m, this unit is also used for the R&S Spectrum Rider level display. This means that both the level axis of the diagram and the level at the marker position are assigned the unit of the transducer. If dBµV/m is selected as the transducer unit, a switch to absolute level indication in V/m is possible.

1. Press the AMPT key.
2. Press the "Unit" softkey.
3. Select the "V" menu item.
   If you are using a transducer with the unit dBµA/m, it is not possible to select another unit. Level indication is entirely in dBµA/m.

6.3.2 Setting the Reference Level

The transducer shifts the trace by its value as a function of frequency. Positive transducer values increase the level, negative values reduce it. To ensure that the trace is always within the diagram, the R&S Spectrum Rider adjusts the reference level accordingly. The reference level is shifted by the maximum transducer value in the positive or negative direction.

6.3.3 Frequency Range of Transducer

If the set frequency range is wider than the span in which a transducer is defined, the R&S Spectrum Rider assumes the transducer values outside the defined range to be zero.

6.3.4 Data Sets Containing Transducer Factors

The R&S Spectrum Rider stores data sets together with any transducer factors that may have been active for the measurement in question. When such a dataset is recalled, the associated transducer factor(s) are switched on as well. Transducer factors recalled as part of a data set do however not appear in the list of transducer factors.

7 Power Meter (R&S FPH-K9)

For highly accurate power measurements, you can connect a power sensor to the R&S Spectrum Rider and perform measurements.

7.1 Using a Power Sensor

A power sensor measures the power in the frequency range defined in the data sheet of the power sensor. This means that you can measure both sine signals and modulated signals precisely over a large dynamic range.

The R&S Spectrum Rider supports the following power sensors.

- R&S FSH-Z1[1]
- R&S FSH-Z18[1]
- R&S NRP-Z11
- R&S NRP-Z21
- R&S NRP-Z22
- R&S NRP-Z23
- R&S NRP-Z24
- R&S NRP-Z27
- R&S NRP-Z28
- R&S NRP-Z31
- R&S NRP-Z37
- R&S NRP-Z51
- R&S NRP-Z52
- R&S NRP-Z55
- R&S NRP-Z56
- R&S NRP-Z57
- R&S NRP-Z58
- R&S NRP-Z81[2]
- R&S NRP-Z85[2]
- R&S NRP-Z86[2]
- R&S NRP-Z91
- R&S NRP-Z92
- R&S NRP-Z96
- R&S NRP-Z98
- R&S NRP-Z211

[1] The FSH sensor do not have an USB connector, but binder adapter instead. The cable identified by FSH-Z144 (USB to binder adapter) is required to connect these sensors on the USB port. This is a RS232 to USB converter cable.

[2] Only these power sensors support the trace mode (power versus time display)

For more information on the characteristics of the supported power sensors see

- the datasheet of theR&S Spectrum Rider
- the website for R&S power sensors

http://www2.rohde-schwarz.com/en/products/test_and_measurement/power_volt_meter/NRPZ.html

The power sensor function turns the R&S Spectrum Rider into a wideband power meter. It then always measures the power of the whole signal in the frequency range of the power sensor. In most cases the signal shape has no effect on the measurement.

1. Press the MODE key.
2. Press the "Power Meter" softkey
   The R&S Spectrum Rider activates the mode for power measurements.

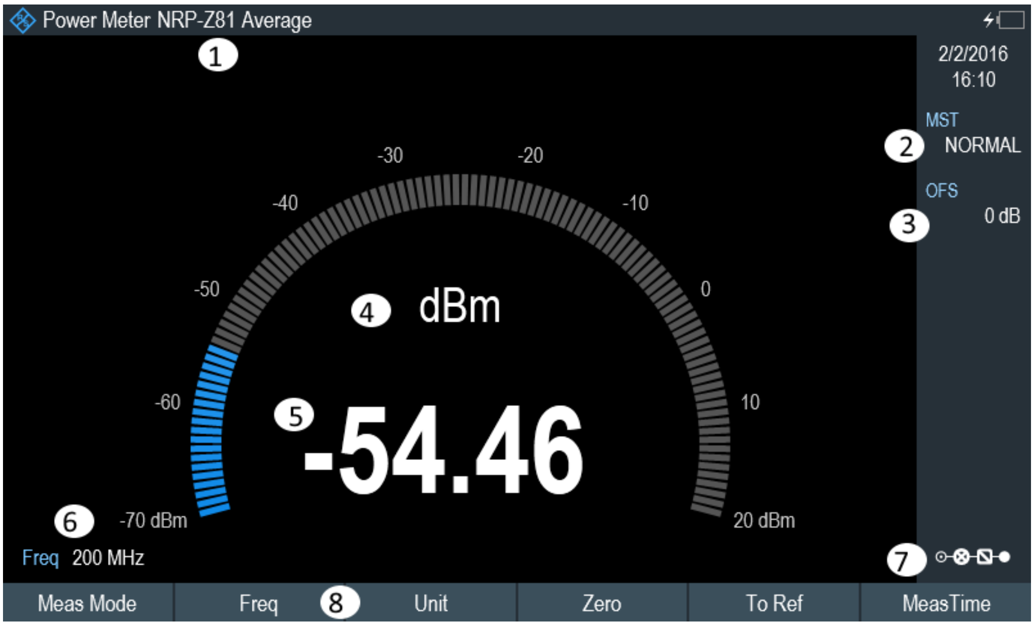


Figure 7-1: Screen layout of the power meter mode

1 = Connected power sensor model
2 = Measurement time
3 = Power offset
4 = Readout of the measured power
5 = Analog readout of the measured power
6 = Measurement frequency
7 = Configuration Overview
8 = Power sensor softkey menu

7.1.1 Connecting a Power Sensor

The R&S Spectrum Rider controls and powers the power sensors via the USB interface on the top of the instrument. See Chapter 3.2.2.4, "USB Port", on page 34.

If you are using the R&S FSH-Z1 and R&S-FSH-Z18 power sensors, connect the power sensor cable to the FSH-Z144 (USB to binder adapter) before connecting it to the USB interface of the R&S Spectrum Rider.

For the test setup of the power sensor , see "Test setup" on page 74.

After connecting the power sensor to the R&S Spectrum Rider, you can connect the DUT to the N-connector of the power sensor.

NOTICE

Risk of damage to the power sensor

Before you start to work with the power sensor, make sure that the continuous power applied to the input of the power sensor does not exceed a certain level.

Refer to the documentation of the power sensor for more information on the maximum input power.

If the R&S Spectrum Rider recognizes a power sensor, it sets up a connection via the interface and after a few seconds shows the measured power. It displays the type of the power sensor in the display header.

If no power sensor has been connected or it is not connected appropriately, the R&S Spectrum Rider shows nothing.

If there are communication problems between the R&S Spectrum Rider and the power sensor, the R&S Spectrum Rider displays one of the following error messages that indicate the possible cause.

Message	Cause	Remedy
Error in zeroing: signal at sensor	A signal was present at the power sensor when zeroing was performed.	Unscrew the power sensor from the device under test and repeat zeroing.
Warning: Input overloaded	The power at the input of the power sensor exceeds the permitted power (23 dBm = 200 mW).	Reduce the power at the sensor input.
Power sensor hardware error	Communication error between the R&S Spectrum Rider and the power sensor.	Unscrew the sensor from the R&S Spectrum Rider and check the connectors. If the problem persists, contact a Rohde & Schwarz service center.
Power sensor error	The power sensor signals an error to the R&S Spectrum Rider	Contact a Rohde & Schwarz service center.
Unknown power sensor model connected	The R&S Spectrum Rider cannot identify the device connected to the power sensor interface.	

7.1.2 Performing and Configuring Measurements

After you have connected a power sensor, the R&S Spectrum Rider immediately starts to measure the signal power.

Defining the center frequency

Power sensors have a memory containing correction values that are dependent on the frequency. Hence, measurement results are the most accurate for signals whose frequency you know.

Note that the R&S Spectrum Rider maintains the center frequency that you have set in another operating mode. In that case it uses that frequency as the power sensor frequency.

If you want to perform measurements on another known signal, you can change the power sensor frequency manually.

1. Press the "Freq" softkey.
   The R&S Spectrum Rider opens an input field to define the frequency opens.
2. Enter the frequency of the signal.
   The R&S Spectrum Rider transfers the new frequency to the power sensor which then corrects the measured power readings.

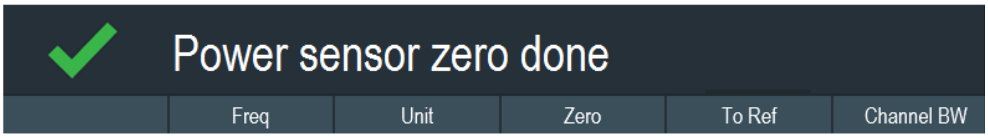
Zeroing the power sensor

Offset voltages and currents have most effect on the power readout when measuring low powers. You can compensate for these offsets by zeroing the power sensor.

Do not apply power during the zeroing process, as the power sensor cannot distinguish between external powers and internal offsets.

1. Press the "Zero" softkey.
2. The R&S Spectrum Rider asks you not to apply any signals to the power sensor during the zeroing process.
3. Disconnect the power sensor from any signal sources.
4. Press the "Continue" softkey to start zeroing.
5. Press "Cancel" to abort zeroing, for example, if you cannot disconnect the signal source.
   The R&S Spectrum Rider immediately starts power sensor zeroing.
   While zeroing is in progress, the R&S Spectrum Rider shows the message “Zeroing power sensor, please wait while the system is zeroing the power sensor”.

When zeroing is over, the R&S Spectrum Rider shows the message "✓ Power sensor zero done".



Selecting the unit for the power readout

The R&S Spectrum Rider can display measured power in relative units (dBm) or in absolute units (W, mW, μW, nW and ρW). It is also possible to set a reference level in dB.

1. Press the "Unit" softkey.
   A submenu to select the unit opens
2. Select the unit you want.
   The R&S Spectrum Rider adjusts the result display accordingly.

Setting the reference level

If you have selected the unit dB Rel, the R&S Spectrum Rider opens an input field to set the reference level. The R&S Spectrum Rider shows the currently set reference level in the diagram header.

1. Enter the reference level you want.
   Alternatively, you can set the current level readout as the reference level.
2. Press the "Reference" softkey.
   The R&S Spectrum Rider sets the current result as the reference level.
   It then displays the measured level relative to the reference level in dB. The unit is automatically set to dB Rel.

Setting the averaging time

The averaging time determines the length of the measurement. The longer the averaging time, the more stable the display, particularly if signals have low power or are noisy.

The averaging time is either "Short", "Normal" or "Long".

- A short measurement time provides stable and accurate results for stationary sine signals with high levels (> -40 dBm). It is also appropriate for measurements that require a high repetition rate.
- A normal measurement time increases the stability of results for signals with low levels or modulated signals.
- A long measurement time is appropriate for signals with very low power levels (<-50 dBm)

To eliminate noise and the effects of noise on the measurement effectively, use the R&S FSH-Z1 power sensor.

1. Press the "MT" softkey.
2. Select the measurement time most suitable for your test setup.

Taking additional loss or gain into account

At high powers that cause the power sensor maximum input level to be exceeded or at very low levels that are below the R&S Spectrum Rider minimum sensitivity, the R&S Spectrum Rider can take additional loss or gain between the DUT and the power sensor into account. These are defined in terms of an offset in dB relative to the measured level. A positive offset corresponds to a loss and a negative offset to a gain.

The R&S Spectrum Rider shows the current offset in the diagram header.

1. Press the AMPT key.
2. Press the "Ref Offset" softkey.
   The entry box for the reference offset opens.
3. Enter the required offset.
   The offset is taken into account in the power or level display.

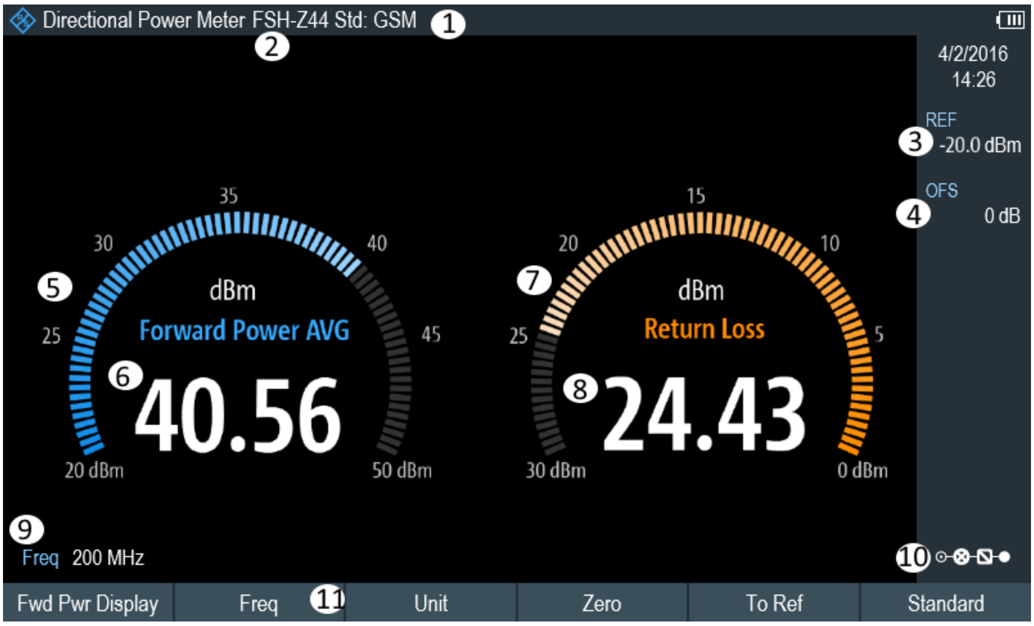
7.2 Using a Directional Power Sensor

For power measurements in both directions (forward and reverse), you can connect directional power sensors to the R&S Spectrum Rider. The R&S Spectrum Rider supports the following directional power sensors:

- R&S FSH-Z14
- R&S FSH-Z44

With a directional power sensor, the R&S Spectrum Rider measures the power of a signal from source to load (forward power) and from load to source (reverse power). The ratio of forward and reverse power is a measure of the load matching. The R&S Spectrum Rider displays the results as the return loss or the standing wave ratio.

1. Press the MODE key.
2. Press the "Power Meter" softkey
   The R&S Spectrum Rider activates the mode for power measurements.



1 = Selected transmission standard
2 = Connected power sensor model
3 = Reference for relative power measurements
4 = Power offset
5 = Readout of the forward power
6 = Analog readout of the forward power
7 = Readout of the matching value
8 = Analog readout of the matching value
9 = Measurement frequency
10 = Configuration Overview
11 = Directional power sensor "MEAS" softkey menu

7.2.1 Connecting a Directional Power Sensor

The R&S Spectrum Rider controls and powers the directional power sensors via a special interface on the top of the instrument.

Connect the power sensor cable via the USB to binder adapter to the USB port of R&S Spectrum Rider. The power sensor itself is located between the source and the load of the test setup.

For the test setup of the directional power sensor, see "Test setup" on page 77.

If the R&S Spectrum Rider recognizes a power sensor, it sets up a connection via the interface and after a few seconds shows the results. It displays the type of the power sensor in the display header. If an error occurs, the R&S Spectrum Rider shows a corresponding message.

For more information, see Chapter 7.1.1, "Connecting a Power Sensor", on page 151.

7.2.2 Performing and Configuring Measurements

After you have connected a power sensor, the R&S Spectrum Rider immediately starts to measure the signal power.

When measuring high powers, pay strict attention to the following instructions to avoid personal injury and to prevent the power sensor from being destroyed

CAUTION

Risk of skin burns and / or damage to the R&S Spectrum Rider

Measuring high powers may lead to skin burns and / or damage to the R&S Spectrum Rider. You can avoid it by:

- Never exceeding the permissible continuous power. The permissible continuous power is indicated on a diagram on the back of the power sensor.
- Turning off the RF power when connecting the power sensor.
- Connecting the RF connectors tightly.

Defining the center frequency

To get the most accurate results, you should synchronize the frequency to that of the signal.

Note that the R&S Spectrum Rider maintains the center frequency that you have set in another operating mode. In that case it uses that frequency as the power sensor frequency.

If you want to perform measurements on another known signal, you can change the power sensor frequency manually.

1. Press the "Freq" softkey.
   The R&S Spectrum Rider opens an input field to define the frequency opens.
2. Enter the frequency of the signal.
   The R&S Spectrum Rider transfers the new frequency to the power sensor which then corrects the measured power readings.

Zeroing the power sensor

For more information, see "Zeroing the power sensor" on page 152.

Setting the power measurement weighting mode

For forward power display, the R&S Spectrum Rider provides both average power and peak envelope power.

1. Press the MEAS key.
2. Press the "Fwrd Pwr Display" softkey.
3. Select the weighting mode you require.

The R&S Spectrum Rider indicates the weighting mode at the Forward Power heading.

- "Average" = average power
- "Peak Envelope" = peak envelope power

Selecting the unit for the power readout

When using a directional power sensor, the R&S Spectrum Rider displays the forward power as a logarithmic level value in dBm (relative value) or as a linear value in W or mW (absolute value). In addition you can define a reference level relative to which the R&S Spectrum Rider indicates the level difference in dB. Load matching is indicated as return loss in dB or as voltage standing wave ratio (VSWR). In addition, the absolutely reflected power can be displayed in W, or the reflected level in dBm.

For more information, see "Selecting the unit for the power readout" on page 153.

Setting the reference level

If you have selected the unit dB Rel for the forward power, the R&S Spectrum Rider opens an input field to set the reference level. The R&S Spectrum Rider shows the currently set reference level in the diagram header.

For more information, see "Setting the reference level" on page 153.

Selecting a standard

To ensure that true results are output when measuring modulated signals, theR&S Spectrum Rider offers the possibility of taking correction values into account for a number of common telecommunications standards.

1. Press the "Standard" softkey.
   A menu to select a standard opens.
2. Select the required standard.
   The R&S Spectrum Rider takes the selected standard into account. The currently active standard is displayed in the display header.

Taking additional attenuation into account

When the directional power sensor is connected to a test point not directly but via a cable, the influence of cable attenuation can be taken into account. For this purpose, the cable attenuation for the measurement frequency in question is to be entered, i.e. as a positive dB value if the power and matching are to be measured at the source and the cable is connected between the source and the power sensor, and as a negative dB value if the power and matching are to be measured at the load and the cable is connected between the load and the power sensor. The directional power sensor then corrects the power and matching values to produce the results that would have been obtained if it had been directly connected to the test point.

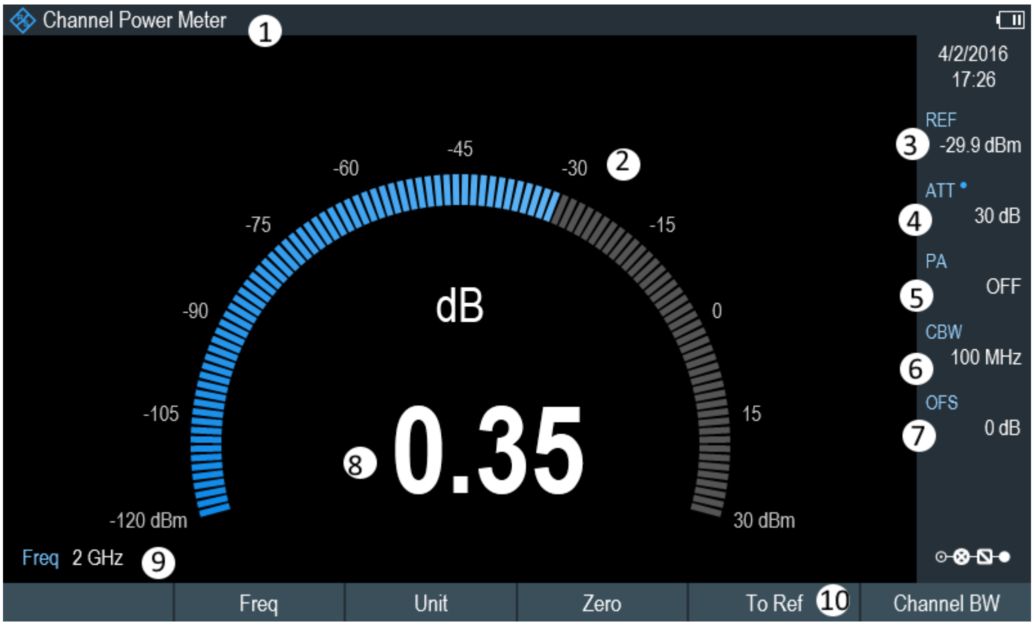
1. Press the "AMPT" key.
2. Press the "Ref Offset" softkey.

The R&S Spectrum Rider opens an input field to define the reference offset.

3. Enter the offset you need.
   The selected offset is displayed in the diagram header and is taken into account in the power (level) and matching results.
   If high powers are applied that exceed the maximum input level of the R&S FSH-Z14 or R&S FSH-Z44, a directional coupler or an attenuator has to be connected ahead of the power sensor. In such cases, the coupling attenuation of the directional coupler or the attenuation value of the attenuator are to be entered as positive dB values (see above) into the R&S Spectrum Rider to ensure true measured power readout. In both cases, a termination or an attenuator of sufficient power-handling capacity has to be connected to the power sensor at the load end. The matching readout is irrelevant in such case since it is likewise corrected by taking into account the attenuation value of the termination or attenuator.

8 Using the Internal Power Meter (R&S FPH-K19)

The R&S Spectrum Rider also supports power measurements without using a power sensor. In that case, you can connect the DUT directly to the R&S Spectrum Rider and still perform accurate channel power measurements.



1 = Channel Power Meter mode
2 = Readout of the measured power
3 = Reference for relative power measurements
4 = RF attenuation setting
5 = Preamplifier state
6 = Measurement channel bandwidth
7 = Power offset
8 = Analog readout of the measured power
9 = Measurement frequency
10 = Channel power softkey menu

Performing and configuring channel power measurements

The configuration of channel power measurements without a power sensor is similar to measurements with a power meter.

The following features are available:

- Defining the frequency
- Zeroing the measurement
- Selecting the unit
- Defining the reference level
- Taking additional loss or gain into account

For more information, see Chapter 7.1.2, "Performing and Configuring Measurements", on page 152.

Defining the channel bandwidth

In addition, you can select the channel bandwidth.

1. Press the MEAS key.
2. Press the "Channel BW" softkey.
   The R&S Spectrum Rider opens an input field to define the channel bandwidth.
3. Enter the required channel bandwidth.
   The R&S Spectrum Rider performs a measurement on the selected channel. Note that it is not possible to change the measurement time, resolution bandwidth and frequency span.

9 Performing Pulse Power Measurements (R&S FPH-K29)

When you equip the R&S Spectrum Rider with firmware option R&S FPH-K29, and connect one of the wideband power sensors available from Rohde & Schwarz (R&S NRP-Z81, -Z85 or -Z86), you can perform pulse power measurements with your R&S Spectrum Rider.

Like the normal power meter application, the pulse power application measures the power of the whole signal in the frequency range of the (wideband) power sensor.

- Connecting the power sensor
- Numerical result display
- Graphical result display (Power vs Time)

1. Press the MODE key.
2. Press the "Power Meter" softkey
   The R&S Spectrum Rider activates the mode for power measurements.

Connecting the power sensor

You can connect the wideband power sensors to the USB port of the R&S Spectrum Rider. For more information, see Chapter 7.1.1, "Connecting a Power Sensor", on page 151.

The measurement starts as soon as the power sensor is connected.

Numerical result display

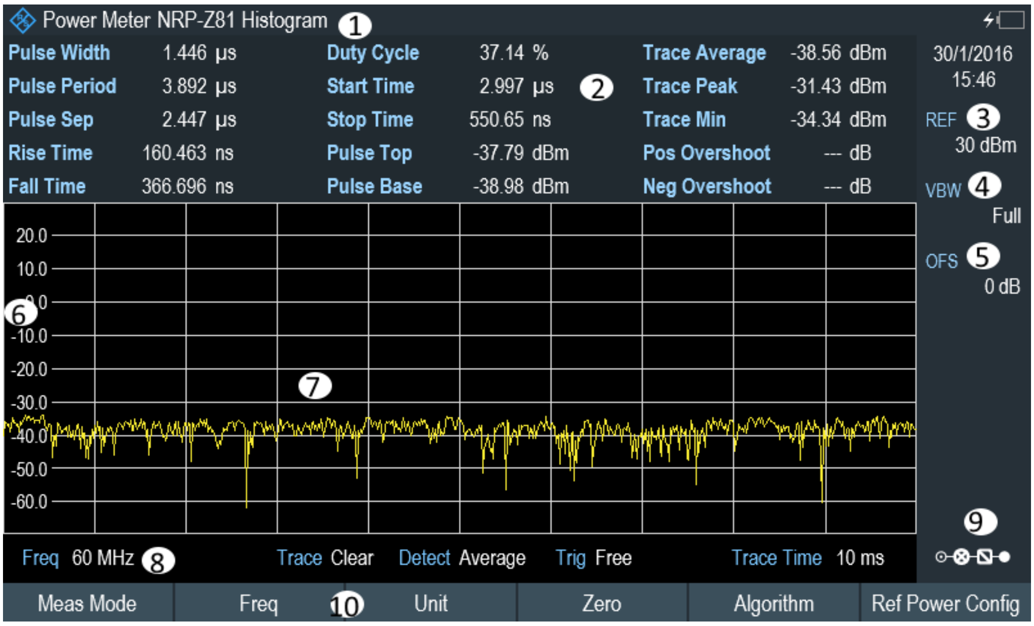
1. Press the MEAS key.
2. Press the "Meas Mode" softkey.
3. Select the "Average" menu item.

The layout and contents of the numerical result display are the same as those described in Using a Power Sensor.

Graphical result display (Power vs Time)

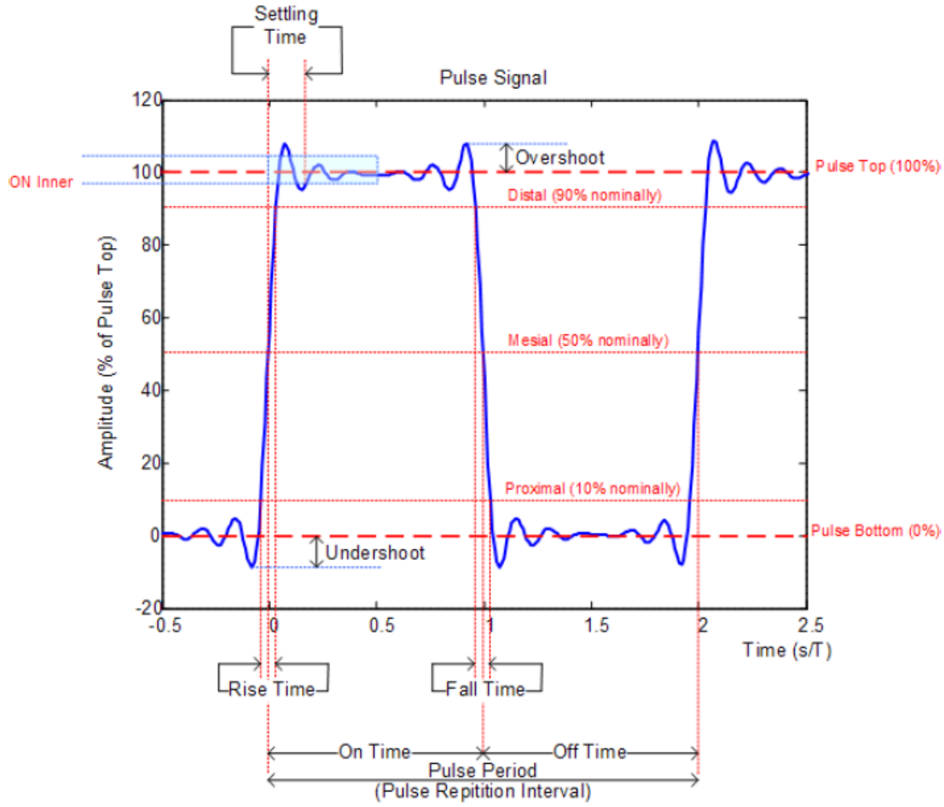
The graphical representation of the results is a special feature only available with the firmware option R&S FPH-K29.

1. Press the MEAS key.
2. Press the "Meas mode" softkey.
3. Select the "Power vs Time" menu item.



1 = Connected power sensor model and type of algorithm for power calculation
2 = Numerical results showing the pulse characteristics
3 = Reference for relative power measurements
4 = Power offset
5 = Video bandwidth
6 = Scale of the x-axis
7 = Diagram showing the pulse characteristics in a graphical format (trace display)
8 = Measurement frequency
9 = Configuration Overview
10 = Softkey menu of the pulse power measurement application

The following power characteristics are calculated and displayed as numerical values (see also the figure below for a graphical representation of the parameters).



Pulse characteristic	Description
Pulse Width	Time that the pulse remains at the top level ("ON"). This is the time between the first positive edge and the subsequent negative edge of the pulse in seconds, where the edges occur at crossings of the mid threshold.
Pulse Period	Time that is elapsing from the beginning of one pulse to the beginning of the next pulse.
Pulse Off Time	Time in the displayed trace that is not occupied by the pulse.
Rise Time	Time required for the pulse to transition from the base to the top level. This is the difference between the time at which the pulse exceeds the lower and upper thresholds.
Fall Time	Time required for the pulse to transition from the top to the base level. This is the difference between the time at which the pulse drops below the upper and lower thresholds.
Duty Cycle	Ratio of the "Pulse Width" to "Pulse Repetition Interval" expressed as a percentage (requires at least two measured pulses).
Start Time	Time offset, relative to the beginning of the trace (0 sec), where the pulse begins (start of the rise time).

Pulse characteristic	Description
Stop Time	Time offset, relative to the beginning of the trace (0 sec), where the pulse stops (end of the fall time).
Pulse Top	Median pulse ON power. The value of this parameter is used as a reference (100%) to determine other parameter values such as the rising / falling thresholds.
Pulse Base	Median pulse OFF power. The value of this parameter is used as a reference (0 %) to determine other parameter values such as the rising / falling thresholds.
Trace Avg	Average power of the signal displayed in the diagram.
Trace Peak	Maximum power of the signal displayed in the diagram.
Trace Min	Minimum power of the signal displayed in the diagram.
Positive Overshoot	Height of the local maximum after a rising edge, divided by the pulse amplitude. The result is a percentage of the pulse amplitude.
Negative Overshoot	Height of the local minimum after a rising edge, divided by the pulse amplitude. The result is a percentage of the pulse amplitude.

9.1 Configuring the Numerical Result Display

The functions available for the numerical result display are the same as those available for normal power sensor measurements.

For more information, see Chapter 7.1.2, "Performing and Configuring Measurements", on page 152.

9.2 Configuring the Power vs Time Result Display

The R&S Spectrum Rider allows you to configure several aspects of the Power vs Time result display and the way the pulse is measured.

9.2.1 Determining Pulse Characteristics

Selecting an algorithm for base and top power calculation

The R&S Spectrum Rider provides several methods (or algorithms) to calculate the base and top power of a pulse.

- "Histogram"
  Calculates the top and base power of the pulse by analyzing the histogram of the trace data. The level of the pulse top calculated by the mean value of all points representing the pulse top. Similarly the level of the pulse base is calculated by the points representing the pulse base.
  This algorithm is recommended for analyzing most of the pulse signals
- "Integration"
  Calculates the top power of the pulse by fitting a rectangle pulse of same energy into the pulse signal as a reference.
  This algorithm is recommended for modulated pulse signals or when the pulse energy must be taken into account, for example when you want to compare the measurement result with that of a thermal power sensor.
- "Peak"
  Assumes that the peak power of the pulse is also the top level of the pulse.

The top and base power are also the reference point for the calculation of pulse timing characteristics.

1. Press the MEAS key.
2. Press the "Algorithm" softkey.
3. Select the algorithm you prefer for your measurement.
   The R&S Spectrum Rider adjusts the results accordingly.

Defining reference levels for pulse timing calculation

To calculate pulse timing parameters, like the rise and fall time of the pulse, you have to define several reference levels. All reference levels are a percentage of the pulse amplitude, either expressed in terms of power (Watt) or voltage (Volt).

The "Low Reference Power" and "High Reference Power" are required to calculate the fall and rise times of the measured pulse. The "Low Reference Power" defines the level at the start of the rising edge and the level at the end of the falling edge of the pulse. The "High Reference Power" defines the level at end of the rising edge and the level at the start of the falling edge.

The "Reference Power" is required to calculate the pulse width, its start time and its stop time.

1. Press the MEAS key.
2. Press the "Ref Power Config" softkey.
3. Define the reference levels as required.

You can always reset the reference levels to their default value with the "Set to Default" menu item.

All the reference levels can be relative to the power or the voltage of the signal. Depending on this selection, different measurement points are being analyzed, so the results may be different.

1. Press the MEAS key.
2. Press the "Ref Power Config" softkey.
3. Select either the "Power" or the "Voltage" menu item as the reference.

9.2.2 Selecting the Video Bandwidth

When you are using a wideband power sensor, you can change the video bandwidth used for the measurement. The main effect of using a small video bandwidth is that it reduces the displayed inherent noise.

Using a small video bandwidth thus increases the measurement sensitivity and allows you to accurately determine the pulse peak power even for weak pulses. Reducing the video bandwidth also increases the trigger sensitivity of the power sensor.

Note however that the video bandwidth should not be smaller than the RF bandwidth of the measured signal. Otherwise, measurement results may become invalid.

9.2.3 Averaging Traces

Selecting the trace mode

The Power vs Time result display provides two trace modes.

- The "Clear / Write" mode overwrites the trace data after each measurement.
- The "Average" mode forms an average over several measurement and displays the data according to the selected detector.
  When you select this mode, you can define the number of measurements over which the trace data is calculated. When you select this mode, you can define the number of measurements over which the trace data is calculated.

1. Press the "Trace" softkey
2. Select the trace mode you prefer for the measurement.

Selecting the detector

When you are averaging traces, you can also select a detector. The detector defines the way the measured data is evaluated and which data is displayed.

In the Power vs Time result display, you can select the "Average" detector or the "Max Peak" detector. The "Average" detector displays the averaged measurement data, while the "Max Peak" detector displays the highest values that have been measured on each pixel.

1. Press the "Detect" softkey.
2. Select the detector you prefer.

9.2.4 Triggering Measurements

In its default state, the R&S Spectrum Rider starts a measurement on completion of the previous measurement ("Free Run" measurements).

However, you can also perform triggered measurements with the power sensor. When you choose to do so, the trigger event (the moment when the actual measurement starts) is either a rising slope in the signal or a falling slope ("Positive" or "Negative" trigger).

1. Press the SWEEP key.
2. Press the "Trigger" softkey.
3. Select either the "Positive" or "Negative" menu item.
   The R&S Spectrum Rider stops measuring the signal until a trigger event occurs.

In case of triggered measurements, you have to define a trigger level by which the signal must rise or fall in order to be recognized.

1. Press the SWEEP softkey.
2. Press the "Trigger" softkey.
3. Select either the "Trigger Level" menu item and define a trigger level.

In addition, you can define a trigger delay time. The trigger delay time defines a time that must pass after the trigger event has occurred before the measurement starts. A negative trigger delay time is called a pre-trigger.

1. Press the SWEEP softkey.
2. Press the "Trigger" softkey.
3. Select either the "Trigger Delay" menu item and define a delay time.
   When a trigger event occurs, the R&S Spectrum Rider takes the delay time into account when drawing the trace.

9.2.5 Selecting the Result Unit

In the pulse measurement application, the R&S R&S Spectrum Rider can display measured power in relative units (dBm) or in absolute units (W).

1. Press the AMPT key.

2. Press the "Unit" softkey.
3. Select the unit you prefer.
   The R&S Spectrum Rider adjusts the y-axis accordingly.

9.2.6 Scaling the Y-Axis

The functionality to scale the y-axis is similar to that of the Spectrum application.

For more information, see Chapter 6.1.3.2, "Setting a Display Range", on page 117.

9.2.7 Using Markers

The Power vs Time diagram supports markers. The functionality is similar to that of the Spectrum application.

For more information, see Chapter 6.1.7, "Using Markers", on page 131 (note that marker functions are not available in the "Power Meter" mode).

10 Analog Modulation (R&S FPH-K7)

The Analog Modulation measurement analyzes the AM or FM modulated signals and calculates the analog modulation parameters using the measurement results. Note that the measurement works properly only if you apply an amplitude or frequency modulated signal. The firmware option R&S FPH-K7 provides the necessary measurement functions to analyze amplitude and frequency modulated signals

The digital signal processing in the R&S Spectrum Rider is used for demodulating amplitude and frequency modulated signals. .

By sampling (digitization) already at the IF and digital down-conversion to the baseband (I/Q), the demodulator achieves maximum accuracy and temperature stability. There is no evidence of typical errors of an analog down-conversion and demodulation like AM to FM conversion and vice versa, deviation error, frequency response or frequency drift at DC coupling.

1. Press MODE key.
   The R&S Spectrum Rider opens the mode menu.
2. Select the "Analog Demod" softkey
   The R&S Spectrum Rider activates the mode for analog modulation.
   See index 1 of Figure 10-1.
3. Press the MEAS key.
   The R&S Spectrum Rider opens the analog modulation measurement menu.
   The measurements are performed in two analog modulation domain: "AM Domain" or "FM Domain" and the measurement readings are available in two different selection: "Mod Trace" and "Mod Summary".
4. Select the required analog modulation domain and measurement selection to view the measurement readings.
   The R&S Spectrum Rider displayed the respective analog modulation measurement. See examples in Figure 10-1

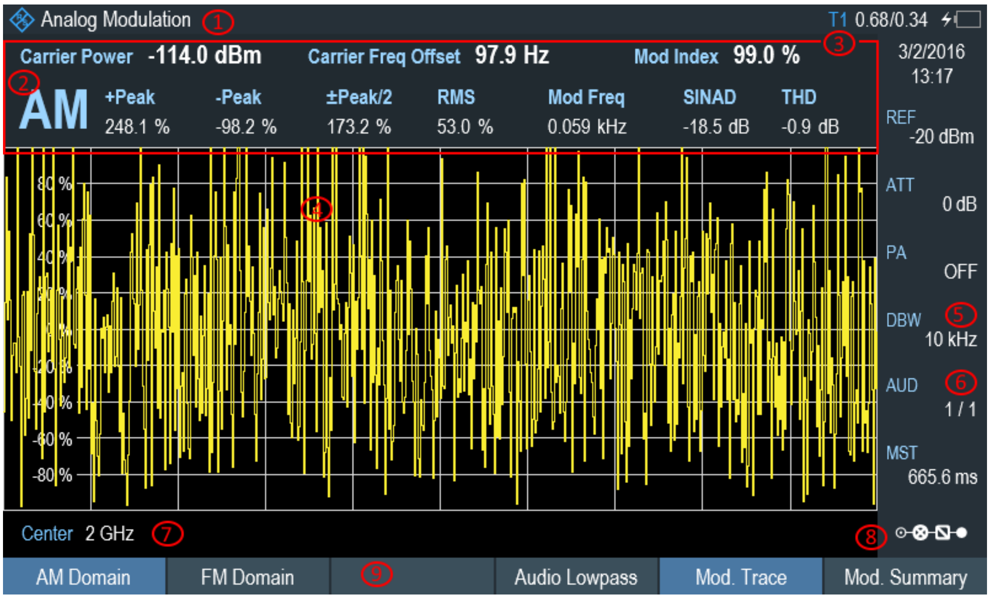


Figure 10-1: AM Domain

1 = Chapter 3.2.3.1, "Title Bar", on page 38
2 = AM or FM modulation
3 = Analog Modulation Parameters
4 = Modulation trace window
5 = Demodulation Bandwidth
6 = Measurement time
7 = Carrier frequency
8 = "Configuration Overview" on page 41
9 = Softkey menu of analog modulation measurement. See Chapter 10.3.1, "Analog Modulation", on page 175.

Figure 10-2: AM Summary

1 = Chapter 3.2.3.1, "Title Bar", on page 38
2 = AM or FM modulation
3 = Upper Limit
4 = Lower Limit
5 = "PASS" or "FAIL" result of the limit test
6 = Analog Modulation Parameters
7 = Demodulation Bandwidth
8 = Carrier frequency
9 = Measurement time
10 = "Configuration Overview" on page 41
11 = Softkey menu of analog modulation measurement. See Chapter 10.3.1, "Analog Modulation", on page 175.

The following analog modulation parameters are calculated:

Table 10-1: Analog Modulation Parameters

Label	Description
Carrier Power	Carrier Power
Carrier Freq Offset	Carrier Frequency Offset
Mod Index or Freq Deviation	Modulation depth for AM modulation or Frequency deviation for FM modulation
+Peak	Positive peak (maximum)
-Peak	Negative peak (minimum)
±Peak/2	Average of positive and negative peaks
RMS	Root Mean Square value
Mod Freq	Modulation frequency
SINAD	Signal-to-noise and distortion Measures the ratio of the total power to the power of noise and harmonic distortions. The noise and harmonic power is calculated inside the AF spectrum span. The DC offset is removed before the calculation. $SINAD[dB] = 20 \cdot \log\left[\frac{\text{total power}}{\text{noise} + \text{distortion power}}\right]$
THD	Total harmonic distortion Measures the ratio of the total power to the power of noise and harmonic distortions. The noise and harmonic power is calculated inside the AF spectrum span. The DC offset is removed before the calculation. $THD[dB] = 20 \cdot \log\left[\frac{\sqrt{\sum_{i=2}^{\infty} U_i^2}}{\sqrt{\sum_{i=1}^{\infty} U_i^2}}\right]$

10.1 Demodulation Bandwidth

The demodulation bandwidth is not the 3 dB bandwidth but the useful bandwidth which is distortion-free with regard to phase and amplitude. See Table 10-2.

Therefore the following formulas apply:

- AM: demodulation bandwidth ≥ 2 x modulating frequency
- FM (CARSON's rule): demodulation bandwidth ≥ 2 x (frequency deviation + highest modulating frequency)

If the center frequency of the analyzer is not set exactly to the signal frequency, the demodulation bandwidth must be selected larger by the carrier offset, in addition to the requirement described above.

In general, the demodulation bandwidth should be as narrow as possible to improve the S/N ratio. The residual FM caused by noise floor and phase noise increases dramatically with the bandwidth, especially with FM.

10.2 Sample Rate, Measurement Time and Audio Lowpass Filter

Depending on the sample rate, the maximum demodulation bandwidths listed in the Table 10-2 can be obtained during the measurement. The permissible value range of the measurement time depends on the selected demodulation bandwidth and audio lowpass filter.

Example: AM modulation with a modulating frequency of 1kHz

1. Calculate the required demodulation bandwidth
   Demodulation Bandwidth = 2 x 1 kHz
2. Select the minimum demodulation bandwidth from table Table 10-2.
   As a result, the demodulation bandwidth of "3000" is selected from the table. This shows that a minimum measurement time of 1.31 seconds is required to capture 3125 of sample rate
3. Select the appropriate audio lowpass filter from Table 10-3.
4. Depending on the sample rate and modulating frequency range, "DBW/1" is selected as the audio lowpass filter.
5. If a faster measurement time is desired, e.g. 6 ms, the audio lowpass, "DBW/10" should be selected to fulfill the requirement on the modulating frequency.

Table 10-2: Relationship on Demodulation Bandwidth, Sample Rate and Measurement Time

Demodulation Bandwidth <= (kHz), "Manual DBW"	Output Sample Rate	Measurement Time (ms), "MST"
2000000	2500000	1
989000	1250000	3
650000	964000	4
500000	625000	6
300000	391000	10
200000	250000	16
100000	125000	32
50000	62500	65
30000	36250	112
20000	25000	163
10000	12500	327
5000	6250	655
3000	3125	1310

Table 10-3: Selection of Audio Lowpass Filter

Selection of Audio Lowpass, DPD (Digital Predistortion) filter	Output Sample Rate	Modulating Frequency (Hz)	
		Maximum Frequency	Minimum Frequency
"DBW/1"	2500000	1000000	6100
	1250000	500000	3050
	964000	325000	2350
	625000	250000	1520
	391000	150000	950
	250000	100000	610
	125000	50000	300
	62500	25000	150
	36250	15000	80
	25000	10000	60
	12500	5000	30
	6250	2500	10
	3125	1500	0
"DBW/10"	250000	100000	60
	125000	50000	300

Selection of Audio Lowpass, DPD (Digital Predistortion) filter	Output Sample Rate	Modulating Frequency (Hz)	
		Maximum Frequency	Minimum Frequency
	96400	32500	230
	62500	25000	150
	39100	15000	90
	25000	10000	60
	12500	5000	30
	6250	2500	10
	3625	1500	0
	2500	1000	0
	1250	500	0
	625	250	0
	312	150	0
"DBW/30"	75757	30303	180
	37878	15152	90
	29212	9848	70
	18939	7576	40
	11848	4545	20
	7575	3030	10
	3787	1515	0
	1893	758	0
	1098	455	0
	757	303	0
	378	152	0
	189	76	0
	94	45	0
"DBW/100"	25000	10000	60
	12500	5000	30
	9640	3250	20
	6250	2500	10
	3910	1500	0
	2500	1000	0
	1250	500	0
	625	250	0

Selection of Audio Lowpass, DPD (Digital Predistortion) filter	Output Sample Rate	Modulating Frequency (Hz)	
		Maximum Frequency	Minimum Frequency
	362	150	0
	250	100	0
	125	50	0
	62	25	0
	31	15	0

10.3 Performing and Configuring Measurements

After the "Analog Modulation" mode is activated, the R&S Spectrum Rider immediately starts to measure the modulated signals.

10.3.1 Analog Modulation

The analog modulation is performed in the AM Domain or FM Domain and the measurement readings are selectable in the "Mod Trace" and "Mod Summary" setting.

- AM Domain
  Measurement is performed on the amplitude modulated signal monitors at the carrier frequency.
  - Modulation Trace
    Measurement is performed and displayed in the trace window.
  - Modulation Summary
    Measurement is performed and displayed in the summary window.
- FM Domain
  Measurement is performed on the frequency modulated signal monitors at the carrier frequency.
  - Modulation Trace
    Measurement is performed and displayed in the trace window.
  - Modulation Summary
    Measurement is performed and displayed in the summary window.

1. Press MEAS key.
   The R&S Spectrum Rider opens the analog modulation menu.
2. Select the required analog modulation domain ("AM Domain" or "FM Domain") and the required measurement setting ("Mod. Trace" or "Mod. Summary") softkey to perform the measurement.
   See index 9 of Figure 10-1.

10.3.2 Defining Frequency

The frequency defines the carrier frequency of the modulated signals.

Carrier Frequency

For more information, see Chapter 6.1.2.1, "Defining the Center Frequency", on page 113.

Carrier Frequency Step Size

For more information, see Chapter 6.1.2.2, "Defining a Frequency Step Size", on page 113.

10.3.3 Defining the Vertical Axis

Reference Level

For more information, see Chapter 6.1.3.1, "Setting the Reference Level", on page 116.

Modulation Depth

The vertical axis of the AM Domain displays the modulation depth of the amplitude modulated signal.

1. Press MEAS key.
2. Select the "AM Domain" softkey
3. Press AMPT key
4. Select the "Dev per Division".
   A drop-down menu to select the step interval on the modulation depth opens.
5. Select the required step interval on the modulation depth.

Frequency Deviation

The vertical axis of the FM Domain displays the frequency deviation of the frequency modulated signal.

1. Press MEAS key.
2. Select the "FM Domain" softkey
3. Press AMPT key
4. Press the "Dev per Division".
   A drop-down menu to select the step interval on the frequency deviation opens.
5. Select the required step interval on the frequency deviation.

Scale Adjustment

The scale adjustment is only available in the "FM Domain" of "Mod Trace" measurement.

1. Press BW key.
2. Select the "Scale Adjust" softkey.
   The R&S Spectrum Rider performs an auto adjustment on the vertical axis in the FM Domain of "Mod Trace" measurement.

RF Attenuation

For more information, see Chapter 6.1.3.5, "Setting the RF Attenuation", on page 118.

Preamplifier (R&S FPH-B22)

For more information, see Chapter 6.1.3.6, "Using the Preamplifier (R&S FPH-B22)", on page 120.

10.3.4 Defining Demodulation Bandwidth and Audio Lowpass Filter

Demodulation Bandwidth

The demodulation bandwidth defines the useful bandwidth used in the modulated signals.

1. Press BW key.
2. Select the "Manual DBW" softkey.
   A drop-down menu to select the demodulation bandwidth opens.
3. Select the required demodulation bandwidth.
   See Chapter 10.1, "Demodulation Bandwidth", on page 172 and Table 10-2.

Audio Lowpass

The "Audio Lowpass", a DPD (Digital Predistortion) designed filter is used to fine tuned the measurements demodulated signals.

1. Press MEAS key.
   The R&S Spectrum Rider opens the analog modulation measurement menu.
2. Select the required analog modulation domain, "AM Domain" or "FM Domain" softkey.
3. Select the "Audio Lowpass" softkey
   A drop-down menu to select the audio lowpass filter opens.
4. Select the required audio lowpass filter.
   See Table 10-3.

10.3.5 Defining FM Broadcast

Depending on the country specific requirements, it maybe necessary to suppress the display of higher frequency component of the modulation signal.

FM Broadcast

The FM broadcast is only enabled with the demodulation bandwidth setting at 200 kHz or 300 kHz.

1. Press BW key.
2. Select the "FM Broadcast" softkey.
   A drop-down menu to select the filter opens.
3. Select the required filter setting.

10.3.6 Limit Settings

The limit line available in the AM and FM summary measurement allows you to perform limit check on the measurements.

The limit line file is created using the "Ama AM Limits" or "Ama FM Limits" editor in the R&S Instrument View software package.

For information on the analog modulation limit line editor, see R&S Instrument View software manual

1. Press LINES key.
2. Select the "Select Limits" softkey.
   The R&S Spectrum Rider opens the "File Manager" dialog to select the limit line file.
3. Select the required limit line file from the file manager.
   Note: The limit line is edited using the Ama AM or FM limit line editor from R&S Instrument View software package.
4. Select the the "Load" softkey.
   The R&S Spectrum Rider activates and loads the limit line values in the table.
   See Figure 10-2.
5. Select the "Audio Beep" to turn on or off the acoustic audio signal for the limit line check status.
   See index 5 of Figure 10-2.
   See also "Audio signal" on page 144.
6. Select the "Clear Limits" to unload the limit line file.

11 Remote Commands

The commands required to perform measurements in the Spectrum application in a remote environment are described here.

11.1 Interfaces and Protocols

The R&S Spectrum Rider supports two different interfaces for remote control.

- LAN Interface: The protocol is based on TCP/IP and supports the VXI-11 standard
- USB Interface

The connectors are located at the side of the instrument and permit a connection to a controller for remote control via a local area network (LAN) or directly via USB.

SCPI

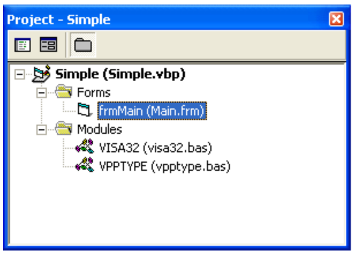
SCPI (Standard Commands for Programmable Instruments) commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

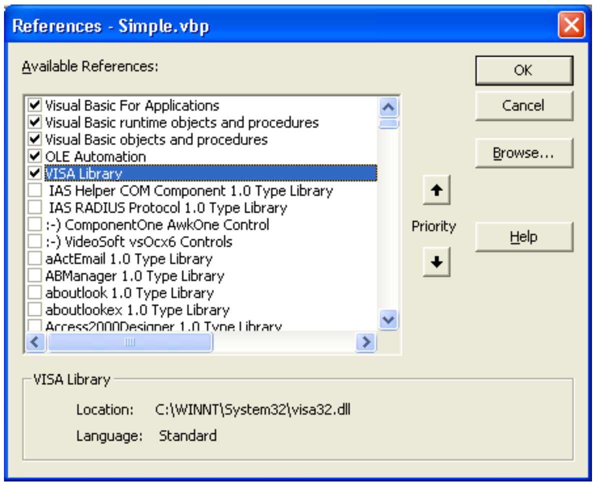
The requirements that the SCPI standard places on command syntax, error handling and configuration of the status registers are explained in detail in the following sections. Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

VISA

VISA is a standardized software interface library providing input and output functions to communicate with instruments. The I/O channel (LAN or USB) is selected at initialization time by means of a channel-specific resource string. For more information about VISA refer to its user documentation.

The programming examples for remote control are all written in Microsoft® VISUAL BASIC®. Access to the VISA functions require the declaration of the functions and constants prior to their use in the project. This can be accomplished either by adding the modules VISA32.BAS and VPPTYPE.BAS or a reference to the VISA32.DLL to the project.





The modules visa32.bas and vpptype.bas can be found in the following location:

<VXIpnpPath>\WinNT\Include (typically C:\VXIpnp\WinNt\Include).

Resetting the R&S Spectrum Rider

Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the device status. Therefore, control programs should always define an initial device status (e.g. with the command *RST) and then implement the required settings.

11.1.1 LAN Interface

To be integrated in a LAN, the instrument is equipped with a standard LAN interface, consisting of a connector, a network interface and protocols (VXI-11).

Instrument access via VXI-11 is usually achieved from high level programming platforms by using VISA as an intermediate abstraction layer. VISA encapsulates the low level VXI-11 (LAN) or USB function calls and thus makes the transport interface transparent for the user. The necessary VISA library is available as a separate product. For details contact your local R&S sales representative.

11.1.2 USB Interface

For remote control via the USB connection, the PC and the instrument must be connected via the USB interface. The required driver comes with the R&S Instrument View software package and is automatically installed on the PC with the software package.

The driver addressed the instrument via the USB interface with the fix IP address 172.16.10.10.

In addition, a remote control connection via the SCPI interface requires the VISA library to be installed on the PC.

11.1.3 Protocols

VXI-11 Basics

The VXI-11 standard is based on the ONC-RPC 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.

Remote control of an instrument via a network is based on standardized protocols which follow the OSI reference model (see Fig. below).

Application	SCPI
Presentation	XDR (VXI-11)
Session	ONC-RPC
Transport	TCP / UDP
Network	IP
Data Link	Ethernet/802.3
Physical	802.3/10BASE-T

Figure 11-1: Example for LAN remote control based on the OSI reference model

Based on TCP/UDP, messages between the controller and the instrument are exchanged via open network computing (ONC) - remote procedure calls (RPC). With XDR (VXI-11), legal RPC messages are known as VXI-11 standard. Based on this standard, messages are exchanged between the controller and the instrument. The messages are identical with SCPI commands. They can be organized in four groups:

- program messages (control command to the instrument)
- response messages (values returned by the instrument)
- service request (spontaneous queries of the instrument)
- low-level control messages (interface messages).

A VXI-11 link between a controller and an instrument uses three channels: core, abort and interrupt channel. Instrument control is mainly performed on the core channel (program, response and low-level control messages). The abort channel is used for immediate abort of the core channel; the interrupt channel transmits spontaneous service requests of the instrument. Link setup itself is very complex. For more details refer to the VXI-11 specification.

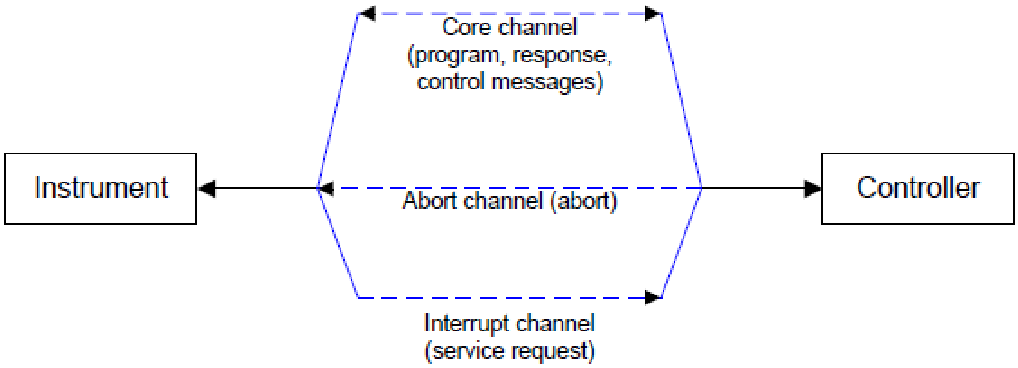


Figure 11-2: VXI-11 channels between instrument and controller

The number of controllers that can address an instrument is practically unlimited in the network. In the instrument, the individual controllers are clearly distinguished. This distinction continues up to the application level in the controller, i.e. two applications on a computer are identified by the instrument as two different controllers.

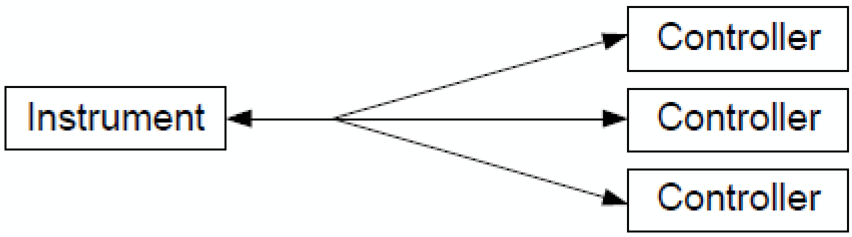


Figure 11-3: Remote control via LAN from several controllers

The controllers can lock and unlock the instrument for exclusive access. This regulates access to the instrument of several controllers.

11.2 Setting Up the Remote Control Connection

11.2.1 Preparing for Remote Control

The short and simple operating sequence below shows how to put the instrument into operation and quickly set its basic functions. The current IP address for LAN operation is shown in the SETUP – Instrument Setup Menu. In case of USB connection the IP address is fixed to 172.16.10.10.

Refer Chapter 3.2.8, "Connecting the R&S Spectrum Rider to a PC", on page 61 for instructions on how to change the IP address.

- Connect the instrument to the LAN or directly to the controller via USB.
- Switch on the instruments.
- Write and start the following program on the controller:

– `status = viOpenDefaultRM(defaultRM)`
  'open default resource manager
– `status = viOpen(DefaultRM, "TCPIP::172.16.10.10", 0, 0, vi)`
  'in case of USB connection
– `status = viopen(DefaultRM, "TCPIP::xxx.xxx.xxx.xxx", 0, 0, vi)`
  'in case of a LAN connection, with xxx.xxx.xxx.xxx = IP address
– `cmd = "*RST;*CLS"`
– `status = viWrite(vi, Cmd, Len(Cmd), retCount)`
  'reset instrument and clear status registers
– `cmd = "FREQ:CENT 100MHz"`
– `status = viWrite(vi, Cmd, Len(Cmd), retCount)`
  'set center frequency to 100 MHz
– `cmd = "FREQ:SPAN 10MHz"`
– `status = viWrite(vi, Cmd, Len(Cmd), retCount)`
  'set span to 10 MHz
– `cmd = "DISP:TRAC:Y:RLEV -10dBm"`
– `status = viWrite(vi, Cmd, Len(Cmd), retCount)`
  'set reference level to -10 dBm
– `viclose vi`
– `viclose default RM`

The instrument now performs a sweep in the frequency range of 95 MHz to 105 MHz.

Changing the IP Address

In order to operate the instrument via remote control, it must be accessed via LAN (IP address) or USB (fixed IP address). If the factory-set remote control address does not fit in the network environment, it can be changed.

Refer Chapter 3.2.8, "Connecting the R&S Spectrum Rider to a PC", on page 61 for instructions on how to change the IP address.

11.3 Instrument Model and Command Processing

The block diagram in Figure 11-4 shows how SCPI commands are serviced in the instrument. The individual components work independently and simultaneously. They communicate with each other by means of so-called "messages".

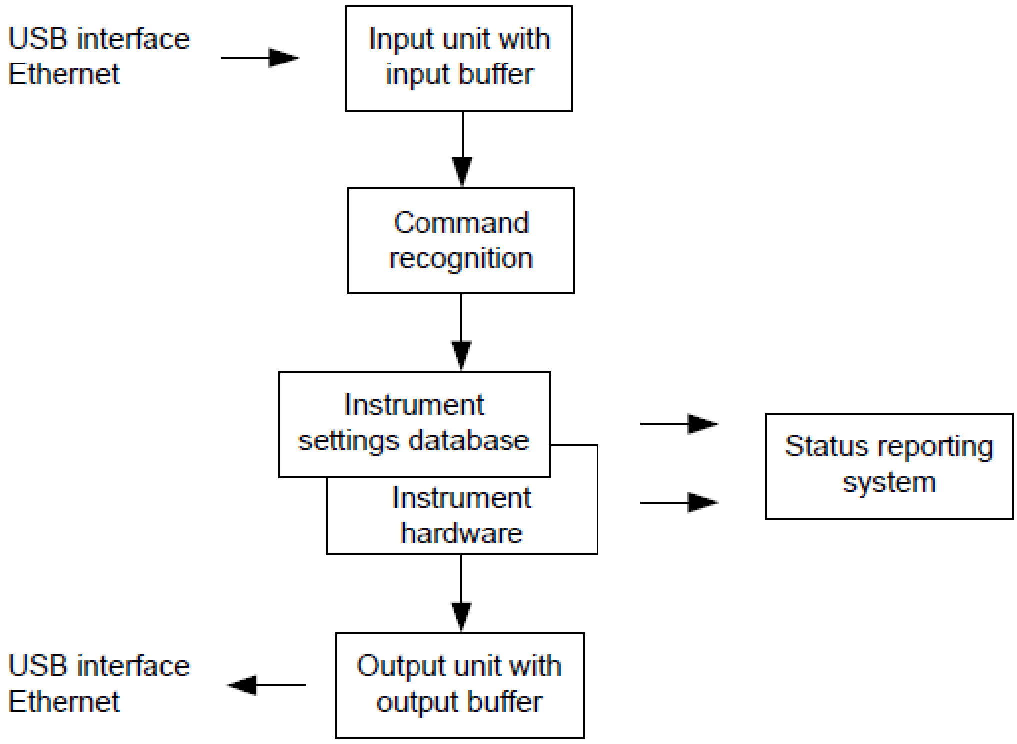


Figure 11-4: Instrument model in the case of remote control

11.3.1 Input Unit

The input unit receives commands character by character from the controller and collects them in the input buffer. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.

If the input buffer is full, the traffic is stopped and the data received up to then are processed. Subsequently the traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of DCL clears the input buffer and immediately resets the command recognition.

11.3.2 Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only DCL is serviced with priority, for example GET (Group Execute Trigger) is only executed after the commands received before. Each recognized command is immediately transferred to the internal instrument settings data base but not executed immediately.

The command recognition detects syntax errors in the commands and transfers them to the status reporting system. The rest of a program message after a syntax error is analyzed further if possible and serviced. After the syntax test, the value range of the parameter is checked, if required.

If the command recognition detects a delimiter, it passes the command to an execution unit that performs the instrument settings. In the meantime, the command recognition is ready to process new commands (overlapping execution). A DCL command is processed in the same way.

11.3.3 Data Base and Instrument Hardware

Here the expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included. The term "data base" denotes a database that manages all the parameters and associated settings required for setting the instrument hardware.

Setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, only passes them on to the hardware when requested by the command recognition. This only takes place at the end of a program message.

The data are checked for compatibility with the current instrument settings before they are transmitted to the instrument hardware. If the execution is not possible, an "execution error" is signaled to the status reporting system. The corresponding settings are discarded.

Before passing on the data to the hardware, the settling bit in the STATus:OPERation register is set (refer to section "STATus:OPERation Register" on page 285). The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

Queries induce the data set management to send the desired data to the output unit.

11.3.4 Status Reporting System

For detailed information, refer to Status Reporting System.

11.3.5 Output Unit

The output unit collects the information requested by the controller, which it receives from the data base management. It processes it according to the SCPI rules and makes it available in the output buffer.

If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data base management, the output unit sends error message

"Query UNTERMINATED" to the status reporting system. No data are sent to the controller, the controller waits until it has reached its time limit. This behavior is defined by IEEE 488.2 and SCPI.

11.4 SCPI Command Structure and Syntax

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure.

SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see Chapter 11.4.4, "Responses to Queries", on page 194).

Remote command examples

Not all commands used in the following examples are implemented in the instrument.

11.4.1 Structure of a Command

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

11.4.1.1 Common Commands

Common commands consist of a header preceded by an asterisk "*" and one or several parameters, if any.

Table 11-1: Examples

Command	Operation	Description
`*RST`	RESET	Resets the device.
`*ESE 253`	EVENT STATUS ENABLE	Sets the bits of the EVENT STATUS ENABLE register.
`*ESR?`	EVENT STATUS QUERY	Queries the contents of the EVENT STATUS register.

11.4.1.2 Device-Specific Commands

Hierarchy

Device-specific commands are of hierarchical structure. The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example:

`SENSe`

This key word denotes the `SENSe` command system.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example:

`SENSe:FREQuency:SPAN 10MHZ`

This command lies in the third level of the `SENSe` system. It sets the frequency span.

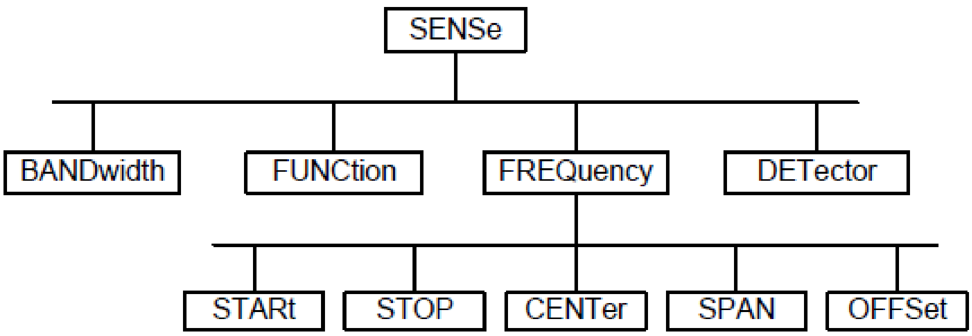


Figure 11-5: Tree structure the SCPI command systems using the SENSe system as example

Multiple keywords

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, i.e. at which position in the header of a command they are inserted.

Example:

`SOURce:FM:POLarity NORMal`

This command contains key word `POLarity` in the third command level. It defines the polarity between modulator and modulation signal.

Example:

`SOURce:FM:EXTernal:POLarity NORMal`

This command contains key word `POLarity` in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

Optional Keywords

Some command systems permit certain key words to be inserted into the header or omitted. These key words are marked by square brackets in the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example:

`[SENSe]:BANDwidth[:RESolution]:AUTO`

This command couples the resolution bandwidth of the instrument to other parameters. The following command has the same effect:

`BANDwidth:AUTO`

Optional keywords with numeric suffixes

Do not omit an optional keyword if it includes a numeric suffix that is relevant for the effect of the command.

Example:

`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.

Long and Short Form

The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permitted.

Example:

`STATus:QUEStionable:ENABle 1`

is equivalent to

`STAT:QUES:ENAB 1`

Upper and lower case notation of commands

Upper-case and lower-case notation only serves to distinguish the two forms in the manual, the instrument itself does not distinguish upper-case and lower-case letters.

Parameter

The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. Refer to Chapter 11.4.2, "Parameters", on page 191 for a detailed description of the various parameters.

Example:

`SENSe:FREQuency:STOP? MAXimum`

Response: 3.5E9

This query requests the maximal value for the stop frequency.

Special Characters

- **Vertical stroke |**
  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

  – `DISPlay:FORMat SINGle | SPLit`
    If parameter `SINGle` is selected, full screen is displayed, in the case of SPLit, split screen is displayed.
    A selection of key words with an identical effect exists for several commands. These keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.
  – `SENSe:BANDwidth|BWIDth[:RESolution]`
    The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1 kHz:
    `SENSe:BAND 1`
    `SENSe:BWID 1`
- **Square Brackets [ ]**
  Key words in square brackets can be omitted when composing the header. The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.

Example

– [SENSe:]BANDwidth|BWIDth[:RESolution] or SENS:BAND:RES
  is equivalent to
  BAND
  Parameters in square brackets can be incorporated optionally in the command or omitted as well
– MMEMory:NETWork:MAP<string>,<string>[,<string>,<string>,<boolean>]
  Entries in square brackets are optional or can be omitted.

- **Braces { }**
  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

Numeric Suffix

If a device features several functions or features of the same kind, e.g. inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1. Optional keywords must be specified if they select a function with the suffix.

Example:

SYSTem:COMMunicate:SERial2:BAUD 9600

This command sets the baud rate of a second serial interface.

Suffix counting

In case of remote control, suffix counting may differ from the numbers of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. With GSM, for instance, slots are counted from 0 to 7. In the case of remote control, the slots are selected with the suffixes 1 to 8. If the numbering differs in manual operation and remote control, it is indicated with the respective command.

11.4.1.3 Overview of Syntax Elements

The following table offers an overview of the syntax elements.

Syntax Element	Description
:	The colon separates the key words of a command. In a program message the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands within a program message. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
"	Quotation marks introduce a string and terminate it.
#	The hash symbol # introduces binary, octal, hexadecimal and block data. ● Binary: #B10110 ● Octal: #O7612 ● Hexa: #HF3A7
" "	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

11.4.2 Parameters

For most commands a parameter needs to be supplemented. The parameter has to be separated from the header by a "white space".

The type of parameter required for each command and the allowed range of values are specified in the command description.

11.4.2.1 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 permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also possible), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example:

`SENSe:FREQuency:STOP 1.5GHz` = `SENSe:FREQuency:STOP 1.5E9`

11.4.2.2 Special Numeric Values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numeric values. In case of a query, the numeric value is returned.

- 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 numerical 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) Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device response.
- NAN
  Not A Number (NAN) represents the value 9.91E37. NAN is only sent as device 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:FREQuency:STOP MAXimum`

Query: `SENSe:FREQuency:STOP?, Response: 3.5E9`

11.4.2.3 Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. The numerical values are provided as response for query.

Example:

Setting command: `CALCulate:MARKer:STATe ON`

Query: `CALCulate:MARKer:STATe?, Response: 1`

11.4.2.4 Text

Text parameters observe the syntactic rules for key words, 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: `INPut:COUPling GROund`

Query: `INPut:COUPling?, Response: GRO`

11.4.2.5 Strings

Strings must always be entered in quotation marks (' or ").

Example:

`SYSTem:LANGuage "SCPI"` or `SYSTem:LANGuage 'SCPI'`

11.4.2.6 Block Data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

`HEADer:HEADer #45168xxxxxxxx`

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.

11.4.3 Structure of a Program Message

A program message may consist of one or several commands. It is terminated by the program message terminator which is the NL (New Line) character for LAN and USB connections.

Several commands in a program message must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon. A colon ":" at the beginning of a command marks the root node of the command tree.

Example:

```
CALL InstrWrite(analyzer, "SENSe:FREQuency:CENTer 100MHz;:INPut:
ATTenuation 10")
```

This program message contains two commands. The first one is part of the SENSe command system and is used to determine the center frequency of the instrument. The second one is part of the INPut command system and sets the input signal attenuation.

If the successive commands belong to the same system, having one or several levels in common, the program message can be abbreviated. For that purpose, 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:

`CALL InstrWrite(analyzer, "SENSe:FREQuency:STARt 1E6;:SENSe:FREQuency:STOP 1E9")`

This program message is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SENSe command system, subsystem FREQuency, i.e. they have two common levels.

When abbreviating the program message, the second command begins with the level below SENSe:FREQuency. The colon after the semicolon is omitted. The abbreviated form of the program message reads as follows:

`CALL InstrWrite(analyzer, "SENSe:FREQuency:STARt 1E6;STOP 1E9")`

However, a new program message always begins with the complete path.

Example:

```
CALL InstrWrite(analyzer, "SENSe:FREQuency:STARt 1E6")
CALL InstrWrite(analyzer, "SENSe:FREQuency:STOP 1E9")
```

11.4.4 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 header.
  Example
  `INPut:COUPling?`
  Response: `DC`
- Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
  Example
  `SENSe:FREQuency:STOP? MAX`
  Response: `3.5E9`
- Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
  Example
  `SENSe:FREQuency:CENTer?`
  Response: `1E6` (for 1 MHz)
- Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).
  Example
  `SENSe:BANDwidth:AUTO?`
  Response: `1` (for ON)
- Text (character data) is returned in a short form.
  Example
  `SYSTem:COMMunicate:SERial:CONTrol:RTS?`
  Response: `STAN` (for standard)

11.5 Command Sequence and Command Synchronization

What has been said above makes clear that all commands can potentially be carried out overlapping. In order to prevent an overlapping execution of commands, one of the commands `*OPC, *OPC? or *WAI` must be used. All three commands cause a certain action only to be carried out after the hardware has been set. By suitable programming, the controller can be forced to wait for the respective action to occur.

For more information, see Table 11-2

Table 11-2: Synchronization using *OPC, *OPC? and *WAI

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending `*OPC?` directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before `*WAI` have been executed.	Sending `*WAI` directly after the command whose processing should be terminated before other commands are executed.

For a couple of commands the synchronization to the end of command execution is mandatory in order to obtain the desired result. The affected commands require either more than one measurement in order to accomplish the desired instrument setting (e.g. auto range functions), or they require a longer period of time for execution. If a new command is received during execution of the corresponding function this may either lead to either to an aborted measurement or to incorrect measurement data.

The following list includes the commands, for which a synchronization via `*OPC, *OPC? or *WAI` is mandatory:

Table 11-3: Commands with mandatory synchronization (overlapping commands)

Command	Purpose
`INIT`	start measurement (sweep)
`INIT:CONT OFF`	Set to single sweep
`CALC:MARK:FUNC:xx?`	All Marker function queries

11.6 Remote Control - Commands

The following chapters provide a detailed description of all the remote control commands currently available for the R&S Spectrum Rider and its firmware options.

Each section describes the commands for one of the operating modes available in the R&S Spectrum Rider, beginning with the description of common commands required to operate the instrument. The structure is based on that of the R&S Spectrum Rider user manual.

- Chapter 11.6.1, "Common Commands", on page 197
- Chapter 11.6.2, "Remote Commands of the Spectrum Analyzer", on page 200
- Chapter 11.6.3, "Remote Commands of the Analog Modulation", on page 242
- Chapter 11.6.4, "Remote Commands of the Power Meter", on page 250

Each section is subdivided into various tasks required to perform measurements with the R&S Spectrum Rider, also based on the structure of the R&S Spectrum Rider user manual. Some commands like those for controlling markers or configuring the frequency axis are available for all operating modes. In that case you will find a list of these commands in the corresponding section.

Availability of commands

The spectrum modes are implemented in the basic unit. For the other modes, the corresponding options are required.

Following the remote control commands required to perform specific measurements, you will find a description of general commands used to set up and control basic instrument functions. These commands are independent of the operating mode. Therefore they are listed separately.

- Chapter 11.6.5, "File Management", on page 255
- Chapter 11.6.6, "Making and Storing Screenshots", on page 261
- Chapter 11.6.7, "Configuring Data Capture", on page 262
- Chapter 11.6.8, "Saving Events", on page 264
- Chapter 11.6.9, "Configuring the Instrument", on page 266
- Chapter 11.6.10, "Status Reporting System", on page 280

All chapters begin with a list of commands available in the context of that chapter. Following that list you will find a detailed description of all the commands.

All individual descriptions contain:

- complete notation and syntax of the command
- description of the effects of the command
- a list of all parameters available for that command or the type of data the command returns in case of query commands
- an example of how a program message would look like
- the `*RST` value

An alphabetical list of all available commands is provided at the end of this manual.

11.6.1 Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. A particular command has the same effect on different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Some of the common commands refer to the Chapter 11.6.10, "Status Reporting System", on page 280.

List of 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,FPH,1321.1111.02/100001,V2.21`

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 all installed and activated options, separated by commas, where:
B<number> describes hardware options
K<number> describes software options

Example: B3,K0,K7,K9

Usage: Query only

***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

***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.

`*TRG` corresponds to the `INITiate:IMMediate` command.

Usage: Event

***TST?**

Self-test query

Initiates self-tests of the instrument and returns an error code

Note: If you start a self-test remotely, then select the "Local" softkey while the test is still running, the instrument only returns to the manual operation state after the test is completed. In this case, the self-test cannot be aborted.

Return values:

<ErrorCode> **integer > 0 (in decimal format)**
An error occurred.

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

11.6.2 Remote Commands of the Spectrum Analyzer

This section provides a detailed description of all remote control commands required to configure and perform measurements with the spectrum analyzer. These commands are available in spectrum analyzer mode only.

11.6.2.1 Configuring the Horizontal Axis

The following commands configure the horizontal (frequency) axis of the active display.

List of commands

- `[SENSe:]FREQuency:SPAN` on page 203
- `[SENSe:]FREQuency:SPAN:AUTO` on page 203
- `[SENSe:]FREQuency:SPAN:FULL` on page 203
- `[SENSe:]FREQuency:STARt` on page 203
- `[SENSe:]FREQuency:STOP` on page 204

[SENSe:]FREQuency:CENTer <CenterFrequency>

This command defines the center frequency of the R&S Spectrum Rider.

In spectrum analyzer mode, the command also defines the measuring frequency for time domain measurements (span = 0).

Parameters:

<CenterFrequency> Range: Depends on the operating mode and is specified in the data sheet.
*RST: fmax /2 with fmax = maximum frequency
Default unit: MHz

Example: `FREQ:CENT 100MHz`
Defines a center frequency of 100 MHz.

[SENSe:]FREQuency:CENTer:STEP <Stepsize>

This command defines the center frequency step size.

Parameters:

<Stepsize> Range: 1 Hz to fmax
*RST: - (AUTO 0.1*SPAN is switched on)
Default unit: MHz

Example: `FREQ:CENT:STEP 120MHz`
Defines a CF step size of 120 MHz.

[SENSe:]FREQuency:CENTer:STEP:LINK <CouplingState>

This command couples and decouples the center frequency step size to the span.

For time domain measurements, the command couples the step size to the resolution bandwidth.

Parameters:

<CouplingState> CENTerf | DIVTen | OFF

CENTerf
Sets the step size equal to the center frequency.

DIVTen
Couples the step size to the span (10 %).

OFF
Turns the coupling off (manual step size).

*RST: DIVTen

Example: `FREQ:CENT:STEP:LINK DIVT`
Couples the step size to 10% of the span.

[SENSe:]FREQuency:INPut:MODE <InputMode>

This command selects the frequency mode. Select the Channel frequency mode only if you want to work with channel tables. In this case, the input of the center frequency is not a frequency value, but a channel number.

Parameters:

<InputMode> CHANnel | FREQ

CHANnel
Sets the frequency input mode to selection of a channel.

FREQ
Sets the frequency input mode to frequency input (in Hz).

*RST: FREQ

Example: `FREQ:INP:MODE CHAN`
Sets the frequency mode to work with channel tables.

[SENSe:]FREQuency:MODE <SweepMode>

This command sets the measurement domain (frequency or time).

In the time domain (CW and FIXed), set the frequency with:

`[SENSe:]FREQuency:CENTer` on page 201

In the frequency domain (SWEep), set the frequency with:

`[SENSe:]FREQuency:CENTer` on page 201

`[SENSe:]FREQuency:SPAN` on page 203

`[SENSe:]FREQuency:STARt` on page 203

`[SENSe:]FREQuency:STOP` on page 204

Parameters:

<SweepMode> SWEep | CW | FIXed

SWEep
Selects the frequency domain (span > 0).

CW
Selects the time domain (span = 0).

FIXed
Selects the time domain (span = 0).

*RST: SWEep

Example: `FREQ:MODE SWE`
Activates frequency domain measurements.

[SENSe:]FREQuency:OFFSet <FreqOffset>

This command defines a frequency offset.

Parameters:

<FreqOffset>	Range:	-100 GHz to 100 GHz
	*RST:	0 Hz
	Default unit:	GHz

Example: `FREQ:OFFS 1GHZ`
Defines a frequency offset of 1 GHz.

[SENSe:]FREQuency:SPAN <FrequencySpan>

This command defines the frequency span.

If you set a span of 0 Hz, the R&S Spectrum Rider starts a measurement in the time domain.

Parameters:

<FrequencySpan>	Range:	Specified in the data sheet.
	*RST:	fmax with fmax = maximum frequency
	Default unit:	GHz

Example: `FREQ:SPAN 10MHz`
Defines a span of 10 MHz.

[SENSe:]FREQuency:SPAN:AUTO <State>

This command turns the automatic calculation of the ideal span on and off.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `FREQ:SPAN:AUTO ON`
Turns automatic span determination on and off.

[SENSe:]FREQuency:SPAN:FULL

This command restores the full span.

This command is an event and therefore has no query and no *RST value.

Example: `FREQ:SPAN:FULL`
Restores full span.

Usage: Event

[SENSe:]FREQuency:STARt <StartFrequency>

This command defines the start frequency for measurements in the frequency domain (span > 0).

Parameters:

<StartFrequency>	Range:	Depends on the operating mode and is specified in the datasheet.
	*RST:	0 Hz
	Default unit:	GHz

Example: `FREQ:STAR 20MHz`
Defines a start frequency of 20 MHz.

[SENSe:]FREQuency:STOP <StopFrequency>

This command defines the stop frequency for measurements in the frequency domain (span > 0).

Parameters:

<StopFrequency>	Range:	Depends on the operating mode and is specified in the datasheet.
	*RST:	fmax
	Default unit:	GHz

Example: `FREQ:STOP 2000MHz`
Defines a stop frequency of 2 GHz.

11.6.2.2 Configuring the Vertical Axis

The following commands configure the vertical (level) axis and level parameters of the active display.

List of commands

- `[SENSe:]CORRection:TRANsducer<1...2>:UNIT?` on page 209
- `UNIT<1...2>:POWer` on page 209

DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y[:SCALe]:ADJust

This command automatically scales the vertical axis for optimum display results.

This command is an event and therefore has no query and no *RST value.

The numeric suffix at DISPlay and TRACe is irrelevant for this command.

Example: `DISP:TRAC:Y:ADJ`
Adjusts the y-axis.

Usage: Event

DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y:SPACing <ScalingType>

This command selects the scaling type of the vertical axis.

The numeric suffix at DISPlay and TRACe is irrelevant for this command.

Parameters:
<ScalingType> LINear | LOGarithmic

LINear
Selects a linear scale (%).

LOGarithmic
Selects a logarithmic scale.

*RST: LOGarithmic

Example: `DISP:TRAC:Y:SPAC LIN`
Selects linear scaling of the level axis.

DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y[:SCALe] <DisplayRange>

This command defines the display range of the vertical axis.

Note that you have to set a logarithmic scaling before you can use this command with `DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y:SPACing` on page 205. For a linear scale, you cannot modify the display range as it is fixed.

The numeric suffix at DISPlay and TRACe is irrelevant for this command.

Parameters:
<DisplayRange> Range: 1 dB to 150 dB
*RST: 100 dB
Default unit: dB

Example: `DISP:TRAC:Y 110dB`
Sets the display range to 110 dB.

DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y[:SCALe]:RLEVel <RefLevel>

This command defines the reference level.

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset. You can set the offset with `DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y[:SCALe]:RLEVel:OFFSet` on page 206.

The numeric suffix at DISPlay and TRACe is irrelevant for this command.

Parameters:

<RefLevel> Sets the reference level; the unit depends on `UNIT<1...2>:POWer` on page 209.

Range: Specified in the data sheet.
*RST: –20 dBm
Default unit: dBm

Example: `DISP:TRAC:Y:RLEV -60dBm`
Sets the reference level to -60 dBm.

DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y[:SCALe]:RLEVel:OFFSet <RefLvlOffset>

This command defines a reference level offset.

The numeric suffix at DISPlay and TRACe is irrelevant for this command.

Parameters:

<RefLvlOffset> Sets the reference level offset.

Range: -100 dB to 100 dB
*RST: 0 dB
Default unit: dB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y[:SCALe]:RPOSition <RefLvlPosition>

This command defines the position of the reference level on the display grid.

First, you have to set a logarithmic scale for the vertical axis with `DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y:SPACing` on page 205. For a linear scale, you cannot modify the reference position.

The numeric suffix at DISPlay and TRACe is irrelevant for this command.

Parameters:

<RefLvlPosition> Defines the reference position in %.

Range: 0 to 10
*RST: 10

Example: `DISP:TRAC:Y:RPOS 5`
Sets the reference position to the 5th grid line.

INPut:ATTenuation <Attenuation>

This command defines the input attenuation.

The attenuation is coupled to the reference level. If you set the attenuation independently, the R&S Spectrum Rider turns off this coupling.

The R&S Spectrum Rider adjusts the reference level if it cannot be set for the current RF attenuation.

Parameters:

<Attenuation> Range: 0 dB to 40 dB
*RST: 0 dB (AUTO is ON)
Default unit: dB

Example: `INP:ATT 30dB`
Defines an attenuation of 30 dB and deactivates coupling to the reference level.

INPut:ATTenuation:MODE <AttenMode>

This command selects the attenuation mode.

Parameters:

<AttenMode> LDIStortion | LNOise

LDIStortion
Selects "Auto Low Distortion" mode.

LNOise
Selects "Auto Low Noise" mode.

*RST: LDIS

Example: `INP:ATT:MODE LNO`
Sets the attenuation mode to Auto Low Noise.

INPut:ATTenuation:AUTO <State>

This command couples and decouples input attenuation to the reference level.

Parameters:

<State> ON | OFF

*RST: ON

Example: `INP:ATT:AUTO ON`
Couples the attenuation set on the attenuator to the reference level.

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:GAIN:STAT ON`

Activates the preamplifier

INPut:IMPedance <Impedance>

This command selects the nominal input impedance. The set impedance is taken into account in all level indications of results.

The setting 75 Ω should be selected, if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The correction value in this case is 1.76 dB = 10 log (75 Ω / 50 Ω).

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω

Default unit: Ohm

Example: `INP:IMP 75`

Sets the input impedance to 75 Ohm.

[SENSe:]CORRection:TRANsducer<1...2>[:STATe] <State>

This command turns a transducer factor on and off.

Before turning it on, you have to select a transducer factor with `[SENSe:]CORRection:TRANsducer<1...2>:SELect` on page 208.

The numeric suffix at TRANsducer specifies the primary or secondary transducer.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CORR:TRAN1 ON`

Activates the primary transducer.

[SENSe:]CORRection:TRANsducer<1...2>:SELect <TransducerName>

This command selects a transducer factor.

If <name> does not exist yet, a new transducer factor is created.

The numeric suffix at TRANsducer specifies the primary or secondary transducer.

Parameters:

<TransducerName> String containing the file name of the transducer factor.

If the file does not exist, the R&S Spectrum Rider creates a new transducer factor.

Example: `CORR:TRAN2:SEL 'FSH-Z38.sectrd'`
Selects the FSH-Z38 secondary transducer factor.

[SENSe:]CORRection:TRANsducer<1...2>:UNIT?

This command queries the unit of the current transducer factor.

The numeric suffix at TRANsducer specifies the primary or secondary transducer.

Example: `CORR:TRAN2:UNIT?`
Queries the unit of the primary transducer.

Usage: Query only

UNIT<1...2>:POWer <Unit>

This command selects the unit of the vertical axis.

The availability of units depends on the operating mode and type of measurement.

The numeric suffix at UNIT is irrelevant for this command.

Parameters:

<Unit> DBM | DBMV | DBUV | VOLT | WATT | DUVM | DUAM | V | W | V_M | W_M2 | RHO | MRHO

Note that the availability of units depends on the operating mode.

*RST: DBM

Example: `UNIT:POW DBUV`
Sets the power unit to dBμV.

11.6.2.3 Configuring Channel Tables

The following commands configure the channel tables.

List of commands

[SENSe:]CHANnel<1...3> <ChannelNumber>

This command selects the channel to be analyzed.

You have to set the frequency mode with `[SENSe:]FREQuency:INPut:MODE` on page 202 to channel first.

The numeric suffix at CHANnel is irrelevant for this command.

Parameters:

<ChannelNumber> Numeric value that selects the number of the channel to be analyzed.

*RST: Depends on the channel table.

Example: See [SENSe:]CHANnel:TABLe:SELect<1...3> on page 210.

[SENSe:]CHANnel:TABLe:SELect<1...3> <ChannelTable>

This command selects a channel table configured for the link direction you have selected with [SENSe:]CHANnel:TABLe:SET on page 211.

Note that if you have previously selected a channel table with [SENSe:]CHANnel:TABLe:SELect:DOWNlink on page 210 or [SENSe:]CHANnel:TABLe:SELect:UPLink on page 211, this command replaces that file.

The numeric suffix at SELect selects the number of the channel.

Parameters:

<ChannelTable> String containing the file name of the channel table.

*RST: ''

Example:

```
CHAN:TABL:SET UP
```
Selects channel tsble selection for uplink signals.
```
CHAN:TABL:SEL 'TV China.CHNTAB'
```
Loads the channel table with the name 'TV China' for the uplink.
```
CHAN:TABL:SEL 'TV Italy.chntab'
```
or
```
CHAN:TABL:SEL:UPL 'TV Italy.chntab'
```
Both commands replace the uplink channel table 'TV China' with 'TV Italy'.
Downlink channel tables are not affected by the commands sent so far.
```
FREQ:INP:MODE CHAN
CHAN 10
```
Select a particular uplink channel (e.g. #10) instead of a (center) frequency.
To select an additional downlink channel table, use either:
```
CHAN:TABL:SET DOWN
```
CHAN:TABL:SEL 'TV Italy.chntab'
or
```
CHAN:TABL:SEL:DOWN 'TV Italy.chntab'
```

[SENSe:]CHANnel:TABLe:SELect:DOWNlink <ChannelTable>

This command selects a channel table configured for downlink signals.

Parameters:

<ChannelTable> String containing the name of the channel table.

*RST: ''

Example: See [SENSe:]CHANnel:TABLe:SELect<1...3> on page 210.

[SENSe:]CHANnel:TABLe:SELect:UPLink <ChannelTable>

This command selects a channel table configured for downlink signals.

Parameters:

<ChannelTable> String containing the name of the channel table.

*RST: ' '

Example: See [SENSe:]CHANnel:TABLe:SELect<1...3> on page 210.

[SENSe:]CHANnel:TABLe:SET <Table>

This command selects the link direction for measurements with channel tables.

Parameters:

<Table> UP | DOWN

UP
Selects the uplink.

DOWN
Selects the downlink.

*RST: UP

Example: See [SENSe:]CHANnel:TABLe:SELect<1...3> on page 210.

11.6.2.4 Setting the Bandwidths

The following commands configure the filter bandwidths of the R&S Spectrum Rider. Note that both groups of commands (`BANDwidth` and `BWIDth`) are the same.

List of commands

[SENSe:]BANDwidth[:RESolution] <ResolutionBW>

This command defines the resolution bandwidth.

Parameters:

<ResolutionBW>	Range:	1 Hz to 3 MHz
	*RST:	- (AUTO is set to ON)
	Default unit:	GHz

Example: `BAND 100 kHz`
Sets the resolution bandwidth to 100 kHz.

[SENSe:]BWIDth[:RESolution] <ResolutionBW>

This command defines the resolution bandwidth.

Parameters:

<ResolutionBW>	Range:	1 Hz to 3 MHz
	*RST:	- (AUTO is set to ON)
	Default unit:	GHz

Example: `BWID 100 kHz`
Sets the resolution bandwidth to 100 kHz.

[SENSe:]BANDwidth[:RESolution]:AUTO <State>

This command couples and decouples the resolution bandwidth to the span.

Parameters:

<State> ON | OFF
*RST: ON

Example: `BAND:AUTO OFF`
Decouples the resolution bandwidth from the span.

[SENSe:]BWIDth[:RESolution]:AUTO <State>

Parameters:

<State> ON | OFF
*RST: ON

Example: `BWID:AUTO OFF`
Decouples the resolution bandwidth from the span.

[SENSe:]BANDwidth:VIDeo <VideoBW>

This command defines the video bandwidth.

Parameters:

<VideoBW>	Range:	1 Hz to 3 MHz
	*RST:	- (AUTO is set to ON)
	Default unit:	GHz

Example: `BAND:VID 10kHz`
Sets the video bandwidth to 10 kHz.

[SENSe:]BWIDth:VIDeo <VideoBW>

This command defines the video bandwidth.

Parameters:

<VideoBW>	Range:	1 Hz to 3 MHz
	*RST:	- (AUTO is set to ON)
	Default unit:	GHz

Example: `BWID:VID 10kHz`
Sets the video bandwidth to 10 kHz.

[SENSe:]BANDwidth:VIDeo:AUTO <State>

This command couples and decouples the video bandwidth to the resolution bandwidth.

Parameters:

<State> ON | OFF
*RST: ON

Example: `BAND:VID:AUTO OFF`
Turns off video bandwidth coupling.

[SENSe:]BWIDth:VIDeo:AUTO <State>

This command couples and decouples the video bandwidth to the resolution bandwidth.

Parameters:

<State> ON | OFF
*RST: ON

Example: `BWID:VID:AUTO OFF`
Turns off video bandwidth coupling.

11.6.2.5 Performing and Triggering Measurements

The following commands control the actual measurement process, including trigger functionality.

Performing the Measurement

The following commands initialize a measurement and set up the sweep.

List of commands

- `*WAI` on page 200
- `ABORt` on page 214
- `INITiate[:IMMediate]` on page 214
- `INITiate:CONTinuous` on page 214

- `[SENSe:]SWEep:COUNt` on page 215
- `[SENSe:]SWEep:POINts` on page 215
- `[SENSe:]SWEep:TIME` on page 215
- `[SENSe:]SWEep:TIME:AUTO` on page 215

ABORt

This command aborts the current measurement and resets the trigger system.

This command is an event and therefore has no query and no *RST value.

Example: `ABOR;`
`INIT:IMM`
Aborts a measurement and starts a new one.

Usage: Event

INITiate[:IMMediate]

This command initiates a new measurement sequence.

With sweep count > 0 or average count > 0, this means a restart of the indicated number of measurements. With trace functions MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

In single sweep mode, synchronization to the end of the indicated number of measurements can be achieved with the command *OPC, *OPC? or *WAI. In continuous–sweep mode, synchronization to the sweep end is not possible since the overall measurement never ends.

This command is an event and therefore has no query and no *RST value.

Example: `INIT:CONT OFF`
`DISP:WIND:TRAC:MODE AVER`
Turns single sweep mode and trace averaging on.
`INIT;*WAI`
Starts the measurement and waits for the end of the sweep.

Usage: Event

INITiate:CONTinuous <State>

This command selects the sweep mode.

Parameters:
<State> ON | OFF

ON
Selects continuous sweeps.

OFF
Selects single sweep.

*RST: ON

Example: `INIT:CONT OFF`
Turns on single sweep mode.

[SENSe:]SWEep:COUNt <#ofSweeps>

This command defines the number of sweeps included in a single sweep. It also defines the number of sweeps the R&S Spectrum Rider uses to average traces or calculate maximum values.

The R&S Spectrum Rider performs one sweep for sweep count 0 or 1.

Parameters:
<#ofSweeps> Range: 1 to 999
*RST: 10

Example: `SWE:COUN 64`
Defines a sweep count of 64 sweeps.
`INIT:CONT OFF`
`INIT;*WAI`
Turns on single sweep mode, starts the sweep and waits for its end.

[SENSe:]SWEep:POINts <NrofPoints>

This command queries the number of measurement points in a single sweep.

This command is a query and therefore has no *RST value.

Parameters:
<NrofPoints> Returns the number of sweep points.

Example: `SWE:POIN?`
Returns the number of sweep points.

[SENSe:]SWEep:TIME <SweepTime>

This command defines the sweep time.

If you set a sweep time with this command, the R&S Spectrum Rider decouples the sweep time from the span and the resolution and video bandwidths.

Parameters:
<SweepTime> Range: Specified in the datasheet.
*RST: - (AUTO is set to ON)
Default unit: s

Example: `SWE:TIME 10s`
Sets the sweep time to 10 s.

[SENSe:]SWEep:TIME:AUTO <State>

This command couples and decouples the sweep time to the span and the resolution and video bandwidths.

Parameters:
<State> ON | OFF
*RST: ON

Example: `SWE:TIME:AUTO ON`
Switches on the coupling to frequency span and bandwidths.

Triggering Measurements

The following commands set up trigger conditions if you are using a trigger for the measurement.

List of commands

[SENSe:]SWEep:EGATe <GateTrigger>

This command turns a gated trigger on and off.

Parameters:
<GateTrigger> ON | OFF
*RST: OFF

Example: `SWE:EGAT ON`
Activates the gated trigger.

[SENSe:]SWEep:EGATe:HOLDoff <GateTriggerHoldOff>

This command defines the length of the gate delay.

Parameters:
<GateTriggerHoldOff> Range: 0 s to 100 s
*RST: 0 s
Default unit: s

Example: `SWE:EGAT:HOLD 2.5`
Sets a gate delay of 2.5 seconds.

[SENSe:]SWEep:EGATe:LENGth <GateTriggerLength>

This command defines the gate length.

Parameters:

<GateTriggerLength> Range: 10 µs to 100 s
*RST: 400 µs
Default unit: s

Example: `SWE:EGAT:LENG 2.5`
Sets a gate length of 2.5 seconds.

[SENSe:]SWEep:EGATe:TIME <GateTriggerLength>

This command defines the sweep time for the gated trigger.

Parameters:

<GateTriggerLength> *RST: 400 µs
Default unit: s

Example: `SWE:GATE:TIME 4ms`
Sets a sweep time of 4 ms for the gated trigger.

TRIGger[:SEQuence]:CLOCk[:FREQuency] <TriggerClock>

This command defines the clock rate of the internal trigger.

Parameters:

<TriggerClock> Clock rate that defines the trigger intervals.
*RST: 100 Hz
Default unit: GHz

Example: `TRIG:CLOC 100`
Triggers a measurement every 100 ms.

TRIGger[:SEQuence]:HOLDoff[:TIME] <TriggerDelay>

This command defines the length of the trigger delay.

Parameters:

<TriggerDelay> Range: 0 s to 100 s
*RST: 0 s
Default unit: s

Example: `TRIG:HOLD 500us`
Sets the trigger delay to 500 µs.

TRIGger[:SEQuence]:LEVel:VIDeo <VideoTrigLevel>

This command defines the level of the video trigger.

Video trigger is available for time domain measurements (span = 0).

Parameters:

<VideoTrigLevel> Range: 0 PCT to 100 PCT
*RST: 50 PCT

Example: `TRIG:LEV:VID 50PCT`
Sets the trigger level to 50%.

TRIGger[:SEQuence]:SLOPe <TriggerSlope>

This command selects the slope of the trigger signal.

The trigger slope applies to all trigger sources.

Parameters:

<TriggerSlope> POSitive | NEGative
*RST: POSitive

Example: `TRIG:SLOP NEG`

TRIGger[:SEQuence]:SOURce <TriggerSource>

This command selects the trigger source.

Parameters:

<TriggerSource> IMMediate | EXTernal | VIDeo | INTernal

IMMediate
Selects Free Run measurements.

EXTernal
Selects an external trigger.

VIDeo
Selects the video trigger.

INTernal
Selects an internal trigger.

*RST: IMMediate
For more information see chapter "Setting the Sweep".

Example: `TRIG:SOUR EXT`
Selects the external trigger input as source of the trigger signal.

11.6.2.6 Working with Traces

The following commands set up the trace and the various functions associated with it, e.g. trace mathematics or the selection of the detector.

List of commands

- `DISPlay<1...2>[:WINDow]:TRACe<1...2>[:STATe]` on page 220
- `DISPlay<1...2>[:WINDow]:TRACe<1...2>:MEMory[:STATe]` on page 220
- `DISPlay<1...2>[:WINDow]:TRACe<1...2>:MODE` on page 220
- `FORMat:BORDer` on page 221
- `[SENSe:]DETector<1...2>[:FUNCtion]` on page 221
- `[SENSe:]DETector<1...2>[:FUNCtion]:AUTO` on page 222
- `TRACe<1...2>[:DATA]?` on page 222
- `FORMat[:DATA]` on page 222

CALCulate<1...2>:MATH<1...2>[:EXPRession][:DEFine] <MathExpression>

This command defines the mathematical expression for relating traces to trace 1.

You have to activate trace mathematics with `CALCulate<1...2>:MATH<1...2>:STATe` on page 219 first.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at MATH selects the number of the trace.

Parameters:

<MathExpression> <list>

(IMPLied - memory)
Subtracts the trace in memory from the current trace.

(memory - IMPlied)
Subtracts the current trace from the trace in memory.

Example: `CALC:MATH (memory - IMPlied)`
Selects the subtraction of the current trace from trace in the memory.

CALCulate<1...2>:MATH<1...2>:COPY:MEMory [<MemorySlot>]

This command stores the selected trace into the memory trace of the R&S Spectrum Rider.

This command is an event and therefore has no query and no *RST value.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at MATH selects the number of the trace.

Parameters:

<MemorySlot>

Example: `CALC:MATH:COPY:MEM`

Usage: Setting only

Copies the trace into the memory.

CALCulate<1...2>:MATH<1...2>:STATe <State>

This command turns trace mathematics on and off.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at MATH selects the number of the trace.

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Example: `CALC:MATH:STAT ON`
Switches on the trace mathematics.

DISPlay<1...2>[:WINDow]:TRACe<1...2>[:STATe] <State>

This command turns a trace on and off.

The numeric suffix at DISPlay is irrelevant for this command. The numeric suffix at TRACe selects the number of the trace.

Parameters:

<State>	ON | OFF	
	*RST:	ON for TRACe1, OFF for TRACe2

Example: `DISP:TRAC2 ON`
Turns the trace 2 on.

DISPlay<1...2>[:WINDow]:TRACe<1...2>:MEMory[:STATe] <State>

This command turns the memory trace on and off.

The numeric suffix at DISPlay is irrelevant for this command. The numeric suffix at TRACe selects the number of the trace.

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Example: `DISP:TRAC:MEM ON`
Activates the memory trace.

DISPlay<1...2>[:WINDow]:TRACe<1...2>:MODE <DisplayMode>

This command selects the trace mode.

If you are using the average, max hold or min hold trace mode, you can set the number of measurements with `[SENSe:]SWEep:COUNt` on page 215. Note that synchronization to the end of the average count is possible only in single sweep mode.

The numeric suffix at DISPlay is irrelevant for this command. The numeric suffix at TRACe selects the number of the trace.

Parameters:

<DisplayMode> WRITe | AVERage | MINHold | MAXHold | VIEW | FREeze | INFinite

*RST: WRITe

You can turn off the trace with `DISPlay<1...2>[:WINDow]:TRACe<1...2>[:STATe]` on page 220.

For more information, see chapter "Trace Mode".

Example:
`SWE:CONT OFF`
`SWE:COUN 16`
Turn on single sweep mode and sets the number of measurements to 16.
`DISP:TRAC:MODE MAXH`
Activates MAXHold mode for the trace.
`INIT;*WAI`
Starts the measurement and waits for the end of the 16 sweeps.

FORMat:BORDer <TransferOrder>

This command selects the format of binary data.

Parameters:

<TransferOrder> NORMal | SWAPped

NORMal
The most significant byte is transferred first big endian).

SWAPped
The least significant byte is transferred first (little endian).

*RST: SWAPped

Example:
`FORM:BORD NORM`
Changes the byte order to normal mode.

[SENSe:]DETector<1...2>[:FUNCtion] <Detector>

This command selects a detector function.

The numeric suffix at DETector specifies the primary or secondary detector.

Suffix:

<1...2> 1...2

Parameters:

<Detector> POSitive | NEGative | SAMPle | RMS | AVERage | APEak

*RST: APE

For more information, see chapter "Detectors".

Example:
`DET POS`
Sets the primary detector to "positive peak".

[SENSe:]DETector<1...2>[:FUNCtion]:AUTO <State>

This command couples and decouples the detector to the trace mode.

The numeric suffix at DETector specifies the primary or secondary detector.

Parameters:

<State> ON | OFF

*RST: ON

Example: `DET:AUTO OFF`

Turns off automatic detector selection for the primary detector.

TRACe<1...2>[:DATA]? <arg0>

This command queries the trace data of the current measurement.

It also transfers data from a file to a particular trace.

With `FORMat[:DATA]` on page 222 command, you can set the data format.

The numeric suffix at TRACe selects the number of the trace.

Parameters:

<arg0> TRACe1 | TRACe2 | LIST

TRACe1
Queries the data of trace 1.

TRACe2
Queries the data of trace 2.

LIST
Queries the peak list of the measurement.

The R&S Spectrum Rider returns 711 values. Each value corresponds to one pixel of a trace.
The unit depends on the measurement and the unit you have set with `UNIT<1...2>:POWer` on page 209.
Note: If you use the auto peak detector, the command reads out positive peak values only.

Example: TRAC:DATA? TRACE1

Reads out the data for trace 1.

Usage: Query only

FORMat[:DATA] <Format>[, <>]

This command selects the data format that is used for transmission of trace data from the R&S Spectrum Rider to the controlling computer.

Note that the command has no effect for data that you send to the R&S Spectrum Rider. The R&S Spectrum Rider automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format> ASCii | REAL

<>

ASCii
Returns the data in ASCII format, separated by commas.

REAL
Returns the data as 32-bit IEEE 754 floating point numbers in the "definite length block format".

*RST: ASCii

In REAL,32 format, a string of return values would look like:
`#42424<value 1><value 2>...<value n>`
with
#4 representing the number of digits of the following number of data bytes (= 4 in this example);
2524 representing the number of following data bytes (2524, corresponds to the 631 sweep points of the R&S Spectrum Rider;
<value> representing 4-byte floating point value.

Example: `FORM ASC`
Selects the ASCii data format.

11.6.2.7 Using Markers

The following commands control the operation of marker, delta markers and marker functions.

Markers and Delta Markers

The following commands are for setting and controlling markers and deltamarkers.

List of commands

- CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>[:STATe] on page 229
- CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>:LEFT on page 229
- CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>:RIGHt on page 230
- CALCulate<1...2>:MARKer<1...6>:Y? on page 230

CALCulate<1...2>:DELTamarker<1...6>[:STATe] <State>

This command turns delta markers on and off.

If you set the suffix at DELTamarker to 1, or use no suffix, the R&S Spectrum Rider interprets this as delta marker 2 because the first marker has to be a normal marker. If more than one normal marker (2 to 6) are already active, the command turns these marker into delta markers. If no delta marker is active yet, the command activates the delta marker and positions it on the trace maximum.

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker selects the deltamarker.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT3 ON`

Turns delta marker 3 on or turn marker 3 into a delta marker.

CALCulate<1...2>:DELTamarker<1...6>:AOFF

This command turns off all active delta markers.

This command is an event and therefore has no query and no *RST value.

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker is irrelevant for this command.

Example: `CALC:DELT:AOFF`

Turns off all delta markers.

Usage: Event

CALCulate<1...2>:DELTamarker<1...6>:MAXimum[:PEAK]

This command positions a delta marker on the current trace maximum.

If necessary, the corresponding delta marker is activated first.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker selects the deltamarker.

Example: `CALC:DELT3:MAX`
Moves delta marker 3 to the maximum peak.

Usage: Event

CALCulate<1...2>:DELTamarker<1...6>:MAXimum:NEXT

This command positions a delta marker on the next smaller trace maximum.

If necessary, the corresponding delta marker is activated first.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker selects the deltamarker.

Example: `CALC:DELT2:MAX:NEXT`
Moves delta marker 2 to the next smaller maximum peak.

Usage: Event

CALCulate<1...2>:DELTamarker<1...6>:MINimum[:PEAK]

This command positions a delta marker on the current trace minimum.

If necessary, the corresponding delta marker is activated first.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker selects the deltamarker.

Example: `CALC:DELT3:MIN`
Moves delta marker 3 to the trace minimum.

Usage: Event

CALCulate<1...2>:DELTamarker<1...6>:X <FrequencyOrTime>

This command positions a delta marker on a particular coordinate on the horizontal axis.

Note that it is possible to place the marker outside the visible trace. In that case, this value is invalid.

If necessary, the corresponding delta marker is activated first.

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker selects the deltamarker.

Parameters:
<FrequencyOrTime> Numeric value that indicates the coordinate on the horizontal axis.

Range: Maximum span.
Default unit: GHz

Example:

`CALC:DELT:MOD REL`
Delta marker positions are relative to marker 1.
`CALC:DELT2:X 10.7MHz`
Positions delta marker 2 10.7 MHz to the right of marker 1.
`CALC:DELT2:X?`
`CALC:DELT2:X:REL?`
Queries the absolute and relative position of delta marker 2.

CALCulate<1...2>:DELTamarker<1...6>:X:RELative <FrequencyOrTime>

This command positions a delta marker on a position relative to the reference marker.

If necessary, the corresponding delta marker is activated first.

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker selects the deltamarker.

Parameters:

<FrequencyOrTime> Defines the distance of the marker to the reference marker.

Range: Depends on the current scaling of the horizontal axis.

Default unit: GHz

Example:

`CALC:DELT3:X:REL 5 kHz`
Sets the delta marker at a distance of 5 kHz to the reference position.

CALCulate<1...2>:DELTamarker<1...6>:Y?

This command queries the vertical position of a delta marker. The result is always a relative value in relation marker 1.

If necessary, the corresponding delta marker is activated first.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end between activating the delta marker and reading out the result. this is only possible in single sweep mode.

In spectrum analyzer mode, the unit depends on the unit you have set and the scaling of the vertical axis.

Parameter or measuring functions	Output unit
DBM | DBPW | DBUV | DBMV | DBUA	dB (lin/log)
WATT | VOLT |AMPere	dB (lin), % (log)

The numeric suffix at CALCulate selects the trace. The numeric suffix at DELTamarker selects the deltamarker.

Parameters:

<MarkerPosition>

Example:
```
INIT:CONT OFF
CALC:DELT2 ON
```
Turns on single sweep mode and delta marker 2.
```
INIT;*WAI
```
Starts a sweep and waits for its end.
```
CALC:DELT2:Y?
```
Queries the position of delta marker 2.

Usage: Query only

CALCulate<1...2>:MARKer<1...6>[:STATe] <State>

This command turns markers on and off.

If you do not use a suffix at MARKer, marker 1 is selected. If one or more delta markers (2 to 6) are already active, the command turns these delta markers into normal markers.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK3 ON`
Turns on marker 3.

CALCulate<1...2>:MARKer<1...6>:AOFF

This command turns off all active markers, delta markers and active marker measurement functions.

This command is an event and therefore has no query and no *RST value.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer is irrelevant for this command.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

CALCulate<1...2>:MARKer<1...6>:MAXimum[:PEAK]

This command positions a marker on the current trace maximum.

If necessary, the corresponding marker is activated first.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Example: `CALC:MARK2:MAX`
Moves marker 2 to the maximum peak.

Usage: Event

CALCulate<1...2>:MARKer<1...6>:MAXimum:NEXT

This command positions a marker on the next smaller trace maximum.

If necessary, the corresponding marker is activated first.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Example: `CALC:MARK2:MAX:NEXT`
Moves marker 2 to the next smaller maximum peak.

Usage: Event

CALCulate<1...2>:MARKer<1...6>:MINimum[:PEAK]

This command positions a marker on the current trace minimum.

If necessary, the corresponding marker is activated first.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Example: `CALC:MARK2:MIN`
Moves marker 2 to the trace minimum.

Usage: Event

CALCulate<1...2>:MARKer<1...6>:X <FrequencyOrTime>

This command positions a marker on a particular coordinate on the horizontal axis.

If one or more delta markers (2 to 6) are already active, the command turns these delta markers into normal markers.

Note that it is possible to place the marker outside the visible trace. In that case, this value is invalid.

If necessary, the corresponding delta marker is activated first.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<FrequencyOrTime> Indicates the coordinate on the horizontal axis.
The unit in spectrum analyzer mode depends on the measurement, e.g. Hz for measurements in the frequency domain and seconds for measurements in the time domain.

Range: Maximum span.
Default unit: GHz

Example: `CALC:MARK2:X 10.7MHz`
Positions marker 2 to frequency 10.7 MHz.

CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>[:STATe] <State>

This command turns marker search limits on and off.

The search limit limits the evaluation range of the trace when "set marker" functions are performed. For example, marker set to peak with command `CALCulate<1...2>:MARKer<1...6>:MAXimum[:PEAK]` on page 227 will set the marker only at the peak of the trace within the search limit.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<State> ON | OFF

*RST: OFF

Example: See `CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>:RIGHt` on page 230.

CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>:LEFT <SearchLimit>

This command defines the left limit of the marker search range.

To use the command, you first have to turn on search limits with `CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>[:STATe]` on page 229.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<SearchLimit> Sets the left marker search limit.
The unit in the spectrum analyzer mode depends on the measurement, e.g. Hz for measurements in the frequency domain and seconds for measurements in the time domain.

Range: Maximum span.
*RST: – (is set to the left diagram border when switching on search limits)
Default unit: GHz

Example: See `CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>:RIGHt` on page 230.

CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>:RIGHt <SearchLimit>

This command defines the right limit of the marker search range.

To use the command, you first have to turn on search limits with `CALCulate<1...2>:MARKer<1...6>:X:SLIMits<1...2>[:STATe]` on page 229.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<SearchLimit> Sets the right marker search limit.
The unit depends on the measurement, e.g. Hz for measurements in the frequency domain and seconds for measurements in the time domain.

Range: Maximum span.
*RST: – (is set to the right diagram border when switching on search limits)
Default unit: GHz

Example:

```
CALC:MARK:X:SLIM ON
CALC:MARK:X:SLIM:LEFT 10MHz
CALC:MARK:X:SLIM:RIGH 100MHz
```

Turns search limits on and defines a search range from 10 MHz to 100 MHz.

CALCulate<1...2>:MARKer<1...6>:Y?

This command queries the absolute vertical position of a marker.

If necessary, the corresponding marker is activated first.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end between activating the delta marker and reading out the result. This is only possible in single sweep mode.

The unit of the return value depends on `UNIT<1...2>:POWer` on page 209.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<MarkerPosition> numeric value of the marker position.

Example:

`INIT:CONF OFF`
`CALC:MARK2 ON`
Turns on single sweep mode and marker 2.
`INIT;*WAI`
Starts a sweep and waits for the end.
`CALC:MARK2:Y?`
Queries the position of marker 2.

Usage: Query only

Marker Functions

The following commands perform various kinds of analysis at the marker position.

List of commands

CALCulate<1...2>:MARKer<1...6>:COUNt:FREQuency?

This command performs a frequency measurement at the marker position and returns the result.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end to make sure that the R&S Spectrum Rideractually reaches the frequency you want to measure. This is only possible in single sweep mode.

Before you can use the command, you have to turn on the frequency counter with `CALCulate<1...2>:MARKer<1...6>:COUNt[:STATe]` on page 232.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer is irrelevant for this command.

Example: See `CALCulate<1...2>:MARKer<1...6>:COUNt[:STATe]` on page 232.

Usage: Query only

CALCulate<1...2>:MARKer<1...6>:COUNt[:STATe] <State>

This command turns the frequency counter at the marker position on and off.

You can read out the result with `CALCulate<1...2>:MARKer<1...6>:COUNt:FREQuency?` on page 231.

Frequency counting is possible only for one marker at a time. If it is activated for another marker, it is automatically deactivated for the previous marker.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end to make sure that the R&S Spectrum Rider actually reaches the frequency you want to measure. This is only possible in single sweep mode.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<State> ON | OFF

*RST: OFF

Example:

```
INIT:CONT OFF
CALC:MARK ON
```

Turns on single sweep mode and marker 1.

```
CALC:MARK:COUN ON
```

Turns on the frequency counter for marker 1.

```
INIT;*WAI
CALC:MARK:COUN:FREQ?
```

Performs a measurement and queries the results of the frequency counter.

CALCulate<1...2>:MARKer<1...6>:FREQuency:MODE <Mode>

This command selects the marker frequency display mode.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<Mode> FREQuency | CHANnel

FREQuency
Sets the marker frequency mode to frequency input (in Hz).

CHANnel
Sets the marker frequency mode to channel input (as a channel number).

*RST: FREQ

Example: `CALC:MARK:FREQ:MODE FREQ`
Selects the frequency display mode.

CALCulate<1...2>:MARKer<1...6>:FUNCtion:CENTer

This command matches the center frequency to the frequency of a marker.

If you use a delta marker, the R&S Spectrum Rider turns it into a normal marker.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Example: CALC:MARK2:FUNC:CENT
Matches the center frequency to the frequency of marker 2.

Usage: Event

CALCulate<1...2>:MARKer<1...6>:FUNCtion:DEModulation[:STATe] <State>

This command turns the audio demodulator on and off when the measurement hits a marker position.

With span > 0, you can define a hold time at the marker position with `CALCulate<1...2>:MARKer<1...6>:FUNCtion:DEModulation:HOLD` on page 234.

In zero span the demodulation is on permanently.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Suffix:

<1...2> 1...2

<1...6> 1...6

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK3:FUNC:DEM ON`
Switches on the demodulation for marker 3.

CALCulate<1...2>:MARKer<1...6>:FUNCtion:DEModulation:HOLD <HoldTime>

This command defines the hold time at the marker position for the demodulation with span > 0.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<HoldTime>	Range:	10 ms to 500 s
	*RST:	0.5 (DEModulation is set to OFF)
	Default unit: s	

Example: `CALC:MARK:FUNC:DEM:HOLD 3s`
Sets a hold time of 3 seconds.

CALCulate<1...2>:MARKer<1...6>:FUNCtion:DEModulation:SELect <DemodType>

This command selects the type of demodulation type for the audio demodulator.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<DemodType>	AM | FM	
	*RST:	AM

Example: `CALC:MARK:FUNC:DEM:SEL FM`
Selects FM demodulation.

CALCulate<1...2>:MARKer<1...6>:FUNCtion:LEVel:ONCE

This command adjusts the reference level to the measured signal power.

This automatic routine makes sure that the that the signal power level does not overload the R&S Spectrum Rider or limit the dynamic range by too small a S/N ratio.

To determine the best reference level, the R&S Spectrum Rider aborts current measurements and performs a series of test sweeps. After it has finished the test, it continues with the actual measurement.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALculate selects the trace and MARKer selects the marker..

Example: `CALC:MARK:FUNC:LEV:ONCE`
Initiates an automatic level adjust routine.

Usage: Event

CALCulate<1...2>:MARKer<1...6>:FUNCtion:NDBDown <MarkerDistance>

This command defines the distance of the n dB down markers to the reference marker.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<MarkerDistance> Distance of the temporary markers to the reference marker in dB.

*RST: 3 dB
Default unit: dB

Example: See `CALCulate<1...2>:MARKer<1...6>:FUNCtion:NDBDown:STATe` on page 235

CALCulate<1...2>:MARKer<1...6>:FUNCtion:NDBDown:FREQuency?

This command queries the horizontal position of the n dB down markers.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<Return values> <frequency1>
Absolute frequency of the n dB marker to the left of the reference marker in Hz.
<frequency2>
Absolute frequency of the n dB marker to the right of the reference marker in Hz.

Example: See `CALCulate<1...2>:MARKer<1...6>:FUNCtion:NDBDown:STATe` on page 235

Usage: Query only

CALCulate<1...2>:MARKer<1...6>:FUNCtion:NDBDown:RESult?

This command queries the frequency spacing or bandwidth of the n dB down markers.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<Return values> <Bandwidth>

Bandwidth in Hz.

Example: See `CALCulate<1...2>:MARKer<1...6>:FUNCtion:NDBDown:STATe` on page 235.

Usage: Query only

CALCulate<1...2>:MARKer<1...6>:FUNCtion:NDBDown:STATe <State>

This command turns the n dB Down marker function on and off.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Parameters:

<State> ON | OFF

*RST: OFF

Example:

`CALC:MARK:FUNC:NDBD:STAT ON`
Turns on the n dB marker function.
`CALC:MARK:FUNC:NDBD 3`
Positions two temporary markers 3 dB below a reference marker.
`CALC:MARK:FUNC:NDBD:FREQ?`
Queries the frequency position of the n dB Down markers; would return e.g. `100000000,200000000`.
`CALC:MARK:FUNC:NDBD:RES?`
Queries the measurement result; would return e.g. `100000000`.

CALCulate<1...2>:MARKer<1...6>:FUNCtion:NOISe[:STATe] <State>

This command turns the noise measurement for all markers on and off.

You can query the results of the noise power density at the marker position with `CALCulate<1...2>:MARKer<1...6>:FUNCtion:NOISe:RESult?` on page 236.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer is irrelevant for this command.

Parameters:

<State> ON | OFF

*RST: OFF

Example: See `CALCulate<1...2>:MARKer<1...6>:FUNCtion:NOISe:RESult?` on page 236.

CALCulate<1...2>:MARKer<1...6>:FUNCtion:NOISe:RESult?

This command queries the result of the noise measurement.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end before reading out the result. This is only possible in single sweep mode.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer is irrelevant for this command.

Example: `INIT:CONT OFF`
Turns on single sweep mode.
`CALC:MARK2 ON`
`CALC:MARK2:FUNC:NOIS ON`
Turns on marker 2 and assigns the noise measurement to that marker.
`INIT;*WAI`
`CALC:MARK2:NOIS:RES?`
Performs the measurement and queries the noise marker results.

Usage: Query only

CALCulate<1...2>:MARKer<1...6>:FUNCtion:REFerence

This command matches the reference level to the power level of a marker.

If you use a delta marker, the R&S Spectrum Riderturns it into a normal marker.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate selects the trace. The numeric suffix at MARKer selects the marker.

Example: `CALC:MARK1:FUNC:REF`
Matches the reference level to the power level of marker 1.

Usage: Event

11.6.2.8 Using Limit Lines

The following commands define limit lines and perform the corresponding limit checks.

List of commands

CALCulate<1...2>:LIMit<1...2>:BEEP[:STATe] <State>

This command turns the beeper that beeps if a limit line is violated on and off.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:LIM:BEEP ON`
Activates the audio beep.

CALCulate<1...2>:LIMit<1...2>:COMMent?

This command queries the description of a limit line.

This command is a query and therefore has no RST value.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2> 1...2

<1...2> 1...2

Example: `CALC:LIM:COMM?`
Queries the description of limit line 1.

Usage: Query only

CALCulate<1...2>:LIMit<1...2>:DEFine <Name>, <Description>, <X-unit>, <X-scale>, <Y-unit>, <X0...X99>, <Y0...Y99>

This command defines the shape of a limit line.

After you have defined the shape of the limit line you still have to activate it with `CALCulate<1...2>:LIMit<1...2>:UPPer:SELect` on page 241 before it takes effect.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Parameters:

<Name> String containing the name of the limit line.
Note: if a limit line with the same name already exists, it will be overwritten.

<Description> String containing a comment for the limit line.

<X-unit> HZ | S | M

Unit of the x-axis.

<X-scale>	ABSolute | RELative Scale of the x-axis.
<Y-unit>	DB | DBM | DBMV | DBUV | V | VOLT | W | WATT | DBUVM | DBUAM | V_M | W_M2 | VSWR Unit of the y-axis.
<X0...X99>	Data points on the x-axis. Note: a limit line may consist of up to 100 horizontal data points.
<Y0...Y99>	Data points on the y-axis.
Example:	`CALC:LIM:DEF 'Line','Example',HZ,ABS,DBM, 10000000,-10, 10000000,0,20000000,0` Defines a limit line with three data points.
Usage:	Setting only

CALCulate<1...2>:LIMit<1...2>:DELete

This command deletes a limit line.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2>	1...2
<1...2>	1...2
Example:	`CALC:LIM2:DEL` Deletes the second limit line.

CALCulate<1...2>:LIMit<1...2>:FAIL?

This command queries the result of a limit check.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end before reading out the result. This is only possible in single sweep mode.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2>	1...2
<1...2>	1...2

Example:	`INIT;*WAI`
	`CALC:LIM1:FAIL?`
	Performs a measurement and queries the result of the check for limit line 1.

Usage: Query only

CALCulate<1...2>:LIMit<1...2>:LOWer:SELect <LimitLine>

This command selects the lower limit line.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2>	1...2
<1...2>	1...2

Parameters:

<LimitLine>	String containing the file name of the lower limit line.

Example: `CALC:LIM:LOW:SEL 'GSM_Lower.rellim'`
Selects the lower limit line.

Usage: Setting only

CALCulate<1...2>:LIMit<1...2>:LOWer:THReshold <Threshold>

This command defines the level of a lower threshold limit line.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2>	1...2
<1...2>	1...2

Parameters:

<Threshold>	Numeric value whose unit depends on the unit you have currently selected for the vertical axis. Default unit: dBm

Example: `CALC:LIM:LOW:THR -10DBM`
Defines a threshold of -10 dBm.

CALCulate<1...2>:LIMit<1...2>:STATe <State>

This command turns a limit check on and off.

You can query the result of the limit check with `CALCulate<1...2>:LIMit<1...2>:FAIL?` on page 239.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

CALCulate<1...2>:LIMit<1...2>:UNIT:X?

This command queries the horizontal unit of a limit line.

This command is a query and therefore has no *RST value.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2> 1...2

<1...2> 1...2

Example: `CALC:LIM:UNIT:X?`
Queries the x-unit of the first limit line.

Usage: Query only

CALCulate<1...2>:LIMit<1...2>:UNIT[:Y]?

This command queries the vertical unit of a limit line.

This command is a query and therefore has no *RST value.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2> 1...2

<1...2> 1...2

Example: `CALC:LIM1:UNIT?`
Queries the y-unit of the first limit line.

Usage: Query only

CALCulate<1...2>:LIMit<1...2>:UPPer:SELect <LimitLine>

This command selects the upper limit line.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:

<1...2> 1...2

<1...2> 1...2

Parameters:
<LimitLine> String containing the file name of the upper limit line.

Example: `CALC:LIM:UPP:SEL 'GSM_Upper.rellim'`
Selects the upper limit line.

Usage: Setting only

CALCulate<1...2>:LIMit<1...2>:UPPer:THReshold <Threshold>

This command defines the level of an upper threshold limit line.

The numeric suffix at CALCulate is irrelevant for this command. The numeric suffix at LIMit selects the limit line.

Suffix:
<1...2> 1...2

<1...2> 1...2

Parameters:
<Threshold> Numeric value whose unit depends on the unit you have currently selected for the vertical axis.
Default unit: dBm

Example: `CALC:LIM:UPP:THR -10DBM`
Defines a threshold of -10 dBm.

11.6.3 Remote Commands of the Analog Modulation

The chapter provides information on remote commands that configure and perform analog modulation measurements.

Availability of remote commands for the analog modulation
Note that the listed remote commands take effect only if R&S FPH-K7 is installed on the R&S Spectrum Rider

11.6.3.1 Setting the Frequency

The following chapter describes command to define and query on the frequency settings

List of commands

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:AFRequency[:RESult]?

This command queries the modulation frequency.

The numeric suffix at CALCulate is irrelevant for this command

Suffix:
<1...2> 1...2

Example: CALC:MARK:FUNC:ADEM:AFR?
Reads out the modulation frequency

Usage: Query only

11.6.3.2 Defining the Vertical Axis

The following chapter describes command necessary to define the vertical scale such as the x-axis deviation per division and settings affecting the amplitude of the measurements.

List of commands

DISPlay<1...2>[:WINDow]:TRACe<1...2>:Y[:SCALe]:PDIVision <DevPerDiv>

This command sets the Y scale (deviation per division) in Hz (FM) or percent (AM).

The numeric suffix at DISPlay and TRACe is irrelevant for this command.

Suffix:

<1...2>	1...2
<1...2>	1...2

Parameters:

<DevPerDiv> Numeric value with the unit range of Hz | kHz| MHz| MAHz| GHz | PCT.

Default unit: GHz

Example: `DISP:TRAC:Y:PDIV 5 PCT`

Set the Y scale (deviation per division) as 5 % in the AM modulation.

11.6.3.3 Defining the Bandwidth

The following chapter describes command to necessary define the demodulation bandwidth.

List of commands

- [SENSe:]ADEMod:BANDwidth:DEModulation on page 244
- [SENSe:]ADEMod:BWIDth:DEModulation on page 244

[SENSe:]ADEMod:BANDwidth:DEModulation <Bandwidth>

This command sets the demodulation bandwidth.

Parameters:

<Bandwidth> Range: 3 KHz to 2 MHz

Default unit: GHz

Example: `ADEM:BAND:DEM 2MHz`

Defines a analog demodulation bandwidth of 2 MHz.

[SENSe:]ADEMod:BWIDth:DEModulation <Bandwidth>

This command sets the demodulation bandwidth.

Parameters:

<Bandwidth> Range: 3 KHz to 2 MHz

Default unit: GHz

Example: `ADEM:BAND:DEM 2MHz`

Defines a analog demodulation bandwidth of 2 MHz.

11.6.3.4 Defining the FM Broadcast

The following chapter describes command that define the FM deemphasis filter.

List of commands

- [SENSe:]FILTer:DEMPhasis:TCONstant on page 245

- `[SENSe:]FILTer:DEMPhasis[:STATe]` on page 245

[SENSe:]FILTer:DEMPhasis:TCONstant <AudioLowpassFilter>

This command sets the time constant for the FM deemphasis filter.

The only supported time constants are 50us and 75us.

Parameters:

<AudioLowpassFilter> Numeric value with the unit range of s | ms| us | ns.

Default unit: s

Example: `FILT:DEMP:TCON 50 us`

Sets the time constant for the FM deemphasis filter to 50 us.

[SENSe:]FILTer:DEMPhasis[:STATe] <State>

This command switches the FM deemphasis filter on or off.

Parameters:

<State> ON | OFF

ON

Turns the FM deemphasis filter on.

OFF

Turns the FM deemphasis filter off.

*RST: OFF

Example: `FILT:DEMP OFF`

Switches off the FM deemphasis filter.

11.6.3.5 Defining the Sweep Mode

The following chapter describes command that define the sweep mode and query measurement time.

List of commands

- `[SENSe:]ADEMod:MTIMe?` on page 245
- `INITiate[:IMMediate]` on page 214
- `INITiate:CONTinuous` on page 214

[SENSe:]ADEMod:MTIMe?

This command queries the measurement time in the analog modulation.

Example: `ADEM:MTIM?`

Queries the measurement time in the analog modulation

Usage: Query only

11.6.3.6 Configuring the Limit Line

The following chapter describes command necessary to configure the limit line and display the individual pass/fail measurement results of the analog modulation parameters.

List of commands

CALCulate<1...2>:ADEModulation:LIMit:SELect <Filename>

This command loads a limit line for the selected measurement mode.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2>   1...2

Parameters:
<Filename>   String containing the file name of the limit line.

Example: `CALC:ADEM:LIM:SEL 'GSM.aamlim'`
Selects the filename for limit line.

CALCulate<1...2>:ADEModulation:LIMit:DELete

This command clears the selected limit..

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2>   1...2

Example: `CALC:ADEM:LIM:DEL`
Clears off the selected limit line.

Usage: Event

CALCulate<1...2>:ADEModulation:LIMit:FAIL?

This command queries the result of a limit check.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end before reading out the result. This is only possible in single sweep mode.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2>   1...2

Example: `CALC:ADEM:LIM:FAIL?`
Queries the result of the check for limit line

Usage: Query only

11.6.3.7 Setting the Measurement Mode

The following chapter describes command necessary to switch to the correct measurement mode.

List of commands

CALCulate:FEED <Measurement>

This command switches the measurement mode.

Parameters:

<Measurement> String containing the measurement mode of analog modulation:

Example: CALC:FEED 'XTIM.AM'
Switches the measurement mode to AM Time.

Example: CALC:FEED 'XTIM.FM'
Switches the measurement mode to FM Time.

Example: CALC:FEED 'XTIM.AMSummary'
Switches the measurement mode to AM Summary.

Example: CALC:FEED 'XTIM.FMSummary'
Switches the measurement mode to FM Summary.

11.6.3.8 Reading out Measurement Results

The following chapter describes command necessary to display the measurement results.

List of commands

- `CALCulate<1...2>:MARKer:FUNCtion:ADEMod:THD[:RESult]?` on page 249
- `CALCulate<1...2>:MARKer:FUNCtion:ADEMod:FERRor[:RESult]?` on page 250
- `CALCulate<1...2>:MARKer:FUNCtion:ADEMod:MINDex[:RESult]?` on page 250
- `TRACe<1...2>[:DATA]?` on page 222

[SENSe:]ADEMod:FM:OFFSet?

This command displays the Frequency Deviation value for FM.

Example: ADEM:FM:OFFS?
Reads out the Frequency Deviation value for FM.

Usage: Query only

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:CARRier[:RESult]?

This command displays the Carrier Power value for both AM/FM.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2> 1...2

Parameters:

Example: CALC:MARK:FUNC:ADEM:CARR?
Reads out the Carrier Power value for both AM/FM.

Usage: Query only

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:AM[:RESult]? <MeasType>

This command displays the results of frequency deviation for AM.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2> 1...2

Parameters:
<MeasType> PPEak | MPEak | MIDDle | RMS

PPEak
+Peak value

MPEak
-Peak value

MIDDle
-±Peak value/2

RMS
RMS value

Example: `CALC:MARK:FUNC:ADEM:AM RMS`
Reads out the RMS value for AM.

Usage: Query only

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:FM[:RESult]? <MeasType>

This command displays the results of frequency deviation for FM.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2> 1...2

Parameters:
<MeasType> PPEak | MPEak | MIDDle | RMS

PPEak
+Peak value

MPEak
-Peak value

MIDDle
-±Peak value/2

RMS
RMS value

Example: `CALC:MARK:FUNC:ADEM:FM RMS`
Reads out the RMS value for FM.

Usage: Query only

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:SINad[:RESult]?

This command displays the SINAD value for both AM/FM.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2> 1...2

Example: CALC:MARK:FUNC:ADEM:SIN?
Reads out the SINAD value for both AM/FM.

Usage: Query only

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:THD[:RESult]?

This command displays the THD value for both AM/FM.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2> 1...2

Example: CALC:MARK:FUNC:ADEM:THD?
Reads out the THD value for both AM/FM.

Usage: Query only

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:FERRor[:RESult]?

This command displays the Carrier Offset value for both AM/FM.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2> 1...2

Example: CALC:MARK:FUNC:ADEM:FERR?
Reads out the Carrier Offset value for both AM/FM.

Usage: Query only

CALCulate<1...2>:MARKer:FUNCtion:ADEMod:MINDex[:RESult]?

This command displays the Modulation Index value for AM.

The numeric suffix at CALCulate is irrelevant for this command.

Suffix:
<1...2> 1...2

Example: CALC:MARK:FUNC:ADEM:MIND?
Reads out the Modulation Index value for AM.

Usage: Query only

11.6.4 Remote Commands of the Power Meter

The chapter provides information on remote commands that configure and perform power measurements with the power sensor. These commands are available in power meter mode only.

Availability of remote commands for Power Sensor measurements
Note that the listed remote commands take effect only if a power sensor is connected.

Contents

- Chapter 11.6.4.7, "Selecting a Telecommunication Standard", on page 254

11.6.4.1 Setting the Frequency

The following chapter describes commands necessary to define frequency settings.

List of commands

[SENSe:]PMETer:FREQuency <Frequency>

This command sets the frequency of the power sensor.

Parameters:

<Frequency> Specified in the data sheet.

Default unit: GHz

Example: `PMET:FREQ 500 MHZ`

Sets the power sensor's frequency to 500 MHz.

CALCulate<1...2>:PMETer:CPOWer:BANDwidth <ChannelBW>

This command defines the channel bandwidth.

Available for the channel power meter.

The numeric suffix at CALCulate is irrelevant for this command.

Parameters:

<ChannelBW> Default unit: GHz

Example: `CALC:PMET:CPOW:BAND 5 MHZ`

Sets the channel bandwidth to 5 MHz.

11.6.4.2 Configuring Power Level Readout

The following chapter describes commands that configure the power level readout.

List of commands

CALCulate<1...2>:PMETer:RELative[:MAGNitude] <RefLevel>

This command sets the reference value for relative measurements.

The numeric suffix at CALCulate is irrelevant for this command.

Parameters:
<RefLevel> Default unit: dBm

Example: `CALC:PMET:REL 30`
The reference value to 30 dBm.

CALCulate<1...2>:PMETer:RELative[:MAGNitude]:AUTO <ONCE>

This command sets the current measurement result as the reference level for relative measurements.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALCulate is irrelevant for this command.

Parameters:
<ONCE> ONCE

Example: `CALC:PMET:REL ONCE`

CALCulate<1...2>:PMETer:RELative[:MAGNitude]:OFFSet <RefLvlOffset>

This command sets an offset for the reference value.

The numeric suffix at CALCulate is irrelevant for this command.

Parameters:
<RefLvlOffset> Default unit: dB

Example: `CALC:PMET:REL -10`

UNIT<1...2>:PMETer:POWer <Unit>

This command selects the unit of the power sensor.

The numeric suffix at UNIT has the following effects:

Table 11-4: Power measurement with R&S FSH-Z1, R&S FSH-Z18 and USB power sensors:

Unit 1	Power unit.
Unit 2	Not available.

Parameters:
<Unit> DBM | DB | WATT | VSWR | W

Note on the parameter DB: when applied to UNIT1, the power is relative to the reference level, when applied to UNIT2, the return loss is displayed.
Note on the parameter VSWR: the parameter is only available if applied to UNIT2.

Example: `UNIT1:PMET:POW DBM`
When measuring with the R&S FSH-Z1, R&S FSH-Z18 or USB power sensors: sets unit to dBm.

11.6.4.3 Defining the Measurement Time

The following chapter describes commands to define the measurement time of the power sensor.

List of commands

- [SENSe:]PMETer:MTIMe on page 253

[SENSe:]PMETer:MTIMe <MeasTime>

This command sets the duration of measurements.

Available for measurements with a power sensor.

Parameters:

<MeasTime> SHORt | NORMal | LONG

Example: `PMET:MTIMe SHOR`
Sets a short measurement time for power measurements.

11.6.4.4 Zeroing of the Power Sensor

List of commands

- CALibration<1...2>:PMETer:ZERO:AUTO on page 253

CALibration<1...2>:PMETer:ZERO:AUTO <ONCE>

This commands starts to zero the power sensor.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at CALibration is irrelevant for this command.

Parameters:

<ONCE> ONCE

Example: `CAL:PMET:ZERO:AUTO ONCE`
Starts to zero the power meter.

11.6.4.5 Defining the Video Bandwidth

Selecting a video bandwidth is only possible when you are measuring the peak envelope power with the R&S FSH-Z44 power sensor based on a customized (= user) standard.

Selecting a video bandwidth is only possible when you are measuring the peak envelope power with the power sensor based on a customized (= user) standard.

See the following commands for more information about these conditions:

- CALCulate<1...2>:PMETer:PRESet[:STATe] on page 255
- CALCulate<1...2>:PMETer:PRESet:SELect on page 255

List of commands

- CALCulate<1...2>:PMETer:PRESet:BANDwidth:VIDeo on page 254

CALCulate<1...2>:PMETer:PRESet:BANDwidth:VIDeo <VideoBW>

This command defines the video bandwidth of the R&S FSH-Z44 power sensor.

The numeric suffix at CALCulate is irrelevant for this command.

Parameters:

<VideoBW> Default unit: GHz

Example: `CALC:PMET:PRES:BAND:VID 10MHZ`
Defines a video bandwidth of 10 MHz.

11.6.4.6 Reading Out Measurement Results

List of commands

- FETCh<1...2>:PMETer on page 254

FETCh<1...2>:PMETer

This command queries the results of measurements with the power sensor.

Parameters:

<Return values> The return values depend on the power sensor in use and the selected suffix at FETCh.
Measurements with R&S FSH-Z1 or R&S FSH-Z18:
`FETC1:PMET?`
power in dBm.
`FETC2:PMET?`
n/a

Example: `FETC2:PMET?`
Returns nothing for R&S FSH-Z1 / R&S FSH-Z18.

11.6.4.7 Selecting a Telecommunication Standard

These commands apply radio communication standards to measurements with the power sensor.

Note that the selection of a standard is available only for the power sensors R&S FSH-Z1 and -Z18.

List of commands

- CALCulate<1...2>:PMETer:PRESet[:STATe] on page 255
- CALCulate<1...2>:PMETer:PRESet:SELect on page 255

CALCulate<1...2>:PMETer:PRESet[:STATe] <State>

This command turns the use of a standard on and off.

The numeric suffix at CALCulate is irrelevant for this command.

Parameters:

<State> ON | OFF

Example: `CALC:PMET:PRES ON`
Activates usage of a standard.

CALCulate<1...2>:PMETer:PRESet:SELect <Standard>

This command selects the standard for power sensor measurements.

The numeric suffix at CALCulate is irrelevant for this command.

Parameters:

<Standard> E.g. GSM | EDGE | WCDMA | CDMAOne | CDMA2000 | DVBT | DAB | TETRA | USER

Example: `CALC:PMET:PRES:SEL GSM`
Selects the GSM standard for power sensor measurements.

11.6.5 File Management

The following commands perform various tasks in the context of file management.

These commands are independent from the operating mode.

List of commands

- SYSTem:SET:LOCK on page 260
- SYSTem:SET:UNLock on page 261

MMEMory:CATalog?

This command queries the files of the current directory.

You can select directories with MMEMory:CDIRectory on page 256.

This command is a query and therefore has no *RST value.

Example: `MMEM:CDIR '\Public\Limit Lines'`
Opens directory 'Limit Lines'.
`MMEM:CAT?`
Returns all files in \Public\Limit Lines.

Usage: Query only

MMEMory:CATalog:DIRectories?

This command queries the directories of the current directory.

This command is a query and therefore has no *RST value.

Example: `MMEM:CDIR '\Public'`
Opens directory \Public.
`MMEM:CAT:DIR?`
Returns all directories in the \Public directory.

Usage: Query only

MMEMory:CDIRectory <PathName>

This command changes the current directory.

Parameters:

<PathName> String containing the path to another directory.

Example: `MMEM:CDIR '\Public'`
Opens directory \Public.

MMEMory:COPY <SourceFile>, <Destination>

This command copies one or more files to another directory.

This command is an event and therefore has no *RST value and no query.

Parameters:

<SourceFile> String containing the path and file name of the source file.

<Destination> String containing the path and name of the destination file.

Example: `MMEM:COPY '\Public\Standards\cdmaOne.obwstd', '\USB\cdmaOne.std'`
Copies the cdmaOne standard file file to a memory stick.

Usage: Setting only

MMEMory:DATA <TargetFile>[, <Block>]

This command writes block data into a file. The delimiter must be set to EOI to obtain error-free data transfer.

When you query the contents of a file, you can save them in a file on the remote control computer.

The command is useful for reading stored settings files or trace data from the instrument or for transferring them to the instrument.

Parameters:

<TargetFile> String containing the path and file name.

<Block> <block_data>
Data block with the structure:
represents hash sign
<number> represents length of the length information
<number> represents length information of the binary data (number of bytes)
<data> binary data with the indicated number of bytes

Example:
`MMEM:NAME '\Public\User\Testfile.txt'`
Creates a new file called 'Testfile.txt'.
`MMEM:DATA '\Public\User\Testfile.txt',#220Contents of the file`
The parameter mean:
- '\Public\...' selects the target file
- #2: hash sign and length of the length information (20 bytes = 2 digits)
- 20: indicates the number of subsequent binary data bytes
- Contents of the file: store 20 binary bytes (characters) to the file
`MMEM:DATA? '\Public\User\Testfile.txt'`
Transfers the contents of the file 'Testfile.txt' to the control computer.

MMEMory:DELete <File>

This command deletes a file.

Parameters:

<File> String containing the path and file name of the file to delete.

Example:
`MMEM:DEL '\Public\Screen Shots\Screen0001.png'`
Deletes the file Screen0001.png.

Usage: Setting only

MMEMory:FILE <FileName>[, <Block>]

This command creates a file.

Parameters:

<FileName> String containing the file name.

<Block> <block_data>

Example: `MMEM:FILE 'TEST.TXT'`
Creates the file TEST.TXT.

MMEMory:FILE:DATE <FileName>[, <Year>, <Month>, <Day>]

This command sets the date of a file.

Parameters:

<FileName> String containing the path and file name.

<Year> Range: 1980 to 2099

<Month> Range: 1 to 12

<Day> Range: 1 to 31

Example: `MMEM:FILE:DATE '\Public\Screen Shots\Screen0001.png',2006,04,01`
Sets the date to April, 1st, 2006.
`MMEM:FILE:DATE? '\Public\Screen Shots\Screen0001.png'`
Returns the modification date of the file Screen0001.png.

MMEMory:FILE:TIME <FileName>[, <Hour>, <Minutes>, <Seconds>]

This command sets the time of a file. The sequence of entry is hour, minute, second.

Parameters:

<FileName> String containing the path and file name.

<Hour> Range: 0 to 23

<Minutes> Range: 0 to 59

<Seconds> Range: 0 to 59

Example: `MMEM:FILE:TIME '\Public\Screen Shots\Screen0006.png',11,04,00`
Sets the time to 11:04:00.

MMEMory:INIT [<DriveName>]

This command formats the indicated drive.

Note: Formatting deletes all data stored on the memory drive.

This command is an event and therefore has no *RST value and no query.

Parameters:
<DriveName>

Example: `MMEM:INIT`
Formats and deletes all data from the drive.

Usage: Setting only

MMEMory:LOAD:STATe <1>, <SettingsFile>

This command loads the settings from a *.set file.

Parameters:
<1>

<SettingsFile> String containing the path and file name.

Example: `MMEM:LOAD:STAT 1,`
`'\Public\Datasets\Dataset001.set'`
Loads the settings from the file Dataset001.

Usage: Setting only

MMEMory:MDIRectory <DirectoryName>

This command creates a new directory.

This command is an event and therefore has no *RST value and no query.

Parameters:
<DirectoryName> String containing the path and new directory name.

Example: `MMEM:MDIR '\Public\USER'`
Creates the a directory called 'User'.

Usage: Setting only

MMEMory:MOVE <SourceFile>, <Destination>

This command renames files, if <file_destination> contains no path. Otherwise the file is moved to the indicated path and stored under the file name specified there.

This command is an event and therefore has no *RST value and no query.

Parameters:
<SourceFile> String containing the path and file name of the source file.

<Destination> String containing the path and name of the destination file.

Example: `MMEM:MOVE '\Public\Screen Shots\Screen0002.png','\Public\Screen Shots\Screen0001.png'`
Renames Screen0002.png to Screen0001.png
`MMEM:MOVE '\Public\Screen Shots\Screen0001.png','\Public\Test\Pic1.png'`
Moves file Screen0006.png to the 'Test' folder and renames the file Pic1.png.

Usage: Setting only

MMEMory:RDIRectory <DirectoryName>

This command deletes the indicated directory. The directory name includes the path and may also include the drive name. The path name complies with DOS conventions.

This command is an event and therefore has no *RST value and no query.

Parameters:
<DirectoryName> String containing the path of the directory to delete.

Example: `MMEM:RDIR '\Public\Screen Shots\`
Deletes the directory 'Screen Shots'.

Usage: Setting only

MMEMory:STORe:STATe <1>, <TargetFile>

This command stores the current device settings in a *set file.

This command is an event and therefore has no *RST value and no query.

Parameters:
<1>

<TargetFile>

Example: `MMEM:STOR:STAT 1,'DATASET001.SET'`
Saves the current device settings in the file DATASET001.SET.

Usage: Setting only

SYSTem:SET:LOCK <arg0>

This command adds write-protection to a dataset.

Parameters:
<arg0> String containing the path and name of the dataset.

Example: `SYST:SET:LOCK 'Dataset001.set'`
Protects the file Dataset001.set from overwriting.

SYSTem:SET:UNLock <arg0>

This command removes write-protection from a dataset.

Parameters:

<arg0> String containing the path and name of the dataset.

Example: `SYST:SET:UNL 'Dataset001.set'`
Removes write-protection from the file Dataset001.set.

11.6.6 Making and Storing Screenshots

The following commands manage screenshots.

These commands are independent from the operating mode.

List of commands

DISPlay<1...2>[:WINDow]:STORe <TargetFile>

This command makes a screenshot of the current display contens in png or jpg format and stores it on the R&S Spectrum Rider internal memory.

You can select a file name for the screenshot in png format with `MMEMory:NAME` on page 262 and select the file format of the screenshot with `HCOPy:DEVice:LANGuage` on page 261.

This command is an event and therefore has no *RST value and no query.

The numeric suffix at DISPlay is irrelevant for this command.

Parameters:

<TargetFile>

Example:
```
HCOP:DEV:LANG PNG
MMEM:NAME '\Public\Screen Shots\Test.png'
DISP:WIND:STOR
```
Makes and stores a screenshot of the current screen in a file 'Test.png'.

Usage: Setting only

HCOPy:DEVice:LANGuage <Format>

This command selects the file format for screenshots.

Parameters:

<Format> PNG | JPG

Example: `HCOP:DEV:LANG PNG`
Selects the png format for screenhots.

HCOPy[:IMMediate]

This command makes a screenshot of the current display contens in png format and stores it on the R&S Spectrum Rider internal memory.

You can select a file name for the screenshot in png format with `MMEMory:NAME` on page 262 and select the file format of the screenshot with `HCOPy:DEVice:LANGuage` on page 261.

To make a screenshot in jpg format, use `DISPlay<1...2>[:WINDow]:STORe` on page 261.

This command is an event and therefore has no *RST value and no query.

Example:
```
HCOP:DEV:LANG PNG
MMEM:NAME '\Public\Screen Shots\Test.png'
HCOP
```
Makes and stores a screenshot of the current screen in a file 'Test.png'.

Usage: Event

MMEMory:NAME <FileName>

This command defines the path and file name that the R&S Spectrum Rider uses for storing screenshots (see `HCOPy[:IMMediate]` on page 262). The path and file name comply with DOS conventions.

This command is an event and therefore has no *RST value and no query.

Parameters:
<FileName> String containing the file name.

Example: `MMEM:NAME 'Public\Screeshots\Test.png'`
Stores the screenshot on the in the corresponding directory on the R&S Spectrum Rider.

11.6.7 Configuring Data Capture

The following commands configure the data capture.

These commands are independent from the operating mode.

List of commands

- SYSTem:CAPTure:SCReen[:STATe] on page 264

SYSTem:CAPTure:COUNter <CaptureCounter>

This command defines the start of the file name counter.

The counter numbers the files stored when you capture data (screenshots, datasets etc.).

Parameters:

<CaptureCounter> String containing the number with which to start numbering files.

*RST: '0000'

Example: `SYST:CAPT:COUN '0100'`
Starts numbering files with 0100, e.g. Measurement0100.png.

SYSTem:CAPTure:DATaset[:STATe] <State>

This command includes or excludes datasets from the data capture.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SYST:CAPT:DAT ON`
Includes datasets into the data capture.

SYSTem:CAPTure:GPX[:STATe] <State>

This command includes or excludes GPX information from the data capture.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SYST:CAPT:GPX ON`
Includes GPX information into the data capture.

SYSTem:CAPTure:MODE <CaptureMode>

This command selects the data types that the R&S Spectrum Rider saves when you capture the current measurement data.

Parameters:

<CaptureMode> SCReen | DATaset | BOTH

SCReen
Saves a screenshot.

DATaset
Saves a dataset.

BOTH
Saves a screenshot and a dataset.

*RST: SCReen

Example: `SYST:CAPT:MODE BOTH`
Captures both a screenshot and a dataset of the current measurement.

SYSTem:CAPTure:SCReen[:STATe] <State>

This command includes or excludes screenshots from the data capture.

Parameters:

<State> ON | OFF

*RST: ON

Example: `SYST:CAPT:SCR ON`
Includes screenshots into the data capture.

11.6.8 Saving Events

The following commands configure the circumstances under which the R&S Spectrum Rider saves events.

These commands are independent from the operating mode.

Using the commands requires an GPS receiver and a storage device (SD card or memory stick).

List of commands

SYSTem:SOEVent:DISTance:INTerval <Seconds>

This command defines a distance that you must cover before the R&S Spectrum Rider saves another coordinate.

Parameters:

<Seconds> Distance between one coordinate and the next.

*RST: 1 m

Example:

`SYST:SOEV ON`
Turns on saving coordinates on an event.
`SYST:SOEV:REC:STOR USB`
Selects a USB device as the storage device.
`SYST:SOEV:SOUR DIST`
`SYST:SOEV:DIST:INT 5`
Saves the coordinates every 5 m.

SYSTem:SOEVent:LIMits:MODE <arg0>

This command selects the limit check condition that must occur in order to save a coordinate.

Parameters:

<arg0> STARtonfail | STOPonfail | FAILonly

STARtonfail
Starts to save all sweeps from the moment a limit check fails.

STOPonfail
Saves all sweeps until a limit check fails.

FAILonly
Saves only sweeps that contain a limit check violation.

*RST: STAR

Example:

`SYST:SOEV:SOUR LIM`
`SYST:SOEV:LIM:MODE FAIL`
Saves all sweeps that contain a violation of a limit check.

SYSTem:SOEVent:RECording:STORage <arg0>

This command selects the storage device to save the coordinates to.

Parameters:

<arg0> SDCard | USB

SDCard
Saves coordinates to an SD card.

USB
Saves coordinates to a USB device.

*RST: SDCard

Example: See `SYSTem:SOEVent:DISTance:INTerval` on page 264

SYSTem:SOEVent:SOURce <arg0>

This command selects the type of event that triggers saving the coordinates of your current location.

Parameters:

<arg0> TIMeinterval | LIMitsfail | DISTanceint | ALLSweeps

TIMeinterval
Saves coordinates after a certain length of time has passed.

LIMitsfail
Saves coordinates when a limit check has failed.

DISTanceint
Saves coordinates after a certain distance has been covered.

ALLSweeps
Saves coordinates after each sweep.

*RST: TIMeinterval

Example: See `SYSTem:SOEVent:DISTance:INTerval` on page 264.

SYSTem:SOEVent:TIME:INTerval <Seconds>

This command defines a time interval that must pass before the R&S Spectrum Rider saves another coordinate.

Parameters:

<Seconds> Time that must pass between one coordinate and the next.

*RST: 1 s

Example:

`SYST:SOEV ON`
Turns on saving coordinates on an event.
`SYST:SOEV:REC:STOR USB`
Selects an USB device as the storage device.
`SYST:SOEV:SOUR TIM`
`SYST:SOEV:TIME:INT 5`
Saves the coordinates every 5 seconds.

SYSTem:SOEVent[:STATe] <State>

This command turns saving of your current coordinates in case of certain events on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: See `SYSTem:SOEVent:DISTance:INTerval` on page 264

11.6.9 Configuring the Instrument

The following commands configure general instrument settings.

These commands are independent from the operating mode.

Contents

11.6.9.1 Mode Selection

This chapter describes all commands that select the operating mode of the R&S Spectrum Rider.

List of commands

INSTrument[:SELect] <OperatingMode>

This command selects the operating mode.

Parameters:

<OperatingMode> SANalyzer | PM | ADEModulation

SANalyzer
spectrum analyzer

PM
power meter

ADEModulation
analog modulation

*RST: SAN

Example:

`INST SAN`
Selects spectrum analyzer mode.

INSTrument:NSELect <OperatingMode>

This command selects the operating mode.

Parameters:

<OperatingMode>

1
spectrum analyzer

5
power meter

18
analog modulation

*RST: 1

Example: `INST:NSEL 1`
Selects spectrum analyzer mode.

11.6.9.2 Controlling the GPS Receiver

This chapter describes all commands that control the GPS receiver.

List of commands

SYSTem:POSition:ALTitude?

This command queries the altitude of the current position of the R&S Spectrum Rider.

Example: `SYST:POS:ALT?`
Return value would be, for example, 554.1.

Usage: Query only

SYSTem:POSition:GPS:CONNected?

This command queries if the R&S Spectrum Rider is currently connected to the GPS receiver.

Example: `SYST:POS:GPS:CONN?`

Usage: Query only

SYSTem:POSition:GPS:CORRection:FREQuency?

This command queries the frequency correction factor.

The R&S Spectrum Rider calculates this factor from a reference signal provided by the GPS receiver. The reference signal is used to determine the deviation of the internal clock of the instrument. The deviation can be turned into a correction factor for the measured frequency.

Example: `SYST:POS:GPS:CORR:FREQ?`
Queries the frequency correction factor.

Usage: Query only

SYSTem:POSition:GPS:QUALity?

This command queries the quality of the GPS signal.

Example: `SYST:POS:GPS:QUAL?`

Usage: Query only

SYSTem:POSition:GPS:SATellites?

This command queries the number of tracked satellites.

Example: SYST:POS:GPS:SAT?

Usage: Query only

SYSTem:POSition:GPS[:STATe] <State>

This command turns the GPS receiver on and off.

Note that the GPS receiver only works if a connection between the R&S Spectrum Rider and a GPS signal transmitter is established.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SYST:POS:GPS ON`

Activates the GPS receiver.

SYSTem:POSition:LATitude?

This command queries the latitude of the current position of the R&S Spectrum Rider.

Example: `SYST:POS:LAT?`

Return value would be, for example, 48,7,40.0 for 48°, 7 ', 40.0" in the northern hemisphere.

Usage: Query only

SYSTem:POSition:LONGitude?

This command queries the longitude of the current position of the R&S Spectrum Rider.

Example: `SYST:POS:LONG?`

Return value would be, for example, 11,36,46.2 for 11°, 36', 46.2" East.

Usage: Query only

SYSTem:POSition:VALid?

This command queries if the current position is valid.

Example: `SYST:POS:VAL?`

Usage: Query only

11.6.9.3 Display Configuration

This chapter describes commands to set up the display of the R&S Spectrum Rider via remote control.

List of commands

DISPlay:BRIGhtness <Brightness>

This command sets the brightness of the display backlight.

Parameters:

<Brightness> Range: 0 to 1
*RST: 0.5

Example: `DISP:BRIG 0.80`
Sets the brightness of the display to 80%.

DISPlay:CMAP <ColorScheme>

This command sets the color scheme of the display.

Parameters:

<ColorScheme> COLor | BW | PF

COLor
Color

BW
Black & white

PF
Printer-friendly

*RST: COLor

Example: `DISP:CMAP BW`
Sets the screen colors to black and white.

DISPlay:CMAP:DEFault

This command sets the display to the default state.

This command is an event and therefore has no query and no *RST value.

Example: `DISP:CMPA:DEF`
Restores the original color scheme.

Usage: Event

DISPlay:DATE:FORMat <DateFormat>

This command sets the display date format.

Parameters:

<DateFormat> DDMMyyyy | MMDDyyyy
*RST: DDMMyyyy

Example: `DISP:DATE:FORM DDMMyyyy`

11.6.9.4 Audio Settings

This chapter describes all commands to control the audio functions of the R&S Spectrum Rider.

List of commands

SYSTem:AUDio:VOLume <Volume>

This command sets the volume of the internal speaker.

Parameters:

<Volume> Range: 0 to 1
*RST: 0.3

Example: `SYST:AUD:VOL 0.40`
Sets the volume to 40%.

SYSTem:BEEPer:VOLume <Volume>

This command sets the volume of the system beeper.

Parameters:

<Volume> Range: 0 to 1
*RST: 0.3

Example: `SYST:BEEP:VOL 0.50`
Sets the volume of the beeper to 50%.

SYSTem:BEEPer:KEY:VOLume <Volume>

This command sets the volume of the keyboard click noise.

Parameters:

<Volume>	Range:	0 to 1
	*RST:	0.3

Example: `SYST:BEEP:KEY:VOL 0.10`
Sets of keyboard clicking volume to 10%.

11.6.9.5 Setting up a Network Connection

This chapter describes all commands that are used if the R&S Spectrum Rider is part of a network.

List of commands

SYSTem:COMMunicate:LAN:ETHernet

This command queries the MAC address of the R&S Spectrum Rider.

This command is a query and therefore has no *RST value.

Example: `SYST:COMM:LAN:ETH?`
Returns the MAC address.

SYSTem:COMMunicate:LAN:GATeway <Gateway>

This command sets the gateway in the LAN.

Parameters:

<Gateway> String containing the identifier of the gateway.

SYSTem:COMMunicate:LAN:SUBMask <Submask>

This command sets the subnet mask of the R&S Spectrum Rider

Parameters:

<Submask> String containing the subnet mask ('x.x.x.x').
*RST: 255.255.255.0

Example: `SYST:COMM:LAN:SUBM '255.255.255.0'`
Sets the subnet mask address to 255.255.255.0.

SYSTem:COMMunicate:SOCKet:ADDRess <IPAddress>

This command sets the IP address of the R&S Spectrum Rider.

Parameters:

<IPAddress> String containing the IP address ('x.x.x.x').

*RST: 172.76.68.24

Example: `SYST:COMM:SOCK:ADDR '172.76.68.30'`

Sets the IP address of theR&S Spectrum Rider to 172.76.68.30.

SYSTem:COMMunicate:SOCKet:DHCP[:STATe] <State>

This command turns the Dynamic Host Configuration Protocol (DHCP) on and off.

Parameters:

<State> ON | OFF

*RST: ON

Example: `SYST:COMM:SOCK:DHCP ON`

Activates DHCP.

SYSTem:COMMunicate:SOCKet:PORT <Port>

This command sets the port number for the connection.

Parameters:

<Port> Port number.

*RST: 5555

Example: `SYST:COMM:SOCK:PORT 1000`

Sets the port number to 1000.

11.6.9.6 System Settings

This chapter describes all commands that define or query general system settings.

List of commands

INPut:IMPedance:PAD <PadType>

This command selects the matching pad connected to the R&S Spectrum Rider.

Parameters:

<PadType> RAM | RAZ | HZTE

Example: `INPut:IMP 75;PAD RAZ`
Selects 75 Ω input impedance and the R&S RAZ as the matching pad.

[SENSe:]ROSCillator:SOURce <Format>

This command selects the source of the frequency reference oscillator.

If you use an external reference signal, make sure to connect the signal to the Ext Ref BNC connector of the R&S Spectrum Rider.

Parameters:

<Format> INTernal | EXTernal

INTernal
Internal reference.

EXTernal
External reference.

Example: `ROSC:SOUR EXT`
Activates external source as reference signal.

SYSTem:ACCessory <Accessory>

This command queries the type of measurement accessory, if one is connected to the R&S Spectrum Rider (for example a power sensor).

Parameters:

<Accessory> Z1 | Z2 | Z3 | Z18 | TS_emf | NONE | UNKNown

Name of the accessory.

Example: `SYST:ACC?`

Queries connected measurement accessories.

SYSTem:ACCessory:AUTO <State>

This command turns automatic detection of connected measurement accessories on and off.

Parameters:

<State> ON | OFF

Example: `SYST:ACC:AUTO ON`

Turns on automatic accessory detection.

SYSTem:BNC:MODE <BNCUsage>

This command configures the BNC sockets.

Parameters:

<BNCUsage> REFerence | TRIGger | BIAS

REFerence
Input for external reference signal.

TRIGger
Input for external trigger.

BIAS
BIAS port.

*RST: TRIGger

Example: `SYST:BNC:MODE BIAS`

Sets the BNC socket to bias.

SYSTem:DATE <Year>, <Month>, <Day>

This command sets the date for the internal calendar.

Parameters:

<Year> Range: 1980 to 2099

<Month> Range: 1 to 12

<Day> Range: 1 to 31

Example: `SYST:DATE 2000,6,1`
Sets the date to 1/6/2000.

SYSTem:ERRor[:NEXT]?

This command queries the oldest entry in the error queue and deletes it.

This command is a query and therefore has no *RST value.

Example: `STAT:ERR?`

Usage: Query only

SYSTem:ERRor:ALL?

This command queries the complete error queue.

This command is a query and therefore no *RST value.

Example: `SYST:ERR:ALL?`

Usage: Query only

SYSTem:ERRor:CODE[:NEXT]?

This command queries the code of the next error in the error queue.

This command is a query and therefore has no *RST value.

Example: `STAT:ERR:CODE?`

Usage: Query only

SYSTem:ERRor:CODE:ALL?

This command queries the complete error queue.

This command is a query and therefore no *RST value.

Example: `SYST:ERR:CODE:ALL?`

Usage: Query only

SYSTem:ERRor:COUNt?

This command queries the number of errors currently in the error queue.

This command is a query and therefore no *RST value.

Example: `SYST:ERR:COUN?`

Usage: Query only

SYSTem:FORMat:IDENt <Format>

This command sets the response format to the *IDN? query. This function is intended for re-use of existing control programs together with the R&S Spectrum Rider.

Parameters:

<Format> LEGacy | NEW

LEGacy
Format that is compatible to the older R&S Spectrum Rider version.

NEW
Format that is compatible to the newer R&S Spectrum Rider version.

Example:
`SYST:FORM:IDEN LEG`
`*IDN?`
IDN would return the older R&S Spectrum Rider version.
`SYST:FORM:IDEN NEW`
`*IDN?`
IDN would return the newer R&S Spectrum Rider version.

SYSTem:HELP:HEADers?

This command returns a list of all available remote control commands.

This command is a query and therefore no *RST value.

Example:
`SYST:HELP:HEAD?`
Returns the syntax of all available commands.

Usage: Query only

SYSTem:HELP:SYNTax? <arg0>

This command returns the full syntax of the specified command.

This command is a query and therefore no *RST value.

Parameters:

<arg0> String containing the command you want to query.

Example:
`SYST:HELP:SYNT? 'SYST:ERR?'`
Returns the full syntax. In this case: 'SYSTem:ERRor[:NEXT]'.

Usage: Query only

SYSTem:LANGuage <Language>

This command sets the language of the R&S FSH user interface. You can query a list of available languages with `SYSTem:LANGuage:CATalog?` on page 278.

Parameters:

<Language> String containing the language.

Example: `SYST:LANG 'english'`
Sets the system language to English.

SYSTem:LANGuage:CATalog?

This command lists all languages available for the user interface.

This command is a query and therefore no *RST value.

Example: `SYST:LANG:CAT?`

Usage: Query only

SYSTem:POWer:SOURce?

This command queries the current R&S Spectrum Rider power source.

This command is a query and therefore has no *RST value.

Example: `SYST:POW:SOUR?`

Usage: Query only

SYSTem:POWer:STATus?

This command queries the remaining power of the battery.

This command is a query and therefore has no *RST value.

Example: `SYST:POW:STAT?`

Usage: Query only

SYSTem:PRESet

Resets the R&S Spectrum Rider to its default state or a state defined by the user, depending on SYSTem:PRESet:MODE.

This command is an event and therefore has no *RST value and no query.

Example: `SYST:PRES`

Usage: Event

SYSTem:PRESet:FACTory

This command initiates an instrument reset back to factory settings.

This command is an event and therefore has no query and no *RST value.

Example: `SYST:PRES:FACT`
Resets the R&S Spectrum Rider to its factory settings.

Usage: Event

SYSTem:PRESet:MODE <Mode>

This command selects the preset mode.

Parameters:

<Mode> DEFault | USER

DEFault
Default preset state.

USER
User defined preset state.

Example: `SYST:PRES:MODE USER`
Selects a user defined preset.

SYSTem:PRESet:USER <PathName>

This command selects a file containing a user defined preset state.

Parameters:

<PathName> Filename of the user defined preset state.

SYSTem:REBoot

This command initiates a reboot of the R&S Spectrum Rider.

This command is an event and therefore has no *RST value and no query.

Example: `SYST:REB`
Restarts the R&S Spectrum Rider.

Usage: Event

SYSTem:SHUTdown

This command turns the R&S Spectrum Rider off.

This command is an event and therefore has no *RST value and no query.

Example: `SYST:SHUT`
Turns the R&S Spectrum Rider off.

Usage: Event

SYSTem:TIME <Hour>, <Minutes>, <Seconds>

This command sets the internal clock.

Parameters:

<Hour> Range: 0 to 23

<Minutes> Range: 0 to 59

<Seconds> Range: 0 to 59

Example: `SYST:TIME 12,30,30`

SYSTem:TZONee <Hour>, <Minutes>

This command defines a shift of the system time to select another time zone.

Parameters:

<Hour>	Range:	0 to 23
<Minutes>	Range:	0 to 59
	*RST:	0,0

Example: `SYST:TZON 01,00`
Shifts the time an hour ahead.

SYSTem:VERSion?

This command queries the SCPI version the remote control is based on.

This command is a query and therefore has no *RST value.

Example: `SYST:VERS?`

Usage: Query only

11.6.10 Status Reporting System

The status reporting system stores all information on the present operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via Ethernet.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers `STATus:OPERation` and `STATus:QUEStionable` which are defined by SCPI and contain detailed information on the instrument.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB.

11.6.10.1 Structure of an SCPI Status Register

Each standard SCPI register consists of 5 parts which each have a width of 16 bits and have different functions. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number that applies to all five parts. For example, bit 0 of the STATus:OPERation register is assigned to the calibration status of the R&S

Spectrum Rider. 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 integer.

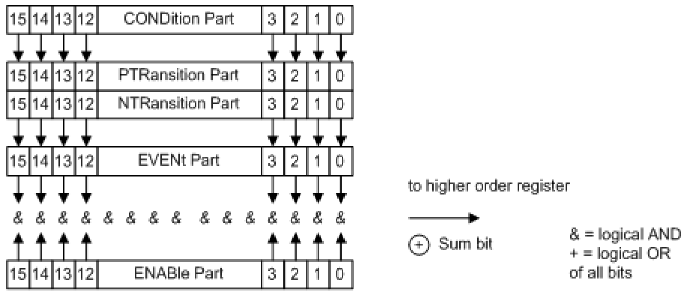


Figure 11-6: The status-register model

CONDition part

The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part

The Positive-TRansition part acts as an edge detector. 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 at will. Its contents is not affected by reading.

NTRansition part

The Negative-TRansition part also acts as an edge detector. 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 at will. Its contents is not affected by reading.

With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part

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 edge 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 part

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 at will. Its contents is not affected by reading.

Sum bit

As indicated above, 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, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.

11.6.10.2 Overview of the Status Register

The following figure shows the status registers used by the R&S Spectrum Rider.

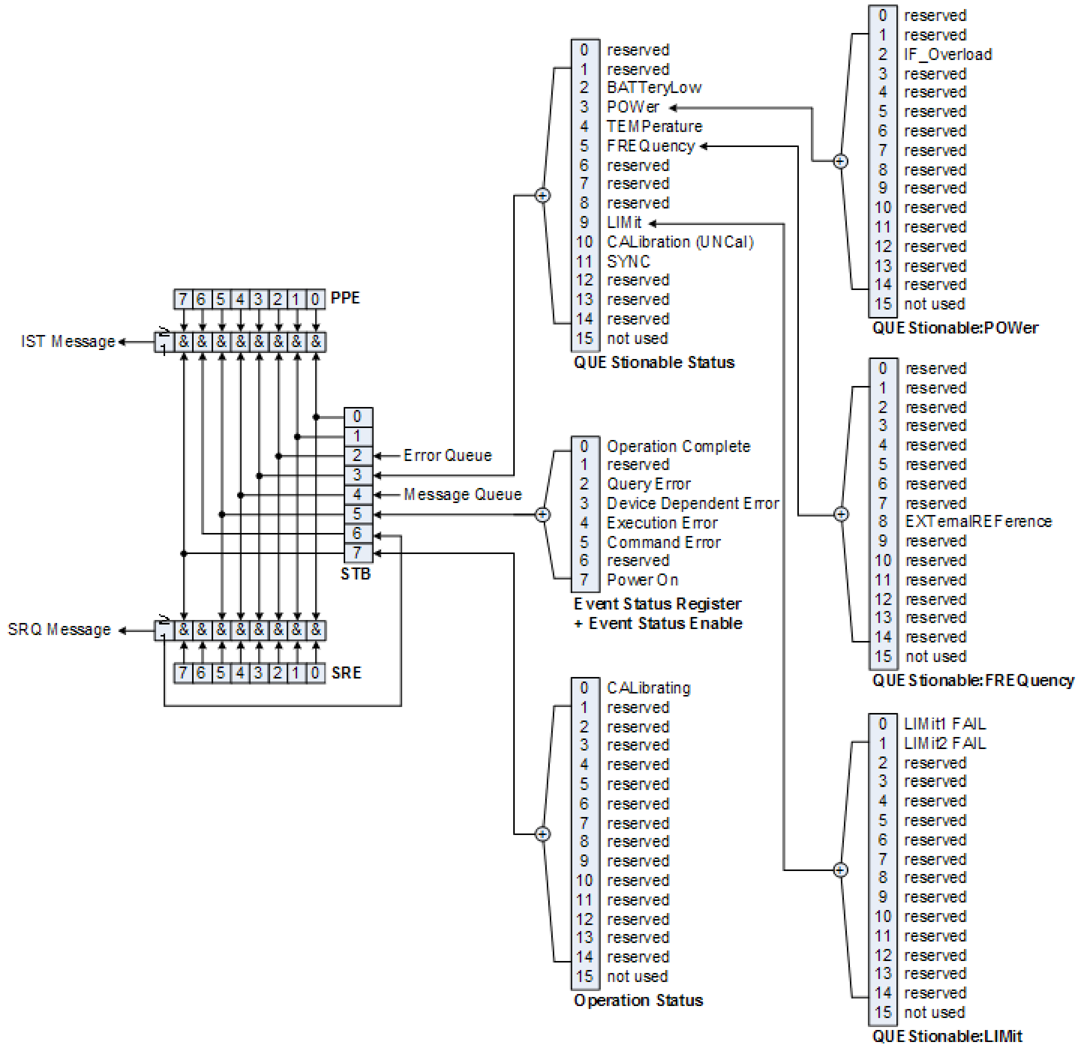


Figure 11-7: Overview of the status registers

11.6.10.3 Status Byte (STB) & Service Request Enable Register (SRE)

The 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. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STATUS BYTE is read using the command `*STB?` or a serial poll.

The STB is linked to the SRE. The latter corresponds to the ENABle part of the SCPI registers in its function. 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, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there. The SRE can be set using the command "*SRE" and read using the command `*SRE?`

Table 11-5: Meaning of the bits used in the Status Byte

Bit No.	Meaning
0 to 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 sum 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 polling the QUEStionable status register.
4	MAV bit (message available) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
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	OPERation status register sum 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 polling the OPERation status register.

11.6.10.4 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 is the associated ENABle part. It can be set using the command `*ESE` and read using the command `*ESE?`.

Table 11-6: Meaning of the bits 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

Bit No.	Meaning
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	Not used
7	Power On (supply voltage on) This bit is set on switching on the instrument.

STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using the commands `STATus:OPERation:CONDition?` or `STATus:OPERation[:EVENt]?`.

Table 11-7: Meaning of the bits in the STATus:OPERation register

Bit No.	Meaning
0	CALibrating This bit is set as long as the instrument is performing a calibration.
1 to 14	Not used
15	This bit is always 0

STATus:QUEStionable Register

This register contains information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be read using the commands `STATus:QUEStionable: CONDition?` and `STATus:QUEStionable[:EVENt]?`.

Table 11-8: Meaning of bits in STATus:QUEStionable register

Bit No.	Meaning
0 to 1	These bits are not used
2	BATTERY LOW If the instrument is running without any external power supply and the charging level of the internal battery is approximately lower than 5% this bit is set to indcate that the system will be shut down automatically in approx. 5 minutes.
3	Not used
4	TEMPerature This bit is set if a questionable temperature occurs.
5 to 8	Not used
9	LIMit (device-specific) This bit is set if a limit value is violated
10	CALibration The bit is set if a measurement is performed unaligned (label UNCAL)
11 to 14	Not used
15	This bit is always 0.

STATus:QUEStionable:FREQuency Register

This register contains information about the reference frequency. It can be read using the commands `STATus:QUEStionable:LIMit:FREQuency?` and `STATus:QUEStionable:FREQuency[:EVENt]?`.

Table 11-9: Meaning of bits in STATus:QUEStionable:FREQuency register

Bit No.	Meaning
0 to 7	Not used
8	EXTernal REFerence This bit is set if an external reference is used.
9 to 14	Not used
15	This bit is always 0.

STATus:QUEStionable:LIMit Register

This register contains information about the observance of limit lines. It can be read using the commands `STATus:QUEStionable:LIMit:CONDition?` and `STATus:QUEStionable:LIMit[:EVENt]?`.

Table 11-10: Meaning of bits in STATus:QUEStionable:LIMit register

Bit No.	Meaning
0	LIMit 1 FAIL This bit is set if limit line 1 is violated.
1	LIMit 2 FAIL This bit is set if limit line 2 is violated.
2 to 14	Not used
15	This bit is always 0.

STATus:QUEStionable:POWer Register

This register contains information about possible overload states. It can be read using the commands `STATus:QUEStionable:POWer:CONDition?` and `STATus:QUEStionable:POWer[:EVENt]?`.

Table 11-11: Meaning of bits in STATus:QUEStionable:POWer register

Bit No.	Meaning
0 to 1	Not used
2	IF_Overload This bit is set if the IF path is overloaded. 'IFOVL' is displayed.
3 to 14	Not used
15	This bit is always 0.

STATus:QUEStionable:SYNC Register

This register contains information about sync and bursts not found, and about premeasurement results exceeding or falling short of expected values.

It can be read using the commands `STATus:QUEStionable:SYNC:CONDition?` and `STATus:QUEStionable:SYNC[:EVENt]?`.

11.6.10.5 Application of the Status Reporting Systems

In order to be able to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are represented in the following.

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. As evident from Figure 11-7, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The ENABle parts of the status registers can be set so that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request effectively, all bits should be set to "1" in enable registers SRE and ESE.

Example:

Use of the command *OPC to generate an SRQ at the end of a sweep

- `CALL InstrWrite(analyzer, "*ESE 1")`
  'Set bit 0 in the ESE (Operation Complete)
- `CALL InstrWrite(analyzer, "*SRE 32")`
  'Set bit 5 in the 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 in a way that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

Serial Poll

In a serial poll, just as with command `*STB`, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster. The serial-poll method has already been 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 with instruments which do not adhere to SCPI or IEEE 488.2.

The VISUAL BASIC command for executing a serial poll is IBRSP(). Serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

Query by Means of Commands

Each part of any status register can be read by means of queries. The individual commands are listed in the description of the STATus Subsystem. The returned value is always a number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue Query

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 displayed via manual operation using the setup menu or queried via remote control using the command `SYSTem:ERRor?`. Each call of `SYSTem:ERRor?` 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.

11.6.10.6 Reset Values of the Status Reporting System

Table 11-12 contains the different commands and events causing the status reporting system to be reset. None of the commands, except `*RST` and `SYSTem:PRESet`, influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 11-12: Resetting the status reporting system

Event	Switching on supply voltage	DCL,SDC				
	Power-On-Status-Clear		(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 EVENt parts of the registers	-	yes	-	-	-	yes
Clear ENABle parts of all OPERation and QUEStionable registers; Fill ENABle parts of all other registers with "1".	-	yes	-	-	yes	-
Fill PTRansition parts with "1"; Clear NTRansition parts	-	yes	-	-	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) Every command being the first in a program message, i.e., immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

11.6.10.7 Remote Commands of the Status Reporting System

The following commands control the status-reporting system `*RST` does not influence the status registers.

The OPERation status register contains information about the calibration status of the instrument.

The QUEStionable status register contains information about the status of the reference and local oscillator, possible overloads of the instrument and the status of limit checks and limit margins.

The commands are independent from the operating mode.

List of commands

STATus:PRESet

This command resets the edge detectors and ENABle parts of all registers to a defined value. All PTRansition parts are set to FFFFh, 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 part of the STATus:OPERation and STATus:QUEStionable registers are set to 0, i.e. all events in these registers are not passed on.

Example: `STAT:PRES`

Usage: Event

STATus:QUEue[:NEXT]?

This command returns the earliest entry to the error queue and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "no error", is returned. This command is identical with the command SYSTem:ERRor.

Example: STAT:QUE?

Usage: Query only

STATus:OPERation[:EVENt]?

This command reads out the EVENt section of the OPERation register.

The command at the same time deletes the contents of the EVENt section.

Usage: Query only

STATus:OPERation:CONDition?

This command reads out the CONDition section of the OPERation register.

The command does not delete the contents of the EVENt section.

Usage: Query only

STATus:OPERation:ENABle <DecimalValue>

This command controls the ENABle part of the OPERation register.

The ENABle part allows true conditions in the EVENt part of the status register to bereported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<DecimalValue> Range: 0 to 65535

STATus:OPERation:NTRansition <DecimalValue>

This command controls the Negative TRansition part of the OPERation register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

STATus:OPERation:PTRansition <DecimalValue>

This command controls the Positive TRansition part of the OPERation register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

STATus:QUEStionable[:EVENt]?

This command reads out the EVENt section of the QUEStionable register.

The command at the same time deletes the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:FREQuency[:EVENt]?

This command reads out the EVENt section of the QUEStionable register.

The command at the same time deletes the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:LIMit[:EVENt]?

This command reads out the EVENt section of the QUEStionable register.

The command at the same time deletes the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:POWer[:EVENt]?

This command reads out the EVENt section of the QUEStionable register.

The command at the same time deletes the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:CONDition?

This command reads out the CONDition section of the QUEStionable register.

The command does not delete the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:FREQuency:CONDition?

This command reads out the CONDition section of the QUEStionable register.

The command does not delete the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:LIMit:CONDition?

This command reads out the CONDition section of the QUEStionable register.

The command does not delete the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:POWer:CONDition?

This command reads out the CONDition section of the QUEStionable register.

The command does not delete the contents of the EVENt section.

Usage: Query only

STATus:QUEStionable:ENABle <DecimalValue>

This command controls the ENABle part of the QUEStionable register.

The ENABle part allows true conditions in the EVENt part of the status register to bereported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<DecimalValue> Range: 0 to 65535

STATus:QUEStionable:FREQuency:ENABle <DecimalValue>

This command controls the ENABle part of the QUEStionable register.

The ENABle part allows true conditions in the EVENt part of the status register to bereported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:
<DecimalValue> Range: 0 to 65535

STATus:QUEStionable:LIMit:ENABle <DecimalValue>

This command controls the ENABle part of the QUEStionable register.

The ENABle part allows true conditions in the EVENt part of the status register to bereported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:
<DecimalValue> Range: 0 to 65535

STATus:QUEStionable:POWer:ENABle <DecimalValue>

This command controls the ENABle part of the QUEStionable register.

The ENABle part allows true conditions in the EVENt part of the status register to bereported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:
<DecimalValue> Range: 0 to 65535

STATus:QUEStionable:NTRansition <DecimalValue>

This command controls the Negative TRansition part of the QUEStionable register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:
<DecimalValue> Range: 0 to 65535

Example: `STAT:QUES:NTR 65535`

STATus:QUEStionable:FREQuency:NTRansition <DecimalValue>

This command controls the Negative TRansition part of the QUEStionable register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:
<DecimalValue> Range: 0 to 65535

Example: `STAT:QUES:NTR 65535`

STATus:QUEStionable:LIMit:NTRansition <DecimalValue>

This command controls the Negative TRansition part of the QUEStionable register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

Example: `STAT:QUES:NTR 65535`

STATus:QUEStionable:POWer:NTRansition <DecimalValue>

This command controls the Negative TRansition part of the QUEStionable register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

Example: `STAT:QUES:NTR 65535`

STATus:QUEStionable:PTRansition <DecimalValue>

This command control the Positive TRansition part of the QUEStionable register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

STATus:QUEStionable:FREQuency:PTRansition <DecimalValue>

This command control the Positive TRansition part of the QUEStionable register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

STATus:QUEStionable:LIMit:PTRansition <DecimalValue>

This command control the Positive TRansition part of the QUEStionable register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

STATus:QUEStionable:POWer:PTRansition <DecimalValue>

This command control the Positive TRansition part of the QUEStionable register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<DecimalValue> Range: 0 to 65535

12 Menu and Softkey Overview

This chapter shows an overview of all instrument functions in the form of softkey and menu overview.

12.1 General Functions

12.1.1 General R&S Spectrum Rider Setup

The SETUP key opens the setup menu that contains functionality to set up the R&S Spectrum Rider in general and functionality to set up the measurement.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Config Overview	Input	RF Impedance	50 Ω, 75 Ω RAM, 75 Ω RAZ, 75 Ω FSH-Z38
		Power Sensor	
	Amplitude	Ref Level	
		Ref Offset	
		Att Mode	Manual, Auto Low Distortion, Auto Low Noise
		RF Attenuation	
		RF Preamplifier	On, Off
	Frequency	Center Freq	
		Freq Offset	
		Span	Manual Span, Full Span, Zero Span, Last Span

Softkey	Menu or Dialog items		Parameters	Parameters selection	
	Bandwidth		RBW	Manual	1 Hz, 3 Hz, 10 Hz, 30 Hz, 100Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz,
				Auto	
			VBW	Manual	1 Hz, 3 Hz, 10 Hz, 30 Hz, 100Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz,
				Auto	
			SWT	Manual, Auto	
	Analysis	Analysis for T1	Trace Mode	Clear/Write, Max Hold Min Hold, Average	
			Average Count		
			Trace Math	Off, Trace - Memory, Memory - Trace	
			Detector	Auto	
		Analysis for T2		Manual	Auto Peak, Max Peak, Min Peak, Sample, RMS
	Trigger		Trigger Mode	Free Run, Video, External Rise, External Fall	
			Trigger Level	0 - 100 %	
			Trigger Delay	1 - 10 s	
Instrument Setup	Hardware		BNC	Trigger Input, Reference Input	
	GPS		GPS	On	
				Off	
			Show GPS Information	On	
				Off	
			Coordinate Format	dd° mm' ss.sss"	
				dd° mm.mmm'	
	LAN		MAC Address	On, Off	
			DHCP		
			IP Address		
			Subnet Mask		

Softkey	Menu or Dialog items	Parameters	Parameters selection
		Gateway	
	Date and Time	Set Date	
		Set Time	
		Time Zone	
	Regional	Language	English, French, German, Spanish, Italian, Portuguese, Japanese, Chinese, Korean, Russian, Hungarian, Traditional Chinese
		Date Format	dd/mm/yyyy,
			mm/dd/yyyy
	Display	Display Backlight	0 - 50 %
		Display Color Scheme	Color
			Black & White
			Printer Friendly
		Keyboard Backlight	0 - 50 %
		Keyboard Backlight Delay	1 - 10 s
		Touch Interface	On
			Off
	Audio	Key Click Volume	0 - 100 %
		System Beeper Volume	0 - 100 %
		Beep on Power Overboard	On
			Off
	Power	Current Power Source	
		Battery Level	
		Battery Low Level	
		Battery Low Level Beep	Repetitive
			Once
			Off
	Reset	Reset Factory Settings	Factory Reset

Softkey	Menu or Dialog items	Parameters	Parameters selection
User Pref-erence	Site Name	Site Name	
		User	
		Comments	
	Preset Key	Preset Mode	User Defined
			Default
		Preset Data-set	
	Working Directory	User working directory	On
			Off
		Working directory	
	Capture	Default File-name	
		Filename Counter Starts at	
		Capture Screen For-mat	PNG
			JPG
	Dataset	Default Data-set Name	
HW/SW info	Hardware	Instrument Model	
		Instrument Serial Num-ber	
		Mainboard Part Number	
		Mainboard Revision	
		Mainboard Serial Num-ber	
		Frontboad Part Number	
		Frontboard Revision	
		Frontboard Serial Num-ber	
		Controller Version	

Softkey	Menu or Dialog items	Parameters	Parameters selection
	Software	Software Version	
Installed Options	Option Administration		
	Install Option		
	Installation Status		

12.1.2 File Management

The SAVE/RECALL key opens the file manager that contains functionality to manage datasets and other files.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Save	Virtual Keyboard (see Chapter 3.2.4, "On-screen Keyboard", on page 43)		
	Exit		
Recall	Load		
	Refresh		
	Exit		
Recall Screenshot	Edit	Rename	
		Cut	
		Copy	
		Paste	
		Delete	
	Preview	Prev	
		Next	
		Exit	
	Refresh		
	Exit		
File Manager	Mark		
	Edit	Rename	
		Cut	
		Copy	
		Paste	
		Delete	

Softkey	Menu or Dialog items	Parameters	Parameters selection
	Preview	Prev	
		Next	
		Exit	
	Load		
	Refresh		
	Exit		

12.1.3 Operating Mode Selection

The MODE key opens the mode menu that contains functionality to select the operating mode of the R&S Spectrum Rider.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Spectrum	See Chapter 6, "Spectrum Analyzer Mode", on page 111		
Analog Demod	See Chapter 10, "Analog Modulation (R&S FPH-K7)", on page 169		
Power Meter	See Chapter 7, "Power Meter (R&S FPH-K9)", on page 149)		

12.2 Functions of the Spectrum Analyzer

This section contains all softkeys and menus that are available in spectrum analyzer mode.

12.2.1 Measurement Selection

The "MEAS" key opens the measurement menu that contains functionality to select and configure the measurement.

The AM/FM/φM is available only if you have installed option R&S FPH-K7.

The spectrogram is available only if you have installed option R&S FPH-K14.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode	Spectrum		
	Channel Power		
	Occupied BW		
	TDMA Power		
	ACLR		
	Spectrun Emission Mask		
	AM Modulationn Depth		
	Harmonics Distortion		

Channel Power

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode			
Standard	Load		
	Refresh		
	Exit		
Level Adjust			
Channel BW			
Power Unit	dBm		
	dBmV		
	dBuV		
	V		
	W		
Power Display	Clear/Write		
	Max Hold		
	Channel Pwr		

Occupied BW

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode			
Standard	Load		
	Refresh		

Softkey	Menu or Dialog items	Parameters	Parameters selection
	Exit		
Level Adjust			
Channel BW			
% Power BW			

TDMA Power

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode			
Standard	Load		
	Refresh		
	Exit		
Level Adjust			
Manual SWT Time			
Burst Length			

Spectrum Emission Mask

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode			
Standard	Load		
	Refresh		
	Exit		
Adjust Settings			
View List			

Harmonics Distortion

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode			
Adjust Settings			
Harmonics			

AM Modulation Depth

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode			
Adjust Settings			
Select Marker			
Threshold			

12.2.2 Frequency Parameters

The FREQ key opens the frequency menu that contains functionality to set up the horizontal axis of the measurement diagram.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Center Freq			
CF Stepszie	0.1 x Span, Manual, Step=Center		
Start Freq			
Stop Freq			
Freq Offset			
Freq Mode	Frequency		
	Select Downlink	Refresh	
		Load	
		Exit	
	Select Uplink	Refresh	
		Load	
		Exit	
	Set to Downlink		
	Set to Uplink		

12.2.3 SPAN Selection

The SPAN key opens the span menu that contains functionality to set the span.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Manual Span			
Full Span			

Softkey	Menu or Dialog items	Parameters	Parameters selection
Zero Span			
Last Span			

12.2.4 AMPT Parameters

The AMPT key opens the amplitude menu that contains functionality to set up the vertical axis of the measurement diagram.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Ref Level			
Range / RefPos	Auto Range		
	Range		
	Linear		
	Ref Position		
Unit	dBm		
	dBmV		
	dBuV		
	V		
	W		
Ref Offset			
Att / Amp / Imp	Preamp		
	Manual Att		
	Auto Low Distortion		
	Auto Low Noise		
	Imp 50Ω		
	75 Ω RAM		
	75 Ω RAZ		
	75 Ω FSH-Z38		
Transducer	Primary		
	Secondary		
	Select Primary	Refresh	
		Load	
		Exit	
	Select Secondary	Refresh	

Softkey	Menu or Dialog items	Parameters	Parameters selection
		Load	
		Exit	

12.2.5 SWEEP Parameters

The SWEEP key opens a menu that contains all functionality to configure the sweep.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Manual SWT			
Auto SWT			
Cont Sweep			
Single Sweep			
Trigger	Free Run		
	Video	0 - 100 %	
	Eternal Rise		
	External Fall		
	Delay	1 - 10 s	

12.2.6 BW Parameters

The BW key opens a menu that contains all functionality to set the bandwidths.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Manual RBW			
Auto RBW			
Manual VBW			
Auto VBW			

12.2.7 Trace Functionality

The TRACE key opens the trace menu that contains functionality to set up the traces.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Trace Mode	View		
	Clear/Write		
	Max Hold		

Softkey	Menu or Dialog items	Parameters	Parameters selection
	Min Hold		
	Average	1 to 10	
Detector	Auto Detector		
	Auto Peak		
	Max Peak		
	Min Peak		
	Sample		
	RMS		
Show	Enable Trace 2		
	Enable Memory 1		
	Enable Memory 2		
Trace▹Memory			
Select Trace			
Trace Math	Math Position		
	Off		
	Trace - Memory		
	Memory - Trace		

12.2.8 Limit Lines

The LINES key opens a menu that contains the functionality to control display and limit lines.

The LINES key opens a menu that contains the functionality to control limit lines.

Softkey	Menu or Dialog items	Parameters	Parameters selection
Show Limit Lines			
Upper Limit	Set Threshold		
	Load From File	Refresh	
		Load	
		Exit	
	Remove		
Lower Limit	Set Threshold		
	Load From File	Refresh	
		Load	
		Exit	

Softkey	Menu or Dialog items	Parameters	Parameters selection
	Remove		
Auto Beep			

12.2.9 Markers

The MARKER key open a menus to control markers and use marker functions.

Softkey	Menu or Dialog items	Parameters	Parameters selection
New Marker			
Marker Type			
Delete Marker	Delete Selected		
	Delete All Delta		
	Delete All		
Select Marker			
Marker Function	Noise		
	Frequency Count		
	N dB Down		
	N dB	-100 to 100 dB	
	Frequency Display		
	Channel Display		
	Demodulation Off		
	AM		
	FM		
	Time		
	Volume	0 - 100%	
Set Marker	Search Range		
	Set To Peak		
	Set To Next Peak		
	Set To Minimum		
	All Marker To Peak		
	Center=Marker Freq		
	Ref Level=Marker Level		

12.3 Functions of the Power Meter

This section contains all softkeys and menus that are available in power meter mode.

12.3.1 Power Meter Measurements

The MEAS key opens a menu that contains the functionality to configure measurements with the power meter.

Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Frequency[1]			
Unit	dBm		
	W		
	dB Rel		
Zero			
To Ref			
Meas Time	Short		
	Normal		
	Long		

[1] If "Freq Mode" (see Frequency Parameters) is set to "Channel", the softkey will display "Channel".

Directional Power Meter with R&S FSH-Z14 & R&S FZH-Z44

Softkey	Menu or Dialog items	Parameters	Parameters selection
Fwd Pwr Display	Average		
	Peak Envelope		
Frequency[1]			
Unit	Forward Power	dBm	
		W	

Softkey	Menu or Dialog items	Parameters	Parameters selection
		dB	
	Reflected Power	dBm	
		W	
		VSWR	
		dB (Return Loss)	
Zero			
To Ref			
Standard	Correction Off		
	GSM		
	EDGE		
	3GPPWCDMA[2]		
	cdmaOne[2]		
	cdma200 1x[2]		
	DVB-T[2]		
	DVB[2]		
	TETRA		
	USER	4 kHz	
		200 kHz	
		600 kHz	

[1] If "Freq Mode" (see Frequency Parameters) is set to "Channel", the softkey will display "Channel".

[2] Only for R&S FSH-Z44

Channel Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Freq			
Unit	dBm		
	W		
	dB Rel		
Zero			
To Ref			
Channel BW			

Pulse Power Measurement

Table 12-1: Pulse power measurement with numeric mode

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode	Average		
	Power vs Time		
Freq			
Unit	dBm		
	W		
Zero			
To Ref			
Meas Time	Short		
	Normal		
	Long		

Table 12-2: Pulse power measurement with trace mode

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Mode	Average		
	Pwr vs Time		
Freq			
Unit	dBm		
	W		
Zero			
Algorithm	Histogram		
	Integration		
	Peak		
Ref Power Config	Low Ref Power	0 - 100 %	
	High Ref Power	0 - 100 %	
	Ref Power	0 - 100 %	
	Set to Default		
	Related to Power		
	Related to Voltage		

12.3.2 Frequency Parameters

The FREQ key opens a menu that contains the functionality to set the frequency.

Table 12-3: Power Meter, Directional Power Meter, Channel Power Meter, Pulse Power Measurement

Softkey	Menu or Dialog items	Parameters	Parameters selection
Frequency[1]			
Freq Mode	Channel[2]		
	Select Downlink	Refresh	
		Load	
		Exit	
	Select Uplink	Refresh	
		Load	
		Exit	
	Set to Downlink		
	Set to Uplink		

[1] If "Freq Mode" is set to "Channel", the softkey will display "Channel".

[2] If "Freq Mode" is previously configured to "Channnel", the menu item will display "Frequency".

12.3.3 BW Parameters

The BW key contains functionality to configure bandwidth parameters.

Table 12-4: Directional Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Standard	Correction Off		
	GSM		
	EDGE		
	3GPPWCDMA[2]		
	cdmaOne[2]		
	cdma200 1x[2]		
	DVB-T[2]		
	DVB[2]		
	TETRA		
	USER	4 kHz	
		200 kHz	
		600 kHz	

Table 12-5: Channel Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Channel BW			

Table 12-6: Pulse Measurement

Softkey	Menu or Dialog items	Parameters	Parameters selection
VBW	Full		
	5 MHz		
	1.5 MHz		
	300 kHz		

12.3.4 Amplitude Parameters

The AMPT key contains functionality to configure level parameters.

Table 12-7: Power Meter, Directional Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Unit	dBm		
	W		
	dB Rel		
Offset			

Table 12-8: Channel Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Unit	dBm		
	W		
	dB		
Offset			
RF At / Amp	Preamp		
	Manual Att		
	Auto		

Table 12-9: Pulse Power Measurement

Softkey	Menu or Dialog items	Parameters	Parameters selection
Ref Level	-70 to 30 dBm		
Range	Scale Adjust		
	100 dB (10.0dB/Div)		
	50 dB (5.0dB/Div)		

Softkey	Menu or Dialog items	Parameters	Parameters selection
	50 dB (5.0dB/Div)		
	30 dB (3.0dB/Div)		
	20 dB (2.0dB/Div)		
	10 dB (1.0dB/Div)		
	50 dB (0.5dB/Div)		
Unit	dBm		
	W		
Offset			

12.3.5 Sweep Configuration

The SWEEP key opens a menu that contains functionality to configure the sweep.

Table 12-10: Power Meter, Directional Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Meas Time	Short		
	Normal		
	Long		

Table 12-11: Pulse Power Measurement

Softkey	Menu or Dialog items	Parameters	Parameters selection
Trace Time		52 us to 1 s	
Conf Meas			
Single Meas			
Trigger	Free Run		
	Positive		
	Negative		
	Trigger Level	-30 to 20 dBm	
	Trigger Delay	-51.1875us to 53 s	
	Trigger Hysteresis	0.1 to 10 dB	
	Dropout Time	0 to 10s	

12.3.6 Limits Line Parameters

The LINES key opens a menu that contains functionality to configure the limits line.

Table 12-12: Power Meter, Channel Power Meter

Softkey	Menu or Dialog items	Parameters	Parameters selection
Show Limit Lines			
Upper Limit	Set Threshold		
	Remove		
Lower Limit	Set Threshold		
	Remove		
Auto Beep			

12.3.7 Trace Parameteres

The TRACE key opens a menu that contains functionality to configure the trace.

Table 12-13: Pulse Power Measurement

Softkey	Menu or Dialog items	Parameters	Parameters selection
Trace Mode	Clear/Write		
	Average		
Detector	Average		
	Max Peak		
Show	Enable Trace 2		
	Enable Memory 1		
	Enable Memory 2		
Trace▹Memory			

12.3.8 Marker Parameters

The MARKER key opens a menu that contains functionality to configure the marker on the trace

Table 12-14: Pulse Power Measurement with trace mode

Softkey	Menu or Dialog items	Parameters	Parameters selection
New Marker			
Marker Type			
Delete Marker	Delete Selected		
	Delete All Delta		
	Delete All		
Select Marker			
Set Marker	Search Range		

Softkey	Menu or Dialog items	Parameters	Parameters selection
	Set To Peak		
	Set To Next Peak		
	Set To Minimum		
	All Marker To Peak		
	Center=Marker Freq		
	Ref Level=Marker Level		

12.4 Functions of the Analog Modulation

This section contains all softkeys and menus that are available in analog modulation mode.

12.4.1 Analog Modulation Measurements

The MEAS key opens a menu that contains the functionality to configure measurements with the analog modulation.

AM Domain, FM Domain

Softkey	Menu or Dialog items	Parameters	Parameters selection
AM Domain[1]			
FM Domain[1]			
Audio Lowpass	DBW/1		
	DBW/10		
	DBW/30		
	DBW/100		
Mod. Trace[1]			
Mod. Summary[1]			

[1]To perform the analog modulation measurerment, select the required modulation domain (AM Domain or FM Domain) and the required measurement setting (Mod. Trace or Mod. Summary).

12.4.2 Frequency Parameters

The FREQ key opens a menu that contains the functionality to set the frequency.

Table 12-15: AM Domain, FM Domain

Softkey	Menu or Dialog items	Parameters	Parameters selection
Center Freq			
CF Stepszie			

12.4.3 BW Parameters

The BW key contains functionality to configure bandwidth parameters.

Table 12-16: AM Domain, FM Domain

Softkey	Menu or Dialog items	Parameters	Parameters selection
Manual DBW	3kHz - 2MHz		
FM Broadcast[1]	Off		
	50us		
	75us		

[1]FM Brooadcast is only enabled when the DBW is set to 200kHz and 300kHz.

12.4.4 Amplitude Parameters

The AMPT key contains functionality to configure the level parameters.

Table 12-17: AM Domain, FM Domain

Softkey	Menu or Dialog items	Parameters	Parameters selection
Ref Level			
Dev per Division	1-100%[1]		
Scale Adjust[2]			
Att / Amp / Imp	Preamp		
	Manual Att		
	Auto Low Distortion		
	Auto Low Noise		
	Imp 50Ω		
	75 Ω RAM		
	75 Ω RAZ		
	75 Ω FSH-Z38		

[1]For AM Domain, the Dev per Division is configurable up to 20%.

[2]Scale Adjust is only enabled in the FM Domain for Mod. Trace measurement.

12.4.5 Sweep Configuration

The SWEEP key opens a menu that contains functionality to configure the sweep.

Table 12-18: AM Domain, FM Domain

Softkey	Menu or Dialog items	Parameters	Parameters selection
Cont Meas			
Single Meas			

12.4.6 Limits Line Parameters

The LINES key opens a menu that contains functionality to configure the limits line.

Table 12-19: AM Domain, FM Domain

Softkey	Menu or Dialog items	Parameters	Parameters selection
Select Limits	Refresh		
	Load		
	Exit		
Clear Limits			
Auto Beep			

12.5 Functions of the Wizard

This section contains all softkeys and menus that are available in the measurement WIZARD.

12.5.1 Measurement Wizard

The WIZARD key opens a menu that contains the functionality to perform wizard measurement..

Softkey	Menu or Dialog items	Parameters	Parameters selection
Load Meas Set	Edit	Rename	
		Cut	
		Copy	

Softkey	Menu or Dialog items	Parameters	Parameters selection
		Paste	
		Delete	
	Refresh		
	Load		
	Exit		
Start Meas	Continue	Next Meas	Continue
			Interrupt
			Skip
			Finish Wizard
			Cancel
		Repeat Meas	
		Interrupt	Leave Menu[1]
			Resume Sequence
			Cancel
		Finish Wizard	
		Cancel	
	Interrupt	Leave Menu[1]	
		Resume Sequence	
		Cancel	Yes
			No
	Skip	Continue	Next Meas
			Repeat Meas
			Interrupt
			Finish Wizard
			Cancel
		Interrupt	Leave Menu[1]
			Resume Sequence
			Cancel
		Skip	Continue
			Interrupt
			Skip
			Finish Wizard
			Cancel

Softkey	Menu or Dialog items	Parameters	Parameters selection
		Finish Wizard	
		Cancel	Yes
			No
	Finish Wizard		
	Cancel	Yes	Save Result
			Discard Result
		No	
Meas Setting	General	User	
		Measurement Definition	
		Number of Steps	
		Description	
	Site	Site Number	
		Comments	
		GPS Position	
Meas Spec			
Meas Results	Mark		
	Edit	Rename	
		Cut	
		Copy	
		Paste	
		Delete	
	Preview	Prev	
		Next	
		Exit	
	Refresh		
	Exit		
Exit			

[1]Press WIZARD key to resume back the wizard measurement, .

13 Appendix

In this appendix, additional information on how a spectrum analyzer works is given.

13.1 How a Spectrum Analyzer Works

Basically, it is possible to measure and analyze RF signals either in the time domain or the frequency domain.

Measurements in the time domain show signal variations over time. You can perform these with an oscilloscope, for example. Measurements in the frequency domain show the frequency components of a signal. To perform measurements in the frequency domain, you can use a spectrum analyzer.

Both modes are essentially equivalent because applying the Fourier transform to any signal converts it into its spectral components. Depending on the signal characteristic to be measured, one method is usually more appropriate than the other. With an oscilloscope, it is possible to tell whether a signal is a sine wave, a square wave with a certain on/off ratio or a sawtooth wave. However, detecting superimposed low-level signals or monitoring the harmonic content of the signal is easier with a spectrum or signal analyzer.

Figure 13-1 shows the theoretical basis of the two measurement methods. In the time domain, an oscilloscope would, for example, show a section of the signal that is a square wave. The same signal, when viewed with a spectrum analyzer, would show a line spectrum (the fundamental and its harmonics).

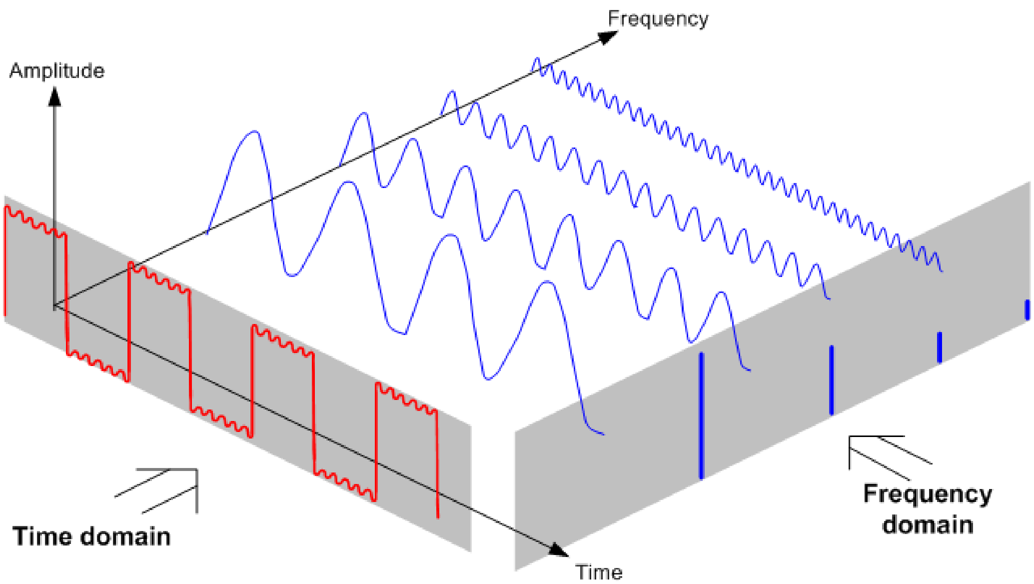


Figure 13-1: Visualization of time domain and frequency domain

Applying the Fourier transform to the periodic square wave transforms it into the frequency domain. The spectrum analyzer would show the fundamental (or frequency of the square wave) and its harmonics.

The spectrum analyzer uses a narrow bandpass filter for measurements in the frequency domain. Only at frequencies containing a signal there is a reading that gives the amplitude of the frequency component.

Figure 13-2 shows the basic principle of how a spectrum analyzer works.

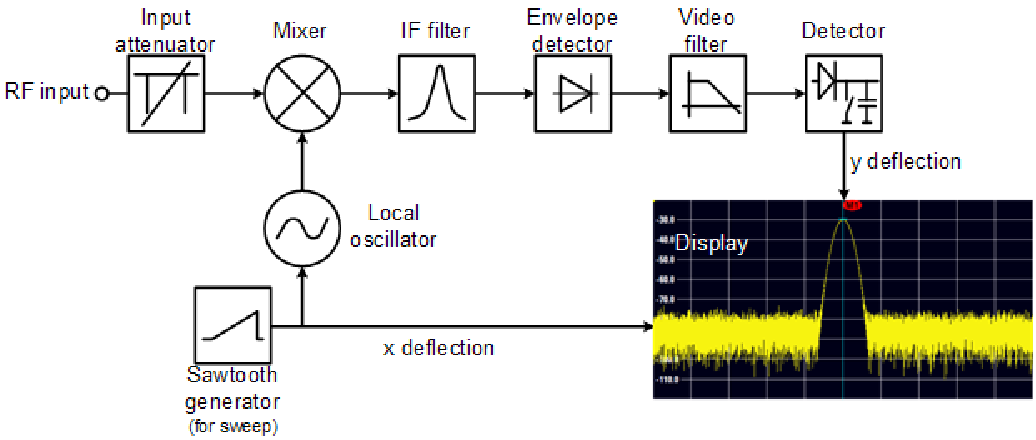


Figure 13-2: Block diagram showing the basic functionality of a spectrum analyzer

The precision attenuator at the R&S Spectrum Rider input attenuates the signal to a level that the mixer can handle without overdriving the mixer. The attenuator is directly coupled to the reference level. You can attenuate the signal in the range from 0 dB to 40 dB in steps of 5 dB.

The mixer converts the RF signal to a fixed intermediate frequency (IF). This process usually involves several stages. It lasts until you get an IF for which good narrowband filters are available. The R&S Spectrum Rider needs three mixing stages to get an IF that the filter can handle. Figure 11-3 graphically shows the mixing process.

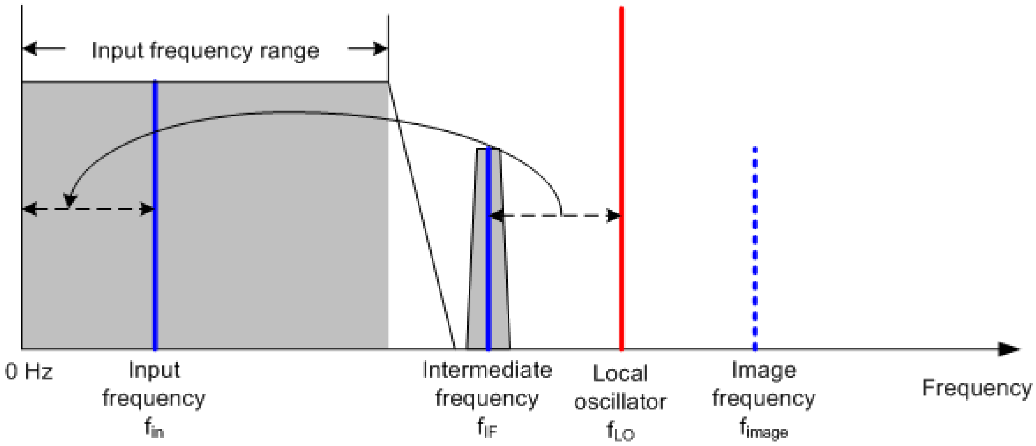
For models with a frequency limit of 3.6 GHz, the IFs are 4892.8 MHz, 860.8 MHz and 54.4 MHz. The conversion from a specific input frequency to the first IF is done by a local oscillator (LO). This LO can be tuned from 4.8 GHz to 8.4 GHz. All other conversions are handled by single-frequency oscillators.

In case of models with a frequency limit of 8 GHz, the IFs are 8924.8 MHz, 860.8 MHz and 54.4 MHz. The conversion from the first to the second IF for these models is done by a second local oscillator.

The frequency of the local oscillator determines the input frequency at which the spectrum analyzer performs measurements: fin = $f_{LO} – f_{IF}$.

The first mixer produces the sum frequency $f_{LO} + f_{in}$ (= image frequency f_{image}) as well as the difference frequency $f_{LO} – f_{in}$.

The image frequency is rejected by the bandpass at the IF so that it does not interfere with the subsequent frequency conversions.



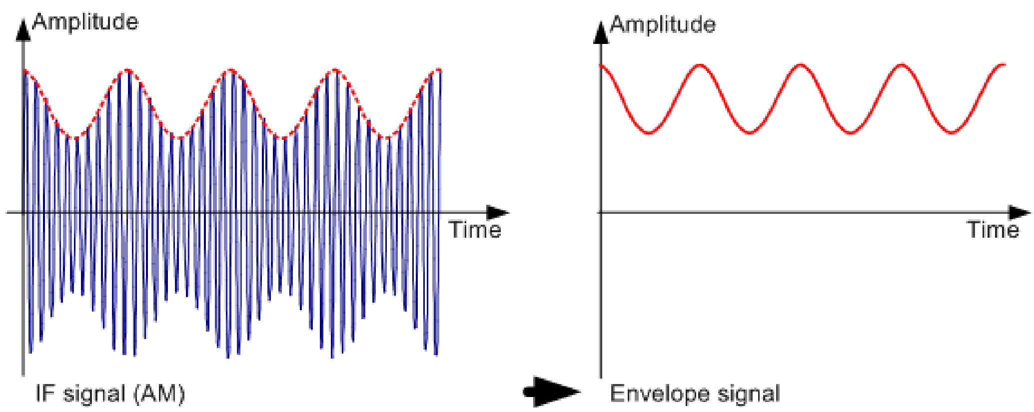
The first local oscillator is tuned with a sawtooth which simultaneously acts as the x deflection voltage for the display. In practice, synthesizer technology is used to generate the frequency of the first local oscillator and for a digital display.

The instantaneous sawtooth voltage therefore determines the input frequency of the spectrum analyzer.

The bandwidth of the IF filter at the IF determines the bandwidth that is used for measurements. Pure sine signals are passed by the IF filter characteristics. This means that signals closer together than the bandwidth of the IF filter cannot be resolved. This is why the bandwidth of the IF filter in a spectrum analyzer is referred to as the resolution bandwidth. The R&S Spectrum Rider has resolution bandwidths from 1 Hz to 3 MHz.

The bandlimited IF is passed to the envelope detector. The envelope detector removes the IF from the signal and outputs its envelope. The output signal from the envelope detector is referred to as the video signal. As it has been demodulated, it only contains amplitude information. The phase information is lost.

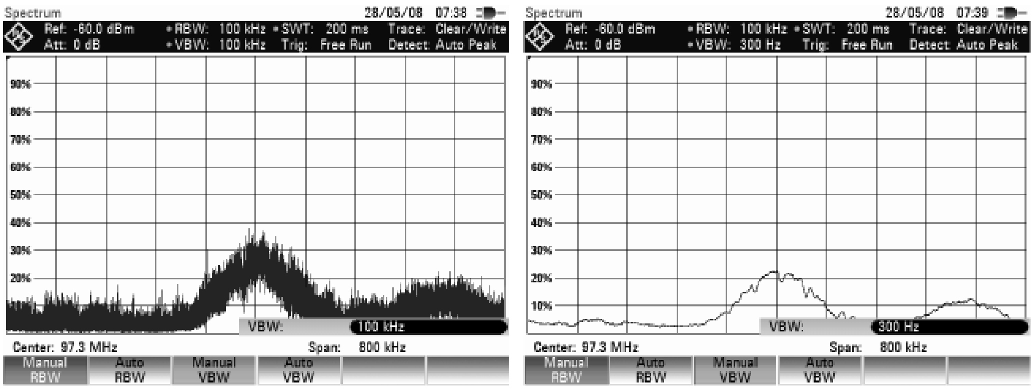
With RF sine signals, the video signal is a DC voltage. With AM signals the video signal contains a DC component whose amplitude corresponds to the carrier power and an AC component whose frequency is equal to the modulation frequency, provided the modulation frequency is inside the resolution bandwidth.



The video filter comes after the envelope detector. The filter is a lowpass with an adjustable cutoff frequency which limits the bandwidth of the video signal. It is particularly useful when sine signals are to be measured in the vicinity of the spectrum analyzer's intrinsic noise. The sine signal produces a video signal that is a DC voltage.

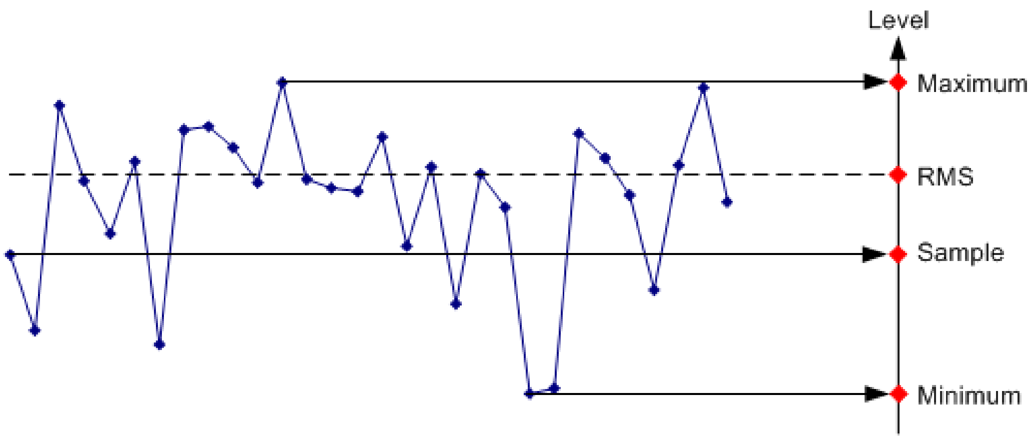
At the IF, however, the noise is distributed over the whole bandwidth or, in the case of the video signal, over half the bandwidth of the resolution filter. By selecting a narrow video bandwidth relative to the resolution bandwidth, the noise can be suppressed, while the sine signal to be measured (= DC) is not affected.

The figures below show a weak sine signal. In the first picture, it is measured with a large video bandwidth and in the second with a narrow video bandwidth.



Limiting the video bandwidth smoothes the trace considerably. This makes it much easier to determine the level of the measured signal.

The detector comes after the video filter. The detector combines the measured spectrum so that it can be represented as one pixel in the trace. The R&S FSH uses 631 pixels to form the trace, i.e. the whole measured spectrum has to be represented using just 631 pixels. Common types of spectrum analyzer detectors are the peak detector (PEAK), the sample detector (SAMPLE) and the RMS detector (RMS). An Auto Peak detector which simultaneously displays the maximum peak and the minimum peak is usually also provided. The Fig. below explains how these detectors work.



The figure above shows 30 measured values which are represented by a single pixel. The peak detector determines and displays the maximum measured value. The Auto Peak detector takes the maximum and minimum and displays them together. The two values are joined by a vertical line segment. This gives a good indication of the level variation over the measured values represented by a single pixel. The RMS detector is used by the spectrum analyzer to determine the RMS value of the measured values. It is therefore a measure of the spectral power represented by a pixel. The sample detector takes an arbitrary measurement value and displays it (in the Fig. above, the first). The other measured values are ignored.

On the basis of the operating principles of detectors, a few recommendations can be made as to their use.

- It is best to use the Auto Peak detector or the peak detector for spectrum analysis over large frequency ranges. This ensures that all signals are displayed.
- The RMS detector is recommended for power measurements on modulated signals. However, the display range should be chosen so as not to exceed 100 times the bandwidth of the signal or the resolution bandwidth, whichever is larger.
- The sample detector or the RMS detector (preferred) should be used for noise measurements. Only these two detectors are capable of measuring noise power correctly
- When measurements are made on sine signals, the level display does not depend on the detector. However, if you use the RMS detector or the sample detector, ensure that the span is not too great. Otherwise, the displayed levels of sine signals may be lower than their true value.

List of Commands

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