

R&S® FSH Handheld Spectrum Analyzer Quick Start



75 Years of
Driving
Innovation


ROHDE & SCHWARZ

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This firmware makes use of several valuable open source software packages. A detailed list of the used open source software is provided on the user documentation CD-ROM (included in delivery).

The verbatim license texts are provided 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. The source code of the open source packages is available on request.

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The following abbreviations are used throughout this manual:

R&S® FSH is abbreviated as R&S FSH.

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Safety Instructions

Make sure to read through and observe the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system.

The product described here has been designed 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, 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 an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product. The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following

safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Symbols and safety labels:



Observe product documentation



PE terminal



Ground terminal



Danger of electric shock



Warning! Hot surfaces



Ground



Attention! Electrostatic sensitive devices

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 putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety 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.

Tags and their meaning

DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	NOTICE indicates a property damage message. In the product documentation, the word ATTENTION is used synonymously.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags

described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. The R&S FSH is protected against dripping water and dust (IP degree 51). Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 4600 m above sea level, max. transport altitude 12000 m above sea level. A tolerance of $\pm 10\%$ shall apply to the nominal voltage and of $\pm 5\%$ to the nominal frequency.
2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may

be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses, batteries). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).

3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.
4. If products/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, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered

by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.

6. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
7. Prior to switching on the product, it must be ensured that the nominal voltage setting on the power supply matches the nominal voltage of the AC supply network.
8. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.

9. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
10. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
11. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.
12. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
13. For measurements in circuits with voltages $V_{rms} > 30\text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
14. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.

15. 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.
16. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.
17. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.
18. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.
19. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
20. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries. If batteries or storage

batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

21. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
22. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
23. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract

the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.

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24. Prior to cleaning, disconnect the product from the AC supply. Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluent for cellulose lacquers.
 25. Any additional safety instructions given in this manual are also to be observed.

Informaciones Elementales de Seguridad

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

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE 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 despreciando las informaciones de seguridad 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 dentro de las instrucciones de la correspondiente documentación de 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 profundos y conocimientos básicas del idioma inglés. Por eso se debe tener en cuenta que el producto sólo pueda ser operado por personal especializado o personas minuciosamente instruidas con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará 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 entréguela a usuarios posteriores.

Símbolos y definiciones de seguridad



Ver documentación de producto



Conexión a conductor protector



Conexión a masa conductora



Peligro de golpe de corriente



¡Advertencia! Superficie caliente

Conexión a tierra

¡Cuidado! Elementos de construcción con peligro de carga electrostática

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas Rohde & Schwarz bajo la denominación de „producto“, entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
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ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
AVISO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo. En la documentación del producto se emplea de forma sinónima el término CUIDADO..

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación de 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 malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento. R&S FSH está protegido contra roción y polvo

(modo de protección IP 51). Si no se convino de otra manera, es para los productos R&S válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 4600 m sobre el nivel del mar, transporte hasta 12000 m sobre el nivel del mar. Se aplicará una tolerancia de $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ sobre la frecuencia nominal.

2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal especializado autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles, baterías), solamente podrán ser sustituidos por partes originales. Después de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de la corriente conductora, control de funcionamiento).

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se produjeran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.

4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (povos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.

5. Ciertos productos, como por ejemplo las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un

bypass pueden correr peligro a causa de la radiación electromagnética. El empresario/ usuario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.

6. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
7. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el fuente alimentación equivalga a la del la red de distribución.
8. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en

bastidores o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

9. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
10. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
11. 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. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
12. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.
13. En las mediciones en circuitos de corriente con una tensión de entrada de $U_{eff} > 30\text{ V}$ se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios

de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).

14. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos del estándar IEC950/EN60950.
15. 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 heridas, fuego o daños en el producto.
16. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
17. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir cortocircuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.
18. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.

19. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

20. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención células de litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.

21. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.

22. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de

horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean observadas. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.

23. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo. El fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
24. Antes de proceder a la limpieza, desconecte el producto de la red. Realice la limpieza con un paño suave, que no se deshilache. No utilice de ninguna manera agentes limpiadores químicos como, por ejemplo, alcohol, acetona o nitrodiluyente.
25. Deben observarse las indicaciones de seguridad adicionales del presente manual.



Hints

1.1 Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product.

You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.

The Rohde & Schwarz quality management system is certified according to:

DIN EN ISO 9001:2000

DIN EN 9100:2003

DIN EN ISO 14001:2004

1.2 Support Center

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.



If you wish to receive the latest news about and updates for a specific instrument, please send us a short e-mail indicating the instrument. We will take care that you will get the right information.

Support Center:

Tel. from Europe: +49 (0) 180 512 42 42*

From outside Europe: +49 89 41 29 - 137 76

Fax: + 49 (0) 89 41 29 - 637 78

E-mail: CustomerSupport@rohde-schwarz.com

* 0.14 Euro/Min within German fixed-line telephone network, varying prices for the mobile telephone network and in different countries.

USA & Canada Customer Support Center:

Tel. from USA: 888-test-rsa (888-837-8772) (opt 2)

From outside USA: +1 410 910 7800 (opt 2)

Fax: +1 410 910 7801

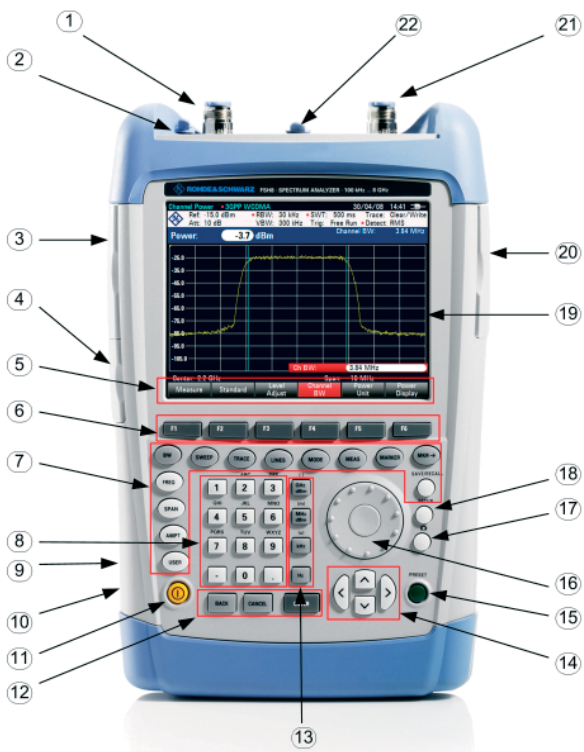
E-mail: CustomerSupport@rohde-schwarz.com



Putting into Operation

2.1 Front view

- 1 RF-input N-connector
- 2 Connector for headphones
- 3 BNC-connector for:
External trigger/external reference input/IF
output (IF-Out)/Video Out or BIAS port
AUX connection for additional accessories
- 4 LAN and USB interface
- 5 Softkey caption
- 6 Softkeys
- 7 Function keys
- 8 (Alpha-)numeric keypad
- 9 Kensington lock
- 10 DC connection for supply from the external AC
power supply
- 11 On/Off button
- 12 Entry keys
- 13 Unit keys
- 14 Cursor keys
- 15 Preset key
- 16 Rotary knob
- 17 Screenshot key
- 18 Setup key
- 19 Display
- 20 SD card slot
- 21 Generator output N-connector
- 22 Connector for power sensor



2.2 Putting into Operation

The following section describes how to put the handheld spectrum analyzer into operation.

Section 3 describes the operation of the spectrum analyzer using simple measurements as examples.

2.2.1 Unpacking the Instrument

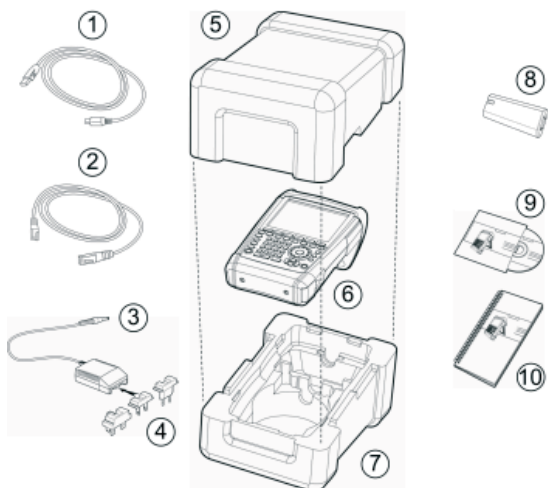
The R&S FSH comes in formfitting packaging that consists of upper and lower shells. The two shells are held together by tape.

The packaging contains all accessories supplied.

- Undo the tape to unpack the analyzer.
- Remove the R&S FSH and the accessories.
- Remove the protective foil from the screen.



Each R&S FSH comes with a unique master PIN. Keep the master PIN in a secure place away from the R&S FSH. If someone enters an incorrect PIN three times in succession, the R&S FSH cannot be used again until the master PIN is entered.



- 1 USB cable
- 2 LAN cable
- 3 Power supply
- 4 AC supply plug (country-specific)
- 5 Upper shell
- 6 R&S FSH
- 7 Lower shell
- 8 Lithium ion battery
- 9 CD-ROM
- 10 Quick Start manual

2.2.2 Setting up the Instrument

The Handheld Spectrum Analyzer R&S FSH has been designed for operation in labs as well as for onsite use for service and maintenance applications.

For any application, the R&S FSH can be set up to optimize ease of operation and the viewing angle of the display.

When used as a desktop instrument, the R&S FSH can either be laid flat or it can be propped up using the fold-out support at the back.



The R&S FSH can be laid flat for operation from above.

Because the grip is slightly raised at the back, the R&S FSH is tilted forward to give the optimum viewing angle for the display.

For use as a desktop, fold out the support at the rear so that the instrument can easily be operated from the front and the display can be read easily (see figure above).

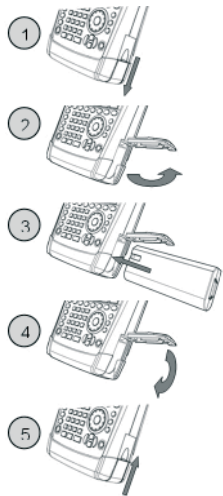
For on-site installation and service measurements, it is best to hold the instrument with both hands. All the controls are easy to reach (e.g. with your thumbs). Use of the R&S HA-Z222 carrying bag is recommended in order to leave both hands free for work on the device under test.

The carrying handle at the top of the R&S FSH can also be used to hang it from cabinet doors, for example. The shape of the grip ensures that the instrument does not fall off.

2.2.3 Switching on the Spectrum Analyzer

The rechargeable lithium ion battery included in the delivery must be inserted into the battery compartment before the R&S FSH is switched on. The battery compartment is situated at the lower right corner of the instrument.

To open the battery compartment, push the cover downward by pressing a finger against the recessed grip (1). Then open the cover upwards (2) and put the rechargeable battery into the R&S FSH as far as it will go with the beveled side facing upward and the grip on the right side (3). To close the cover, fold it downward (4) and push it upward until it clicks fully into place (5).



The R&S FSH can be operated with the AC power supply included in the delivery or with the replaceable battery. The lithium ion battery which is supplied has a capacity of approximately 4 Ah and permits up to three hours' operation when fully charged. The R&S FSH battery may not be

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fully charged when it is dispatched. For battery operation it must therefore first be charged. The charging time when the instrument is switched off is approximately 2.5 hours. If the instrument is switched on, the charging time is extended by approximately one hour to 3.5 hours. An R&S HA-Z203 external charger is available to charge an additional replacement battery. Another battery (R&S FSH-Z206) with a capacity of approximately 6 Ah and an operating time of approximately 4.5 hours is additionally available as an accessory.

For use with the supplied power supply R&S HA-Z201 the power adapter jack plug should be pushed into the POWER ADAPTER socket on the left side of the instrument. Then connect the power supply unit to an AC outlet. The voltage range of the power supply unit is 100 V to 240 V AC.

NOTICE

Risk of damage to the instrument

- *Only use the supplied power supply R&S HA-Z201.*
 - *AC supply voltage must be compatible to the voltage specified on the power supply unit.*
 - *Attach the appropriate adapter to the power supply.*
-

During operation in the field, the battery can be charged with the R&S HA-Z202 car adapter plugged into the cigarette lighter socket.

CAUTION

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

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

To switch on the R&S FSH, press the yellow button



at the bottom left of the front panel.

The R&S FSH displays an arrow within the battery charge status indicator at the top right of the display to show that it is connected to the mains and is charging. If the battery is fully charged, a plug icon is displayed instead of the battery icon.

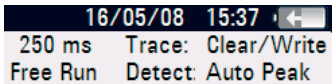


Fig.: Battery is charging

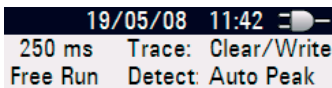


Fig.: R&S FSH is being powered by the AC supply and the battery is fully charged

When the R&S FSH is switched on, it recalls the settings that it was using when it was last switched off.



If the internal battery is completely flat, the R&S FSH cannot be switched on even though it is connected to the AC supply via the power supply unit. In this case, the internal battery must be charged for a while with the instrument switched off. Only then can the instrument be switched on.

2.2.4 Charging the Battery

The R&S FSH is fitted with a replaceable lithium ion battery. The operating time depends on the battery's charge status, the ambient temperature and the operating mode. The operating times for a fully charged battery at room temperature in the operating mode SPECTRUM is shown in the table below:

Battery type: R&S HA-Z204 (supplied)

Operating time: approx. 3 h

Battery type: R&S HA-Z206 (available as an accessory)

Operating time: approx. 4.5 h



The R&S FSH battery is not fully charged at time of delivery. Therefore it must be charged after delivery.

When stored over an extended period, self-discharging reduces the battery charge. The battery should therefore be charged before use if it is going to be the sole power source for a long period of operation.

The battery's charge status is shown at the top right of the screen (see figure below). If the battery is fully charged, the battery icon is filled white. As the battery discharges, the white coloring disappears in four steps until just the battery outline indicates that the battery is flat.

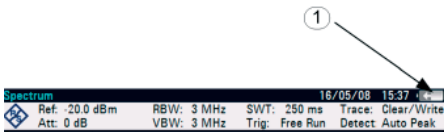
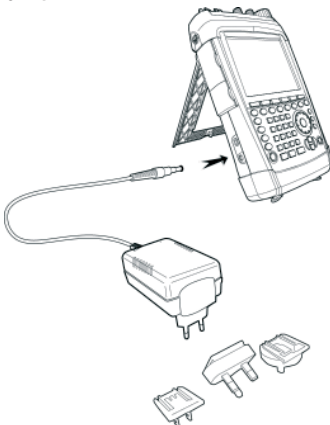


Fig.: Battery charge state (1)

Using the supplied power supply unit or the car adapter

The battery is charged via the included power supply unit or the R&S HA-Z202 car adapter (order number 1309.6117.00) which is connected to the jack on the right-hand side of the carrying handle. If required, equip the power supply unit with the country-specific plug. Remove the plug from the power supply unit toward the front and firmly connect the appropriate plug to the power supply unit.



For rapid charging, be sure to switch off the R&S FSH during charging. If the R&S FSH is switched on, the charging current is reduced by the power drain of the instrument. Battery charging therefore takes longer.

The charging times are shown below:

Battery type: R&S HA-Z204 (supplied)

Charging time (R&S FSH switched off):
approx. 2.5 h

Charging time (R&S FSH switched on):
approx. 3.5 h

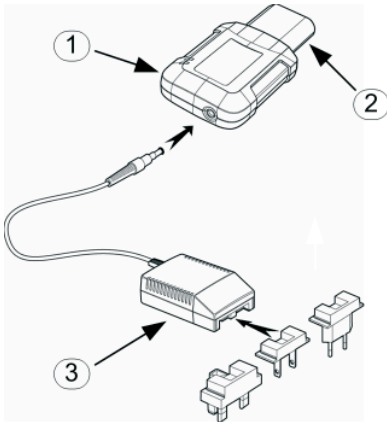
Battery type: R&S HA-Z206 (available as an accessory)

Charging time (R&S FSH switched off):
approx. 3.5 h

Charging time (R&S FSH switched on):
approx. 4.5 h

To lengthen the operating time with one battery charge, the R&S FSH has an automatic cut-off circuit for the display background lighting after a selectable time (0 to 99 minutes) after the last input. The cut-off is deactivated in the default setting.

Using the R&S HA-Z203 battery charger



- 1 External charger R&S HA-Z203
- 2 Lithium ion battery R&S HA-Z204 or HA-Z206
- 3 Power supply unit R&S HA-Z201 or R&S HA-Z202 car adapter

For external charging, the lithium ion battery is plugged into the R&S HA-Z203 external charger (available as an accessory: order number 1309.6123.00) and supplied with current via the AC power supply. The charging process is indicated by the orange LED (CHARGE) on the charger. As soon as the battery is fully charged, this LED goes off and the green LED labeled READY begins to light up. The auto power down mode is deactivated in the default setting.



The R&S HA-Z203 external charger can also be powered by the R&S HA-Z202 car adapter.

2.2.5 Spectrum Analyzer Connectors

The R&S FSH has the following connections on the upper side:

RF input

Connect the RF input via a cable with an N connector to the DUT. Make sure that it is not overloaded.

The maximum permissible continuous power at the RF input is 20 dBm (100 mW). It can be loaded with up to 30 dBm (1 W) for a maximum of three minutes. If the instrument is loaded with 1 W for longer, it may be destroyed. The RF input is protected from static discharges and voltage pulses by a limiting circuit.

WARNING

Risk of electrical shock

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

NOTICE

Risk of damage to the coupling capacitor, the input attenuator and the mixer

The DC input voltage must never exceed the value specified in the data sheet.

Tracking generator output

(general output, models 1309.6000.14, 1309.6000.18, 1309.6000.24 and 1309.6000.28 only)

The tracking generator output power for the different R&S FSH models is as follows:

Model: R&S FSH4 (1309.6000.14, 1309.6000.18)

Frequency: 100 kHz to 3.6 GHz

Tracking generator output power: 0 dBm nominal

Model: R&S FSH8 (1309.6000.24, 1309.6000.28)

Frequency: 300 kHz to 3.6 GHz

Tracking generator output power: 0 dBm nominal

Model: R&S FSH8 (1309.6000.24, 1309.6000.28)

Frequency: 3.6 GHz to 8 GHz

Tracking generator output power: -5 dBm nominal

The tracking generator output power can be reduced with an integrated step attenuator by a maximum of 40 dB in 1 dB steps in all R&S FSH models.

NOTICE

Risk of damage to the tracking generator output

The reverse voltage up to the voltage stated on the R&S FSH housing must not be exceeded.

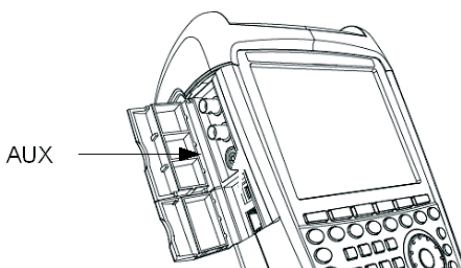
Connection for the power sensor

The connection is especially configured for power sensors. It is used for both the power supply and data transfer via the power sensor interface. The R&S TS-EMF isotropic antenna (order number 1158.9295.13) can additionally be controlled via this connection.

Headphone connection

A 3.5 mm jack is provided for headphones. The internal impedance of the connector is approx. 10 ohm.

Connection for additional accessories (AUX)



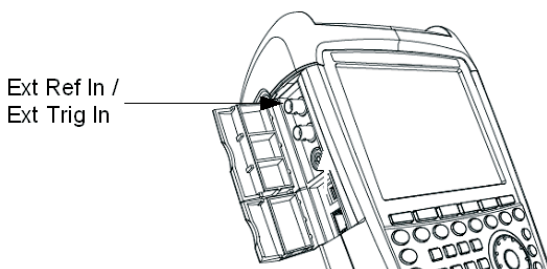
Further accessories like the GPS receiver (HA-Z240, order no. 1309.6700.02) can be connected to the AUX connection on the left side of the instrument.

On the left of the R&S FSH, underneath protective caps, there are two connections which are described in more detail below:



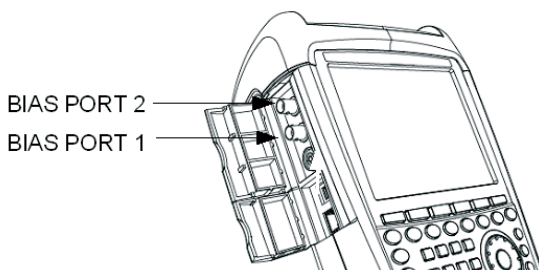
Both BNC sockets can be configured for various applications. The names of the individual connections are embossed on the insides of the protective covers.

Input for external trigger or external reference (EXT TRIG/EXT REF)



Either an external trigger signal to start a measurement or a 10 MHz reference signal for frequency synchronization is fed in via the EXT TRIG/EXT REF BNC socket. The trigger threshold is similar to that of TTL signals. The level for the reference signal must be larger than 0 dBm. The necessary settings can be entered in the SETUP menu (SETUP key, INSTRUMENT SETUP softkey).

BIAS Port 1/BIAS Port 2 direct current inputs (for models 1309.6000.24 and 1309.6000.28 only)



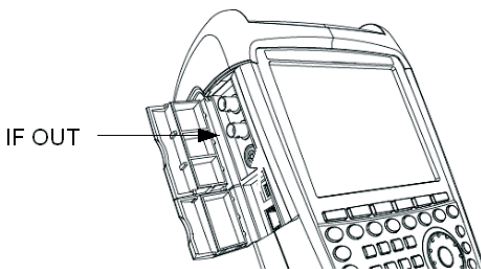
Active equipment under test can be supplied with power via the BIAS Port 1 and BIAS Port 2 direct current inputs. Direct current is supplied with the assistance of a suitable power adapter (600 mA max. / 50 V max.).

NOTICE

Risk of damage to the instrument

Never apply currents above > 600 mA or voltages above 20 V to the BNC sockets if the BNC connectors are not configured as BIAS input ports. If the BNC connectors are configured as BIAS input ports never apply currents above > 600 mA or voltages above 50 V.

IF output (IF-Out)/Video Out



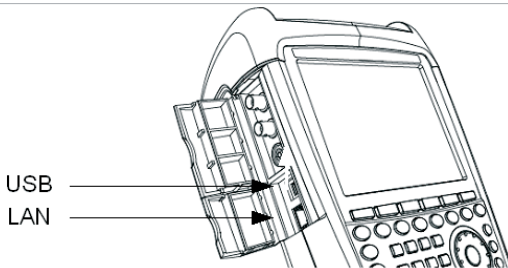
The BNC socket shown in the diagram above can be used as an intermediate frequency output (21.4 MHz) or a video output.

NOTICE

Risk of damage to the instrument

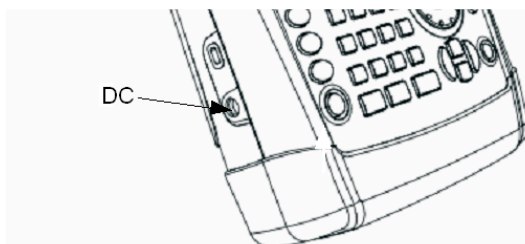
Never apply currents above > 600 mA or voltages above 20 V to the BNC sockets if the BNC connectors are not configured as BIAS input ports. If the BNC connectors are configured as BIAS input ports never apply currents above > 600 mA or voltages above 50 V.

USB and LAN interface



The R&S FSH can be connected to a computer via either a USB or a LAN interface for data transfer. The interfaces are on the left side below a protective cover (see figure above). A USB cable and a LAN connection cable for direct connection to the computer are supplied. The LAN interface is configured via the SETUP key.

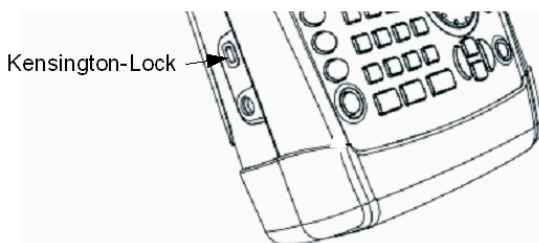
DC connection for supply from the external AC power supply



The R&S FSH is supplied with current by the AC/DC transformer power supply via the DC connection, and the R&S FSH battery is charged.

The internal battery can also be charged from a vehicle's cigarette lighter socket. The adapter required is available as an accessory for the R&S FSH (R&S HA-Z202, order no. 1309.6117.00).

Mechanical locking device



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

2.2.6 Hardware Settings

Set the R&S FSH to detect connected accessory automatically.

Setting the auto accessory detection

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Select AUTO ACCESSORY DETECTION below the heading HARDWARE with the rotary knob or the cursor keys (^ or v).

Auto Accessory Detection	On
Detected Accessory	

- Confirm with ENTER.

A submenu opens in which the automatic detection of accessories is set ON or OFF.

- Confirm with ENTER.



If the connected accessory is detected the item is displayed in the field DETECTED ACCESSORY below the heading HARDWARE.

2.2.7 Screen Settings

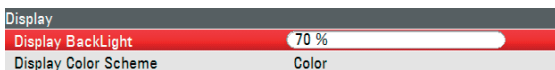
The R&S FSH's screen is a TFT color LCD. Indoors, its brightness depends on the intensity of the backlighting. The viewing angle can be optimized by adjusting the color setting. To achieve maximum contrast, the screen can be switched from color display to black-and-white display. Under extreme light conditions, it can be advantageous to select the high-contrast monochrome display.

To strike a balance between battery operating time and screen display quality, set backlighting to the minimum brightness needed.

Setting display backlight

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.



- Select DISPLAY BACKLIGHT below the heading DISPLAY with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

An input field opens in which the current background lighting ratio is displayed in percent. 100 % is the maximum brightness.

- Enter the desired brightness value with the rotary knob or the cursor keys in 10 % steps or enter the value directly via the numeric keys.
- Confirm with ENTER.

The input range lies between 0 % and 100 %.

Setting the display color scheme

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Display	
Display BackLight	70 %
Display Color Scheme	Color
Audio	Color
Key Click Volume	Black & White

- Select the DISPLAY COLOR SCHEME menu item below the heading DISPLAY with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

A submenu opens.

- Select COLOR (color screen display) with the rotary knob or the cursor keys (^ or v) or BLACK & WHITE (monochrome display).
- Confirm with ENTER.

2.2.8 Audio Settings

Set the key click volume and the system beeper volume in the INSTRUMENT SETUP settings.

Setting the key click volume

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Audio	
Key Click Volume	40 %
System Beeper Volume	30%

- Select KEY CLICK VOLUME below the heading AUDIO with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

An input field opens in which the current key click volume is displayed in percent.

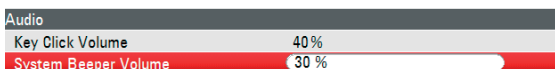
- Enter the desired volume value with the rotary knob or the cursor keys in 10 % steps or enter the value directly via the numeric keys.
- Confirm with ENTER.

The input range lies between 0 % and 100 %.

Setting the system beeper volume

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.



- Select SYSTEM BEEPER VOLUME below the heading AUDIO with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

An input field opens in which the current system beeper volume is displayed in percent.

- Enter the desired volume value with the rotary knob or the cursor keys in 10 % steps or enter the value directly via the numeric keys.
- Confirm with ENTER.

The input range lies between 0 % and 100 %.

2.2.9 Regional Settings

The regional settings allow to select a different language, date format and length unit. Set the desired regional settings in the INSTRUMENT SETUP settings.

Setting the language

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Regional	
Language	English
Date Format	dd/mm/yy
Length Unit	meter

- Select LANGUAGE below the heading REGIONAL with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

A list opens in which the supported languages are itemized:

Chinese	Korean
French	Portuguese
German	Russian
Italian	Spanish
Japanese	

- Select the desired language with the rotary knob or the cursor keys.
- Confirm with ENTER.

Setting the date format

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Regional	
Language	English
Date Format	dd/mm/yy
Length Unit	meter

- Select DATE FORMAT below the heading REGIONAL with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

A submenu appears.

- Select DD/MM/YY or MM/DD/YY with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

2.2.10 Setting the Date and Time

The R&S FSH has an internal clock that can apply a date and time stamp. The user can reset the date and time.

Setting the date

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Date and Time	
Set Date	13/03/2009
Set Time	12:03:11

- Select the SET DATE menu item below the heading DATE ANDTIME with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

An input field opens. In the input field, the date is shown in the currently selected format: dd/mm/yyyy or mm/dd/yyyy.

- Depending on the date format, change the day (dd) or month (mm) with the rotary knob, cursor keys or a numerical entry.
- Confirm with ENTER.

The cursor then automatically moves to the second field in the date (day or month, depending on the date format). Proceed with the next two fields as with the first.

Setting the time

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Date and Time	
Set Date	13/03/2009
Set Time	12:04:10

- Press the SETUP key. Select the SET TIME menu item below the heading DATE ANDTIME with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

The currently set time appears in "hours:minutes" format in the input field.

- Change the hours with the rotary knob, the cursor keys or by numeric input.
- Confirm with ENTER.

After input, the cursor automatically moves to the minutes display. Input is identical to the procedure for setting the hour display.

After the minutes have been entered, the R&S FSH verifies the validity of the entered time. If the time is not valid, the R&S FSH sets the next valid time.

2.3 Self Alignment

The self alignment calibrates the instrument settings for vector network analyzer and overrides the manufacturer's calibration stored in the instrument.

For the self alignment a short circuit (Short), an open circuit (Open) and 50 ohm match (Load) is required. In addition, a through connection must be established with an appropriate cable.

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Self Alignment	
Self Alignment	
Last Alignment Date	22/01/2009

- Select the SELF ALIGNMENT menu item below the heading SELF ALIGNMENT with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

A warning is shown:

! Warning !
Self Alignment overwrites the factory calibration data.
Are you sure?
Press YES to continue, press NO to cancel

Pressing YES will perform the self alignment. Pressing NO discards this action. Follow the instructions displayed on the screen.

2.4 Setting the Instrument Default Setup

2.4.1 Setting Preset

The PRESET key sets the R&S FSH to the default setup. This allows a new configuration based on defined measurement parameters to be entered, without parameters from a previous setting unintentionally still being active.



Setting the instrument to default setup only affects the present mode you are working with.

- Press the PRESET key.

The R&S FSH is set to the default setup. The span depends on the model. With the R&S FSH4, it is 3.6 GHz; with the R&S FSH8 it is 8 GHz.

2.4.2 Reset to Factory Settings

RESET TO FACTORY SETTINGS set the R&S FSH to factory defaults. All settings in the different menus are set to the original factory settings and all saved datasets, user defined transducer factors, limit lines, standards, channel tables and cable models will be deleted. Only the factory default files will be re-installed.

NOTICE

Risk of data loss

All saved datasets will be lost.

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Reset

Reset to Factory Settings

- Select RESET TO FACTORY SETTINGS with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

A warning is shown.

! Warning !

Reset to Factory Defaults?

(All saved datasets will be lost)

Press YES to continue, press NO to cancel

Pressing YES will perform the reset. Pressing NO discards this action. If YES is pressed, an information window is shown during the device rebooting.

2.5 Selecting External Reference / External Trigger / Direct Current Input (BIAS Port 2)

The ExtTrig / Ext Ref BNC connector on top of the R&S FSH can be used either as an input for an external trigger or an external reference. The BNC socket can additionally be used as a direct current input for PORT 2 (BIAS PORT 2) (see also the chapter on spectrum analyzer connections) Switchover is via the SETUP menu.

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

- Select menu item BNC1 MODE below the heading HARDWARE with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

A selection list opens.

- Select the desired function for the BNC socket with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

Hardware	
BNC1 Mode	Trigger Input
BNC2 Mode	IF-Out

NOTICE

Risk of damage to the instrument

Never apply currents above > 600 mA or voltages above 20 V to the BNC sockets if the BNC connectors are not configured as BIAS input ports. If the BNC connectors are configured as BIAS input ports never apply currents above > 600 mA or voltages above 50 V.

The EXT TRIG setting is only for input configuration. The use of the external trigger must be set in the SWEEP menu (SWEEP key, TRIGGER softkey).

If the input is configured for the external reference and if no reference signal is present at the input, a warning will appear on the screen. This is meant to prevent users from carrying out a measurement without a valid reference.

2.6 Selecting the Intermediate Frequency Output (IF Out) / Direct Current Input (BIAS Port 1)

The IF-Out / BIAS Port 1 BNC socket on the left side of the R&S FSH can be used either as an intermediate frequency output / video output or as a direct current input for PORT 1 (BIAS PORT 1) (see also the chapter on spectrum analyzer connections).

The selection is located in the setup menu.

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

Hardware	
BNC1 Mode	Trigger Input
BNC2 Mode	IF-Out

- Select the BNC2 MODE menu item below the heading HARDWARE with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

A selection list opens.

- Select the desired function for the BNC socket with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

NOTICE

Risk of damage to the instrument

Never apply currents above > 600 mA or voltages above 20 V to the BNC sockets if the BNC connectors are not configured as BIAS input ports. If the BNC connectors are configured as BIAS input ports never apply currents above > 600 mA or voltages above 50 V.

2.7 Enabling Options

The R&S FSH can be fitted with options (e.g. distance-to-fault measurements on cables) which are enabled by entering a key code. The key code is based on the unique serial number of the instrument. To add an option, enable it with a key code.

Operation

- Press the SETUP key.
- Press the INSTALLED OPTIONS softkey.
- Select INSTALL OPTION... under the OPTION ADMINISTRATION header.
- Confirm with ENTER.

An entry box in the lower right corner of the screen is displayed.

- Type in the the appropriate option key.
- Confirm with ENTER.

If the key entry was successful, the following notification is given in the bottom of the screen:

Installation successful!

If the key entry failed, the following notification is given in the bottom of the screen:

Invalid key code!

The correct key code can then be entered.

2.8 Checking the Installed Options

The R&S FSH displays the installed options in the Setup menu so you can check them:

- Press the SETUP key.
- Press the INSTALLED OPTIONS softkey.

The R&S FSH displays all available options with the appropriate status below the header OPTION INSTALLATION STATUS.

Installed Options	
Option Administration	
Install Option...	
Option Installation Status	
Remote Control (K40)	Installed
Distance to Fault (K41)	Installed
Vector Network Analysis (K42)	Installed

Measure Setup | Instrument Setup | HW/SW Info | **Installed Options** | Exit

If an option is installed, the installation status differs for permanent or temporary installed options.

2.9 Setting up a LAN or USB Connection to a PC

The powerful R&S FSH4View software is available to document measuring results, create limit lines, channel tables, etc. The software is supplied with the R&S FSH. Connection to a PC is possible via either LAN or USB. The following description covers the main steps for setting up the connection between the R&S FSH and the R&S FSH4View software.

The R&S FSH4View software must be installed on the PC before the connection is made. To do this, place the CD-ROM supplied in the CD drive. From the autostart menu select menu item FSH4View to install the software. Follow the instructions on the screen.



If no connection can be established between the R&S FSH4View software and the R&S FSH following successful configuration, please check the firewall settings on your PC.

2.9.1 Direct connection via LAN

Connect the R&S FSH directly to the PC with the LAN cable supplied. The R&S FSH LAN interface is situated on the left side underneath a protective cap (see also the chapter on spectrum analyzer connections).

DHCP is switched on by default on the R&S FSH. DHCP on the R&S FSH must be switched off for a direct connection.

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list with the general settings.

- Select the DHCP MODE menu item below the heading LAN PORT with the rotary knob or the cursor keys (^ or v) and confirm with ENTER.
- A list opens. Select OFF with the rotary knob or the cursor keys (^ or v) and confirm with the ENTER key. DHCP is now deactivated.

LAN Port	
MAC Address	00-90-b8-18-81-aa
DHCP	On
IP Address	Off
Subnet Mask	On

Setting the IP address

To establish the connection, the IP address of the PC used and that of the R&S FSH must be identical, except for the digits following the last dot.

Example:

PC IP address:	172.76.68.30
R&S FSH IP address:	172.76.68.24

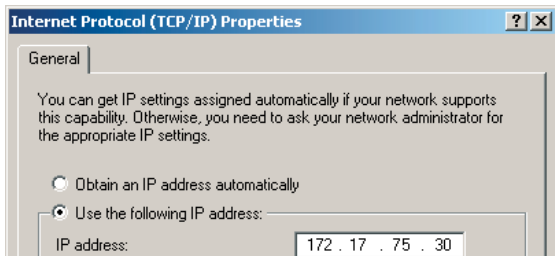


Fig.: IP address set on the PC

- Select the IP ADDRESS menu item from the list under the heading LAN PORT with the rotary knob or the cursor keys (^ or v) and confirm with ENTER.
- An input field opens. Enter the IP address of the PC (e.g. 172.76.68.24) with the numeric keys and confirm with the ENTER key.

LAN Port	
MAC Address	00-90-b8-18-81-aa
DHCP	Off
IP Address	172.17.75.1
Subnet Mask	255.255.255.0

Fig.: Setting the IP address on the R&S FSH

Setting the subnet mask

The PC's and the R&S FSH's subnet mask must also match in order to make a connection.

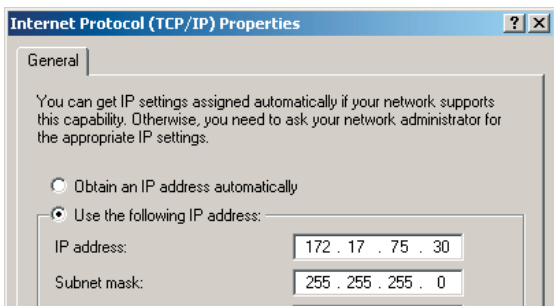


Fig.: Subnet mask set on the PC

- Select the SUBNET MASK menu item from the list below the heading LAN PORT with the rotary knob or the cursor keys (^ or v) and confirm with ENTER.

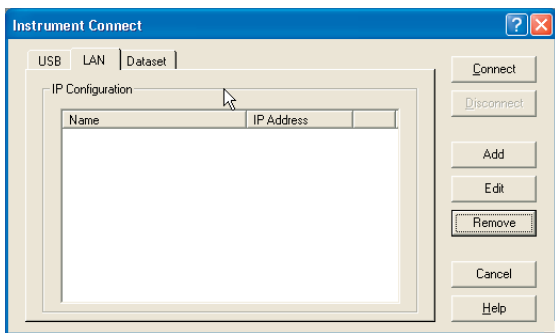
- An input field opens. Enter the subnet mask used on the PC, e.g. 255.255.255.0 with the numeric keys and confirm with the ENTER key.

LAN Port	
MAC Address	00-90-b8-18-81-aa
DHCP	Off
IP Address	172.17.75.1
Subnet Mask	255.255.255.0

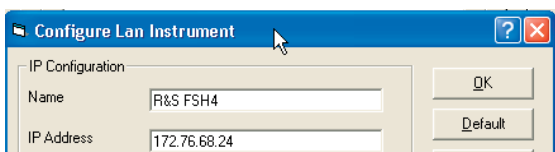
Fig.: Setting the subnet mask on the R&S FSH

R&S FSH4View software configuration:

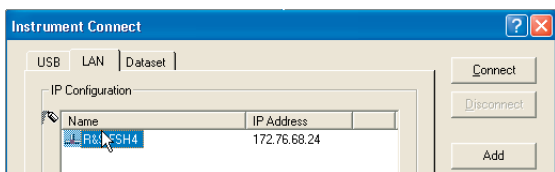
- Start the R&S FSH4View software on the PC.
- Select the LAN tab in the INSTRUMENT CONNECT dialog window.
- Click ADD to create a new network connection.



- Enter the name for the new network connection in the open window, e.g. R&S FSH4.
- Enter the IP address set for the R&S FSH in the IP Address input field, in this case 172.76.68.24, and confirm with OK.



The connection is now configured and appears in the INSTRUMENT CONNECT window.



- Select the new connection named “R&S FSH4” and make the connection to the R&S FSH with CONNECT.

2.9.2 Connection via an existing LAN network

The R&S FSH’s IP address can be automatically drawn from the DHCP server, or a fixed address can be defined manually. With manual allocation, a fixed IP address and subnet mask must be assigned to the R&S FSH as described in the chapter on direct LAN connection. The R&S FSH4View software must then be configured as described with the assigned IP address.



Contact your IT system manager to obtain a free IP address.

In networks with a DHCP server, the Dynamic Host Configuration Protocol (DHCP) permits automatic allocation of the network configuration to the R&S FSH connected via LAN cable. For this purpose, DHCP must be active on the R&S FSH.

DHCP is switched on by default on the R&S FSH. If the setting has been altered, proceed as follows:

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list with the general settings.

LAN Port	
MAC Address	00-90-b8-18-81-aa
DHCP	On
IP Address	172.17.75.1
Subnet Mask	255.255.255.0

- Select the DHCP MODE menu item below the heading LAN PORT with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

A selection list opens.

- Select ON with the rotary knob or the cursor keys (^ or v).
- Confirm with ENTER.

DHCP is now active.

The R&S FSH is now allocated an IP address and the subnet mask by the DHCP server. This can take several seconds. The values then appear under IP ADDRESS and SUBNET MASK under the LAN PORT heading.

In this example:

IP-address:	172.17.75.1
Subnet mask:	255.255.255.0

The R&S FSH4View software must then be configured as described in the chapter on direct LAN connection.



The IP address and subnet mask assigned by the DHCP server must then be used to create a new LAN connection.

2.9.3 Connection via USB

- Switch on the R&S FSH.
- Connect the R&S FSH directly to the PC with the USB cable supplied. The R&S FSH USB interface is situated on the left side under a protective cap (see also the chapter on spectrum analyzer connections).

When connected for the first time, the wizard for finding new hardware appears on the PC screen.

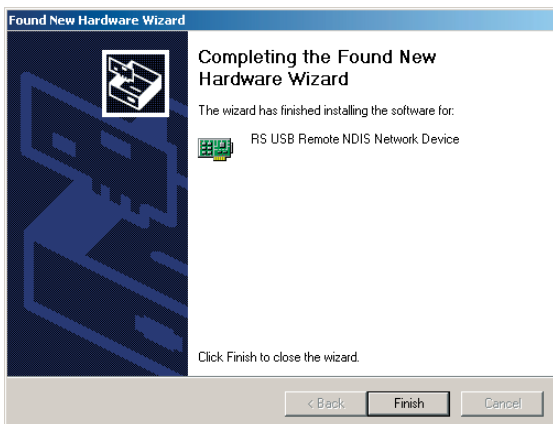


- Select **INSTALL THE SOFTWARE AUTOMATICALLY (RECOMMENDED)**.
- Confirm with **NEXT**.



The R&S FSH4View software must be installed on the PC. Only then can the hardware wizard find the necessary drivers for the USB connection.

After a few seconds, the wizard reports that the software for the new hardware has been installed.



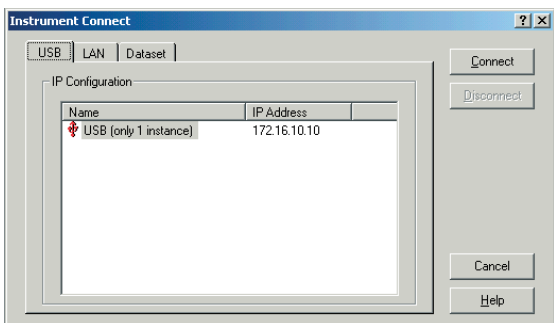
- Click FINISH to finish the installation.

The connection is now set up.

- Open the R&S FSH4View software on the PC.

The INSTRUMENT CONNECT dialog opens.

- Select the USB tab in the INSTRUMENT CONNECT dialog.



- Select the R&S FSH4 connection.

- Click CONNECT.



The FSH internally emulates a LAN connection. The IP address displayed by FSH4View for the USB connection is for information only. It is fixed to 172.16.10.10 and cannot be changed in FSH4View or the instrument.





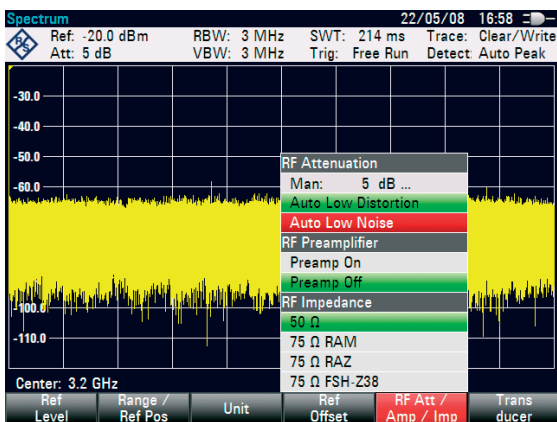
Getting started

This section explains the basic operation of the Handheld Spectrum Analyzer R&S FSH using some simple measurements as examples. A more detailed description of operation and functions, such as selecting menus and setting measurement parameters, is given in section 3 of the manual on the CD-ROM.

3.1 Controlling the RF Attenuator

Depending on the selected reference level, the R&S FSH sets the attenuator on the RF input to a suitable value. It offers two modes: one for the highest possible sensitivity (AUTO LOW NOISE) and one for the lowest possible intermodulation products (AUTO LOW DISTORTION). The difference between the two modes is that the attenuation that the R&S FSH sets for the RF attenuator is 5 to 10 dB higher for AUTO LOW DISTORTION than for AUTO LOW NOISE. The default setting is AUTO LOW DISTORTION. The table in the chapter on working with a pre-amplifier shows the setting for the RF attenuator as a function of the reference level.

- Press the AMPT key.
- Press the RF ATT/AMP/IMP softkey.
- Select the desired AUTO LOW NOISE or AUTO LOW DISTORTION mode with the rotary knob or the cursor keys below the RF ATTENUATION menu item.

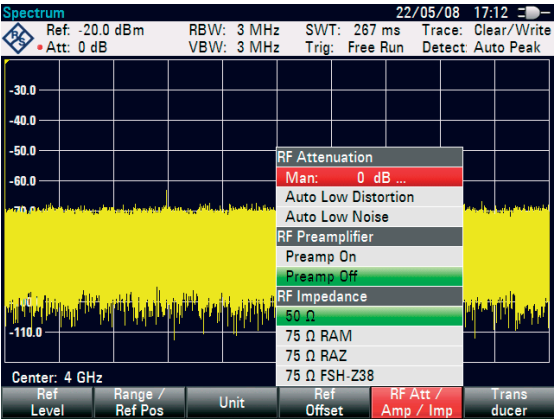


- Confirm with ENTER or the RF ATT/AMP/IMP softkey.

The current attenuation value for the RF attenuator is displayed in the status bar at the upper edge of the screen below the Att: caption.

To set the attenuator manually, proceed as follows:

- Press the AMPT key.
- Press the RF ATT/AMP/IMP softkey.
- Select the MAN: sub-item below the RF ATTENUATION menu item with the rotary knob or the cursor keys.
- Confirm with ENTER.



The current attenuation value of the attenuator is displayed in the input field. This value can be changed with the rotary knob or the cursor keys in 5 dB steps within the 0 dB to 40 dB range. The desired value can also be entered directly via the numeric keypad.

- Confirm the input of the attenuation value with ENTER.



The set damping value for the attenuator is displayed in the status bar at the upper edge of the screen behind the Att: caption.

To re-activate automatic attenuator setting as described, select either AUTO LOW NOISE or AUTO LOW DISTORTION.

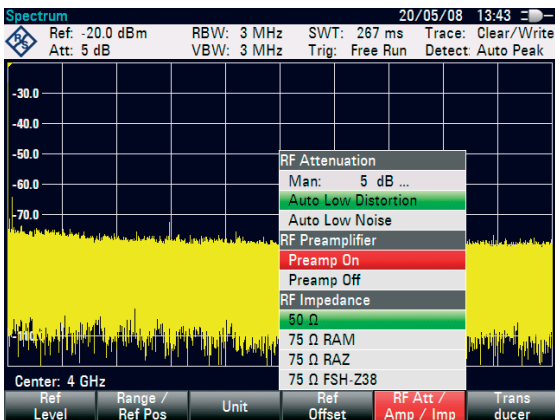
3.2 Using a Preamplifier

The R&S FSH has an internal preamplifier for increasing sensitivity. Depending on the frequency, this amplifier has 15 dB to 20 dB gain and increases sensitivity by 10 to 15 dB. It is fitted behind the RF attenuator and in front of the input mixer.

- Press the AMPT key.
- Press the RF ATT/AMP/IMP softkey.

The R&S FSH changes to the submenu for configuring the pre-amplifier. The green selection bar displays the current setting.

- Select the desired setting in the RF PREAMPLIFIER submenu with the rotary knob or the cursor keys (PREAMP ON or PREAMP OFF).
- Confirm with ENTER or the RF ATT/AMP/IMP softkey.



If the preamplifier is switched on, its use is coupled to the reference level, thus ensuring the optimum dynamic range of the R&S FSH at all times.

The table below shows the positions of the RF attenuator and the preamplifier as a function of the reference level.

Reference level	Preamplifier OFF		Preamplifier ON	
	RF attenuation		RF attenuation	Preamplifier
	Low Noise	Low Distortion	Low Noise	
≤ -30 dBm	0 dB	0 dB	0 dB	On
-29.9 to -25 dBm	0 dB	0 dB	10 dB	On
-24.9 to -20 dBm	0 dB	0 dB	5 dB	On
-19.9 to -15 dBm	0 dB	5 dB	10 dB	On
-14.9 to -10 dBm	0 dB	10 dB	0 dB	Off
-9.9 to -5 dBm	5 dB	15 dB	5 dB	Off
-4.9 to 0 dBm	10 dB	20 dB	10 dB	Off
0.1 to 5 dBm	15 dB	25 dB	15 dB	Off
5.1 to 10 dBm	20 dB	30 dB	20 dB	Off
10.1 to 15 dBm	25 dB	35 dB	25 dB	Off
15.1 to 20 dBm	30 dB	40 dB	30 dB	Off
20.1 to 25 dBm	35 dB	40 dB	35 dB	Off
25.1 to 30 dBm	40 dB	40 dB	40 dB	Off

3.3 Measurements on CW Signals

A basic task performed by spectrum analyzers is measuring the level and frequency of sinewave signals. The following examples illustrate the most effective way of performing these measurements with the R&S FSH.

A signal generator is used as a signal source, e.g. the Signal Generator R&S SML.

Measurement setup

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

Signal generator settings:

Frequency: 700 MHz

Level: -30 dBm

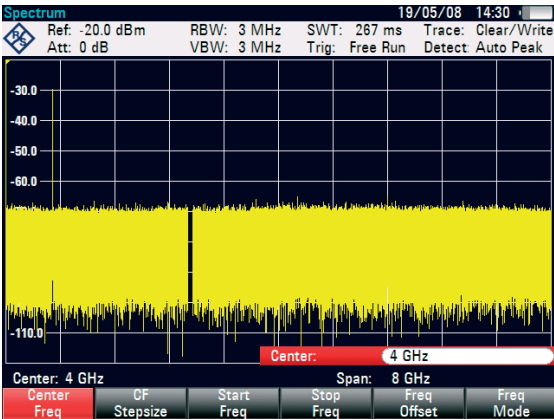
3.3.1 Level Measurement

First, set the R&S FSH to its default settings to show all the operating steps that are required.

- Press the PRESET key.

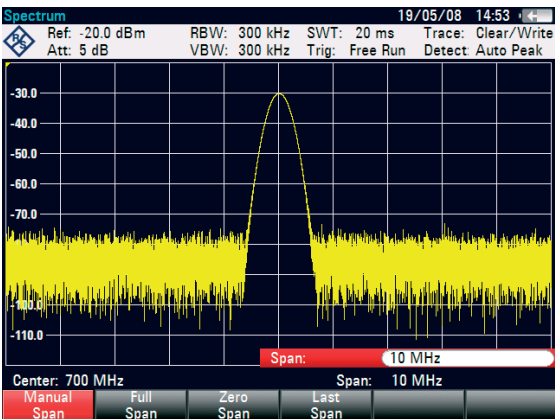
The analyzer displays the frequency spectrum over the R&S FSH's maximum frequency span. At 700 MHz, the generator signal is displayed as a vertical line.

To analyze the generator signal at 700 MHz in more detail, reduce the frequency span. Set the R&S FSH's center frequency to 700 MHz and reduce the span to 10 MHz.



- Press the FREQ key.
- Enter '700' using the numeric keypad and confirm the entry with the MHz key.
- Press the SPAN key.
- Enter '10' using the numeric keypad and confirm the entry with the MHz key.

The R&S FSH now displays the generator signal with a higher resolution.

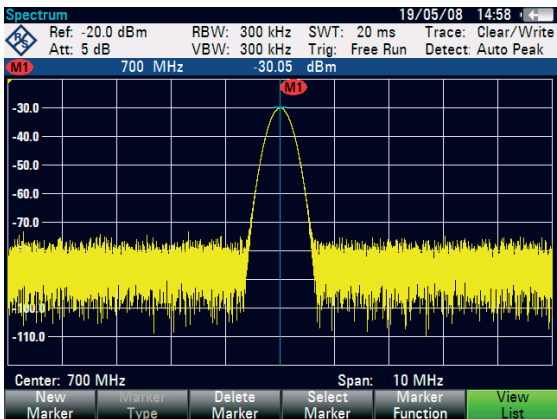


The R&S FSH has markers for reading off signal levels and frequencies. Markers are always positioned on the trace. Both the level and frequency at their current positions are displayed on the screen.

- Press the marker key.

The marker is activated and is automatically positioned on the trace maximum. A vertical line on the measurement diagram indicates the marker frequency. A short horizontal line on the trace indicates the level.

The R&S FSH displays the level and the frequency of the marker position numerically above the measuring screen.



3.3.2 Setting the Reference Level

The level shown by spectrum analyzers at the top of the measurement diagram is called the reference level (REF LEVEL). To obtain the best dynamic range from a spectrum analyzer, its full level range should be used. This means that the maximum spectrum level should be at or close to the top of the measurement diagram (= reference level).

The reference level is the maximum level on the level axis (y axis).

Reduce the reference level by 10 dB to increase the dynamic range.

- Press the AMPT key.

The softkeys for the AMPT menu are displayed and the REF LEVEL softkey label is highlighted in red, i.e. it is enabled for value entry. The red value entry box at the bottom right-hand corner of the measurement diagram displays the current reference level.

- Enter '30' using the numeric keypad and confirm the entry with the '-dBm' key.

The reference level is now set to -30 dBm. 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 is also an effective way to shift the trace maximum so that it coincides with the top of the measurement diagram. If the marker is positioned on the trace maximum (as in the example), the reference level can be set to the marker level by entering the following keystrokes:

- Press the MARKER-> key.
- Press the CENTER=MKR/LEVEL softkey.
- Select LEVEL=MARKER LEVEL in the selection box by using the rotary knob or the cursor keys (\wedge or \vee).
- Press the ENTER key.

The reference level is then set to the measured level indicated by the marker. Only a few keystrokes are needed to set the optimal reference level.

3.3.3 Frequency Measurements

The R&S FSH's trace displays 631 measurement points (frequency points). The marker is always positioned on one of these measurement points. The R&S FSH calculates the marker frequency from the measurement point frequency, and the center frequency and 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 FSH has a frequency counter to increase the accuracy of the marker-frequency readout, It

stops the sweep at the marker position, counts the frequency and then continues the sweep.

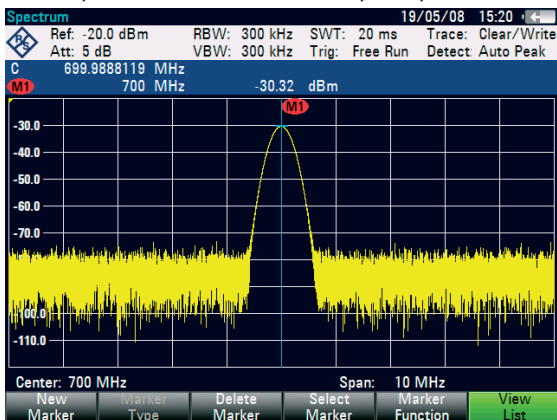
The following measurement example is based on the previous example.

- Press the MARKER FUNCTION softkey in the marker menu.

The MARKER FUNCTION selection box opens.

- Select FREQUENCY COUNT from the selection box using the rotary knob or the cursor keys (\wedge or \vee).
- Press the ENTER key.

The label 'M:' at the upper left-hand corner of the measurement diagram changes to 'C:' to tell you that the frequency counter has been switched on. The resolution of the frequency readout is now 1 Hz no matter what span has been set. The accuracy is determined by the R&S FSH's internal reference frequency. It is far higher than that of pixel-oriented, marker-frequency readout.



3.3.4 Harmonic Measurements of a Sinewave Signal

Since a spectrum analyzer can resolve different signals in the frequency domain, it is ideal for measuring harmonic levels or harmonic ratios. To speed up these operations, the R&S FSH has marker functions that deliver fast results with only a few keystrokes.

As above, a signal generator with a 100 MHz output frequency and an output level of -20 dBm is used in the following measurement example.

First, the R&S FSH is set to its default settings to show all measurement steps that are needed.

- Press the PRESET key.

The analyzer displays the frequency spectrum from the largest available span. At 100 MHz, the generator signal is displayed as a line. The generator harmonics are displayed as lines at frequencies that are multiples of 100 MHz.

To measure the second harmonic ratio, set the start and stop frequency as follows:

- Press the FREQ key.

The softkey menu opens entering the frequency.

- Press the START FREQ softkey.
- Enter '50' using the numeric keypad and confirm the entry with the MHz key.

- Press the STOP FREQ softkey.
- Enter '250' using the numeric keypad and confirm the entry with the MHz key.

The R&S FSH now displays the spectrum from 50 MHz to 250 MHz and thus the signal at 100 MHz and its second harmonic at 200 MHz.

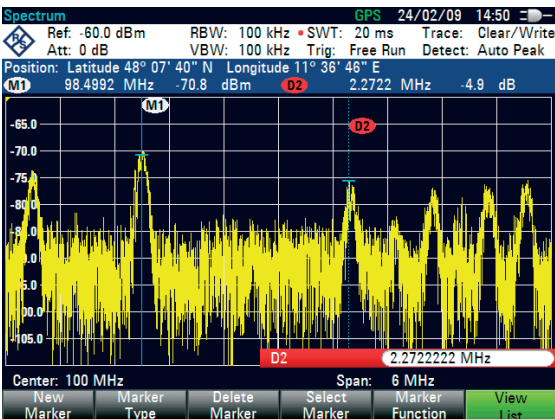
To measure the harmonic ratio, set the marker on the fundamental and the delta marker on the second harmonic.

- Press the MARKER key.

The softkey menu opens for marker entry and automatically positions the main marker on the trace maximum.

- Press the NEW MARKER softkey.

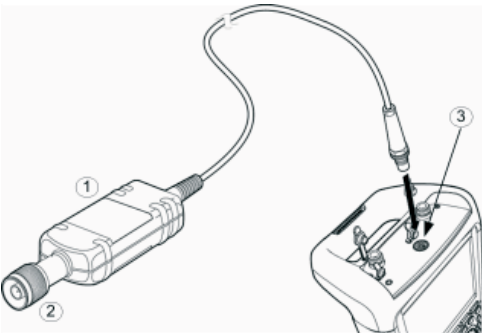
The delta marker is activated (vertical dotted line) and is automatically placed on the next trace maximum (= second harmonic). The harmonic ratio in dB is displayed at the top of the screen.



3.4 Power Measurements Using the Power Sensor

For highly accurate power measurements, the R&S FSH provides the Power Sensor R&S FSH-Z1 or R&S FSH-Z18 as options. They measure power in the span 10 MHz to 8 GHz or 10 MHz to 18 GHz, respectively.

The Power Sensor is controlled and powered via a special RS-232-C interface at the top of the instrument.



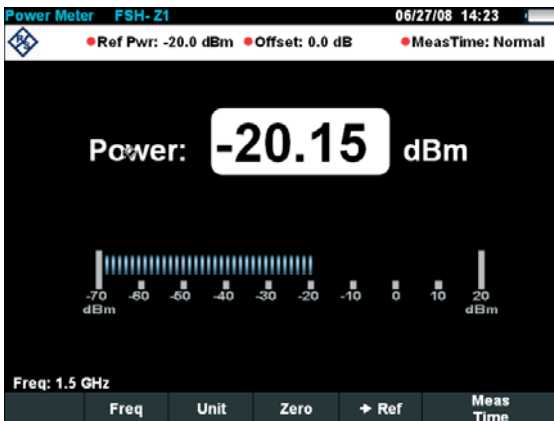
- 1 Power Sensor R&S FSH-Z1 or R&S FSH-Z18
- 2 Power Sensor connector (Device under Test)
- 3 Interface for Power Sensor

NOTICE

Risk of damage to the sensor due to 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 ($\leq 10 \mu\text{s}$) power peaks up to 1 W (30 dBm) are permissible.



- Connect the power sensor cable to the R&S FSH's power sensor connector and screw into position.
- Press the MODE key.
- Press the POWER METER softkey.

The R&S FSH changes to power measurement mode and opens the screen for the power measurement. If a power sensor has not been connected, no measured value is displayed. If a power sensor has been connected, the R&S FSH sets up a connection via the interface and, after a few seconds, displays the measured power.

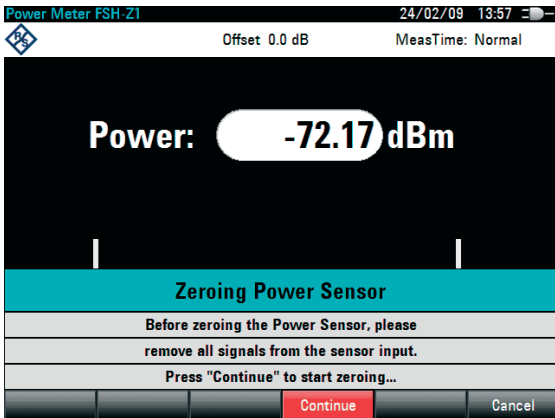
If there are any communication problems with the power sensor, the R&S FSH outputs error messages (sensor error: error number) indicating the possible causes (see main manual).

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

- Press the ZERO softkey.

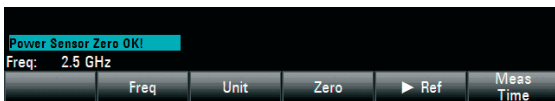
The R&S FSH outputs a message telling you not to apply any signals to the power meter while zeroing is being performed.

- Disconnect the power sensor from any signal sources.
- Start zeroing with the softkey CONTINUE.



The R&S FSH immediately starts power meter zeroing. While this process is being performed, the R&S FSH outputs the message "Zeroing power sensor, please wait..."

When zeroing is over, the R&S FSH outputs the message „Power Sensor Zero OK“ and switches back to the softkey menu for the power sensor.



- Connect the signal under test to the R&S FSH-Z1 or R&S FSH-Z18.

The R&S FSH shows the measured power level in dBm.

For a highly accurate measurement, enter the frequency of the signal under test.

- Press the FREQ softkey.
- Using the numeric keys, enter the frequency you want and confirm the entry with the ENTER key or by pressing the FREQ softkey again.

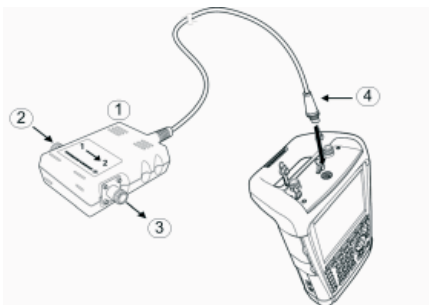


The R&S FSH transfers the new frequency to the power sensor which then corrects the measured power readings.

3.5 Power and Return Loss Measurements with the R&S FSH-Z14 or the R&S FSH-Z44

The Directional Power Sensors R&S FSH-Z14 and R&S FSH-Z44 are connected between the source and the load and measure the power flux in both directions, i.e. from the source to the load (forward power) and from the load to the source (reverse power). The ratio between reverse power and forward power is a measure of the load matching and is displayed as the return loss or standing wave ratio.

The R&S FSH-Z14 and the R&S FSH-Z44 have an asymmetrical design and must therefore 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). They are driven and powered via a special serial interface.



- 1 Directional Power Sensor R&S FSH-Z44
- 2 Source
- 3 Load
- 3 Power sensor socket

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.*
-

Operation

- Connect the cable on the power sensor to the power sensor socket on the R&S FSH and screw it on. Insert the directional power sensor between the source and the load.
- Press the MODE key.
- Press the POWER METER softkey.

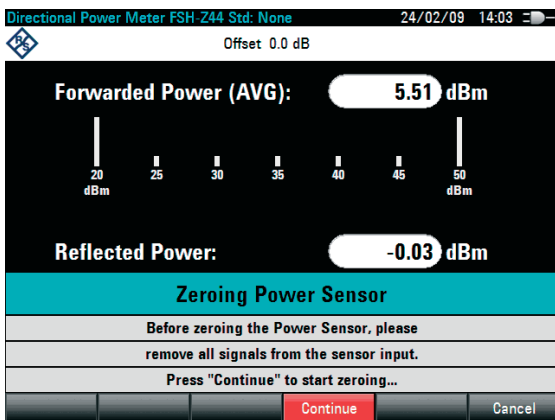
The R&S FSH changes to power measurement mode and opens the screen and the menu for the directional power measurement. If no power sensor is connected, no measured value is displayed. If a power sensor is connected, the R&S FSH establishes a connection to the power sensor via the interface and, after a few seconds, displays the connected power sensor type (R&S FSH-Z14 or R&S FSH-Z44) as well as the measured forward power and return loss of the load.

Before performing the power measurement, zero the power sensor.

- Press the ZERO softkey.

The R&S FSH informs you not to apply any signals while the power sensor is being zeroed.

- Disconnect the power sensor from any signal sources.
- Start zeroing with the CONTINUE softkey.



The softkey CANCEL can be used to cancel zeroing before it begins, e.g. if the signal source cannot be disconnected.

The R&S FSH immediately starts power sensor zeroing. While this is being done, the R&S FSH outputs the message "Zeroing power sensor, please wait..."

When zeroing is over, the R&S FSH outputs the message “Power Sensor Zero OK” and switches back to the softkey menu for the power sensor.

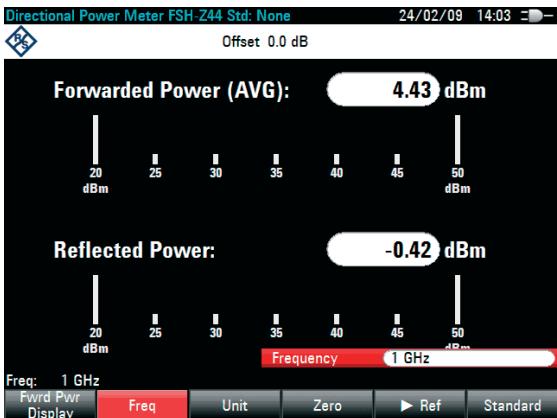
- Now connect the R&S FSH-Z14 or R&S FSH-Z44 between the source and the load.
- The R&S FSH displays the measured forward power level in dBm and the VSWR of the load.

To achieve maximum measurement accuracy, enter the frequency of the signal under test.

- Press the FREQ softkey.

The R&S FSH opens the entry box for the frequency.

- Enter the desired frequency using the numeric keys.
- Terminate the input with the ENTER key or by pressing the FREQ softkey again.



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

3.6 Measurement of the Transfer Function of Two-Port Networks

(Only for R&S FSH with tracking generator: order no. 1309.6000.14, 1309.6000.18, 1309.6000.24 or 1309.6000.28.)

For measurements of the gain or attenuation of four-port devices, the R&S FSH provides a tracking generator which generates a sinewave signal exactly at the receive frequency of the R&S FSH.

For measurements on devices under test which require an external voltage (e.g. power amplifiers), connect the supply of a voltage from a suitable AC power supply to the appropriate BIAS PORT 1 or BIAS PORT 2 input (for R&S FSH models 1309.6000.24 and 1309.6000.28 only).

- Press the MODE key.
- Press the NETWORK ANALYZER softkey.

The R&S FSH changes to network analyzer mode and switches on the tracking generator. Since no calibration is performed, (UNCAL) is displayed at the top.

Before calibration, the span you want should be set because calibration is valid only for the calibrated span.

- Press the FREQ key.
- Using the numeric keys, enter the center frequency.

- Press the SPAN key.
- Using the numeric keys, enter the span.

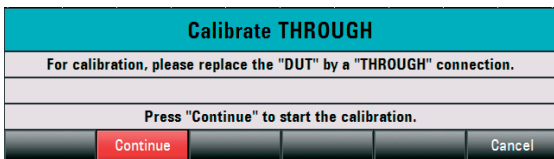
Alternately, the start and stop frequencies can be entered using the START FREQ and STOP FREQ softkeys in the frequency menu.

3.6.1 Calibrating the R&S FSH for Vector Measurement of the Transmission Function

(Only for R&S FSH models 1309.6000.24 and 1309.6000.28 with option R&S FSH-K42)

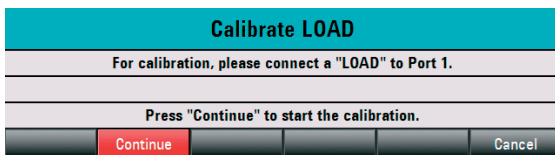
- Press the MEAS key.
- Press the CALIBRATE softkey.
- Select TRANSMISSION FWD (PORT1 -> 2) using the rotary knob and confirm with ENTER or the CALIBRATE softkey.

To calibrate the transfer measurement, the R&S FSH requests that the RF input be connected to the tracking generator output.



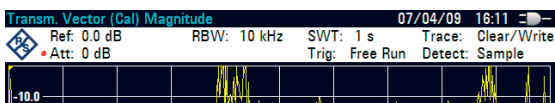
- Connect the RF input of the R&S FSH directly to the tracking generator output without the DUT.
- Press the CONTINUE softkey to start calibration.

The R&S FSH then requests to terminate the output of the tracking generators into 50 Ω (LOAD).



- Connect the generator output with the 50 Ω termination.
- Press the CONTINUE softkey.

When calibration is over, TRANSM. VECTOR (CAL) is displayed in the upper area of the screen to indicate that the R&S FSH is vector-calibrated for transmission measurement.



3.6.2 Calibrating the R&S FSH for Scalar Measurement of the Transmission Function

The following example shows a scalar measurement of the transmission function. If the option R&S FSH-K42 is installed, the measurement must first be switched to scalar (only for R&S FSH models 1309.6000.24 or 1309.6000.28).



Select *VECTOR* to increase the accuracy (for R&S FSH models 1309.6000.24 and 1309.6000.28 with option K42 (vector network measurements) only). For R&S FSH models 1309.6000.14 and 1309.6000.18 and without option K42 only *SCALAR* can be selected.

- Press the MEAS key.
- Press the MEAS MODE softkey.
- Using the rotary knob or cursor keys (\wedge or \vee), select SCALAR.
- Confirm with ENTER or the MEAS MODE softkey.
- Press the CALIBRATE softkey in the main menu for the network analyzer.

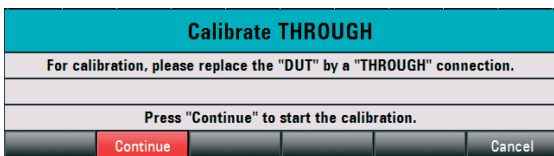


With R&S FSH models 1309.6000.24 and 1309.6000.28, the transmission can be measured in a forward or reverse direction. With models 1309.6000.14 and 1309.6000.18, in reverse direction only.

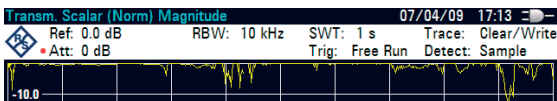
- Select the desired measurement direction forward or reverse with the rotary knob or the cursor keys (\wedge or \vee) NORMALIZETRANSM. FWD. (PORT 1 -> PORT 2) or NORMALIZE TRANSM. REV. (PORT 2 -> PORT 1).
- Confirm with ENTER or the CALIBRATE softkey.

The R&S FSH requests that the RF input be connected to the tracking generator output for directional calibration.

- Connect PORT 1 and PORT 2 directly with a measuring cable without a device under test.
- Press CONTINUE to start the calibration.



After the calibration is finished, the R&S FSH displays TRANSM. SCALAR (NORM) at the top.



3.6.3 Measure the magnitude of the transfer function



After a two-port calibration it is possible to switch between forward and reverse without having to recalibrate the R&S FSH anew. See also the paragraph on two-port calibration in the chapter on measuring the scalar return loss (for R&S FSH models 1309.6000.24 and 1309.6000.28 only).

- Connect the DUT between the RF input and the generator's output.

The R&S FSH displays the magnitude of the transfer function. You can read out values with the markers, for example.



The calibration for the transmission measurement is not lost if the start, stop frequency, the center frequency and the span are subsequently changed within the calibrated frequency domain. In this case, the R&S FSH interpolates the correction data between the reference points of the calibration. In this case, the R&S FSH displays (Approx) at top left and indicates the possibly increased measurement error. If the modified frequency domain lies outside the calibrated frequency range, the calibration becomes invalid and (UNCAL) is displayed at top left. To restore the last valid calibration, proceed as follows:

- Press the CALIBRATE softkey in the main menu for the network analyzer.
- Select RESTORE CALIBRATION SETTINGS with the rotary knob or the cursor keys (\wedge or \vee).

The R&S FSH restores all instrument settings which were used at the time of the last calibration. The calibration is reactivated and (CAL) is displayed at top left.

When a data record for scalar reflection measurement in calibrated state is saved, the R&S FSH also discards the calibration data with the remaining settings. This means that it is possible to measure without first having to recalibrate after the settings have been restored.

3.7 Return Loss Measurement

(For R&S FSH models with a tracking generator and a built-in VSWR bridge only, order no. 1309.6000.24 or 1309.6000.28)

The R&S FSH-Z28 (0 GHz to 8 GHz) or R&S FSH-Z29 (0 GHz to 3.6 GHz) calibration standard is required for measuring the return loss.

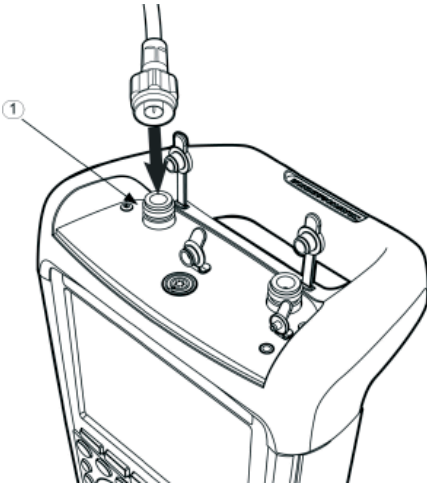


Fig.: PORT 1 (1)

The reflection measurement can be taken using the R&S FSH with the built-in VSWR bridge at either port 1 or port 2. The figure above shows the connection of the device under test to PORT 1.

- For measurements on devices under test which require an external voltage supply (e.g. power amplifiers), connect the supply voltage from a suitable AC power supply to the appropriate BIAS PORT 1 or BIAS PORT 2 input.

The test setup must be calibrated prior to the measurement. This is done using a short and an open circuit at the point where the reflection is to be measured. If the device under test is directly connected to the R&S FSH, the measuring port is at PORT 1 or PORT 2. If a cable is used between the device under test and PORT 1 or PORT 2 the calibration is made at the measurement end of the cable.

- Press the MODE key.
- Press the NETWORK ANALYZER softkey.

The R&S FSH changes to network analyzer mode and switches on the tracking generator. Since no calibration is performed, (UNCAL) is displayed at the top left.

Before performing calibration, set the required span because calibration is valid only for the calibrated span.

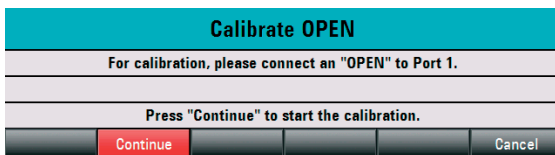
- Press the FREQ key.
- Using the numeric keys, enter the center frequency.
- Press the SPAN key.
- Using the numeric keys, enter the span.

Alternatively, the start and stop frequency can be input using the START FREQ and STOP FREQ softkeys in the frequency menu.

3.7.1 Calibrate the R&S FSH for the Vector Return Loss Measurement

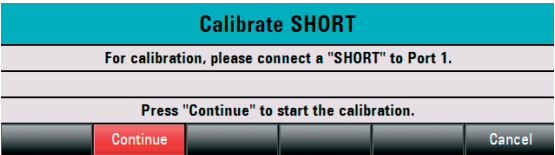
- Press the MEAS key.
- Press the CALIBRATE softkey.
- Select REFLECTION PORT 1 using the rotary knob or the cursor keys.
- Confirm with ENTER or by pressing the CALIBRATE softkey.

The R&S FSH displays a message requesting termination of the measurement input into an open circuit (Open).



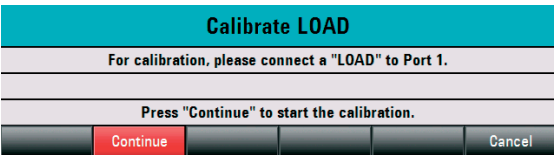
- Terminate the measurement input of the VSWR bridge or the end of the measurement cable into an open circuit.
- Start open-circuit calibration by pressing CONTINUE.

When the open-circuit calibration is done, the R&S FSH outputs a message requesting the termination of the measurement port into a short circuit (SHORT).



- Terminate the measurement input of the bridge or the end of the measurement cable into a short circuit.
- Start the short-circuit calibration by pressing CONTINUE.

In the third step of calibration, terminate the measurement port into a 50 Ω termination.



- Terminate the measurement input of the bridge or the end of the measurement cable into a 50 Ω termination (LOAD)
- Start termination calibration by pressing CONTINUE.

When calibration is done, the R&S FSH outputs the message "Calibration Done" for three seconds. REFL. VECTOR (CAL) is displayed in the upper area of the diagram. The R&S FSH is vector-calibrated for reflection measurements.

Vector reflection measurements

Select a measurement within the FORMAT softkey menu. A detailed description of the measurements is given in the Operating Manual in chapter "Measuring the Reflection Magnitude."

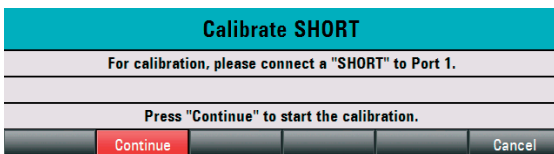
3.7.2 Calibrate the R&S FSH for the Scalar Return Loss Measurement

The following example shows a scalar measurement of return loss. If the option R&S FSH-K42 is installed, measurement must first be switched to scalar.

- Press the MEAS key.
- Press the MEAS MODE softkey.
- Using the rotary knob or cursor keys (\wedge or \vee), select SCALAR.
- Confirm with ENTER or the MEAS MODE softkey.
- Press the CALIBRATE softkey in the main menu for the network analyzer.
- Select NORMALIZE REFLECTION PORT 1 or NORMALIZE REFLECTION PORT 2 with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm with ENTER.

The R&S FSH starts calibration and displays a message requesting to perform SHORT calibration.

- Connect a short circuit to the PORT 1 or PORT 2 measurement input and to the end the measuring cable.
- Using CONTINUE start the SHORT calibration.

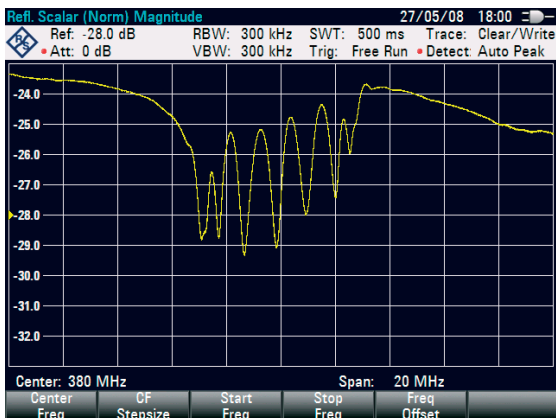


After the calibration is finished, the R&S FSH displays (CAL) at the top. This indicates that the R&S FSH is calibrated for scalar reflection measurements.

Scalar reflection measurements

- Connect the device under test to the calibrated measurement port.

The R&S FSH displays the return loss of the device under test in dB:



The R&S FSH additionally offers to display the reflection in VSWR or as a reflection coefficient. Proceed as follows:

- Select the FORMAT softkey.
- Select VSWR or REFLECTION COEFFICIENT with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm the selection with the ENTER key or the FORMAT softkey.

3.7.3 Restore Calibration Settings

The calibration remains valid if the start frequency, stop frequency, center frequency and span are subsequently changed within the calibrated frequency range. In this case, the R&S FSH interpolates the correction data between the reference points of the calibration. In this case, the R&S FSH displays (Approx) at top left and indicates the possibly increased measurement error. If the modified frequency range lies outside the calibrated frequency range, the calibration becomes invalid and (UNCAL) is displayed at top left. To restore the last valid calibration, proceed as follows:

- Press the CALIBRATE softkey in the main menu for the network analyzer.
- Select RESTORE CALIBRATION SETTINGS with the rotary knob or the cursor keys (\wedge or \vee).

The R&S FSH restores all instrument settings which were used at the time of the last calibration. The calibration is reactivated and (CAL) is displayed at top left.

When saving a data set for a vector or a scalar reflection measurement in a calibrated state, the R&S FSH can store the calibration data along with the other settings. Thus, after the setting is recalled, a measurement can be performed without prior calibration.

3.7.4 Using the Factory Calibration

To use the factory calibration, proceed as follows:

- Press the CALIBRATE softkey in the main menu for the network analyzer.
- Select USER CALIBRATION OFF with the rotary knob or the cursor keys (\wedge or \vee) and conclude with the ENTER key or the CALIBRATE softkey.

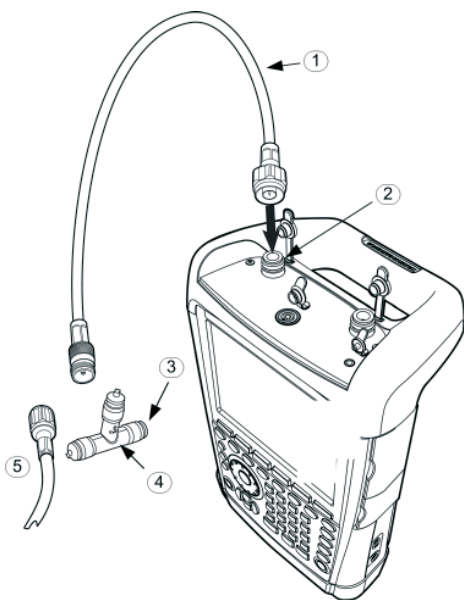
The R&S FSH now uses the calibration data recorded in the factory. (UNCAL) is displayed at the top left of the screen.



The R&S FSH is already calibrated across the complete frequency range at the factory. The reference plane for the factory calibration is PORT 1 or PORT 2. If the device under test is directly connected to one of the measuring ports, the reflection can be determined with sufficient accuracy without further calibration. To improve measurement accuracy, or if an additional cable is used between the device under test and PORT1 or PORT2, it is recommended that the calibration described above be performed.

3.8 Measuring Cable Faults

(For R&S FSH models with a tracking generator and a built-in VSWR bridge only, order no. 1309.6000.24 or 1309.6000.28, and installed option R&S FSH-K41 (distance to fault measurement). The R&S FSH-Z20 spare RF cable and the spare FSH-Z28 (0 GHz to 8 GHz) or R&S FSH-Z29 (0 GHz to 3.6 GHz) calibration standard are also required.)



- 1 Measurement cable
- 2 PORT 1 RF-Input
- 3 Short
- 4 Calibration standard R&S FSH-Z28 or R&S FSH-Z29
- 5 Device under test

- For measurements on devices under test which require an external voltage supply (e.g. power amplifiers), connect the supply voltage from a suitable AC power supply to the BIAS PORT 1 input.
- Connect the RF test cable supplied with option R&S FSH-Z20 to PORT 1.



The RF test cable must be used. Results are invalid without this cable.

- Press the MODE key.
- Press the DISTANCETO FAULT softkey.

The R&S FSH switches on the distance-to-fault measurement function.

The R&S FSH delivers optimum results if the center frequency is set to the frequency at which the device under test is operated.

- Press the FREQ key.
- Input the center frequency (CENTER), e.g. frequency of the antenna at the end of the cable under test.

To perform distance-to-fault cable measurements, the R&S FSH needs to be informed about the type of cable and its approximate length. Frequency-dependent cable models can be generated with the supplied "R&S FSH4 View" software for Windows and loaded onto the R&S FSH. The procedure is described in the R&S FSH View manual.

Selecting a cable model from the list

- Press the MEAS key.
- Press the CABLE MODEL softkey.

The R&S FSH displays the list of loaded cable models.

- Select the desired cable model with the rotary knob or the cursor keys (\wedge or \vee).
- Using the SELECT softkey, activate the cable model you have selected.

The analyzer returns to the DTF measurement menu and displays the cable used for the measurement in the upper left-hand corner of the screen.

The R&S FSH uses the cable length to determine the optimal span for the measurement and for scaling the x axis in DTF mode. For best results, the cable should be specified 20% to 50% longer than the actual cable length.

- Press the CABLE LENGTH softkey.

The R&S FSH opens the cable length value entry box and displays the current length setting.

- Using the numeric keys, enter the cable length in meters and terminate the entry with the ENTER key or one of the unit keys or adjust the cable length using the rotary knob (1 m steps) or the cursor keys (\wedge or \vee) (10 m steps).

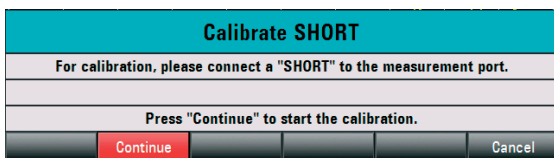
The minimum cable length is 0 m. The maximum cable length that can be set is 1500 m.

Calibrating the test setup

- Press the CALIBRATE softkey.
- Select the DTF ONLY menu item with the rotary knob or the cursor keys (\wedge or \vee) and confirm the selection with the ENTER key or the CALIBRATE softkey.

The R&S FSH opens a text window that prompts you to terminate the measurement cable with a SHORT.

- Firmly screw the SHORT to the output end of the measurement cable.
- Press the CONTINUE softkey to start the SHORT calibration.



When calibration is over, the R&S FSH displays **DTF CAL** in the top left-hand corner of the screen.



The R&S FSH performs calibration over its entire span. It is thus not necessary to perform a new calibration following a change of frequency range or cable length. The calibration data is stored in the R&S FSH memory. Thus, the calibration is valid after the operating mode is changed or after the instrument is switched off.

- Remove the SHORT from the measurement cable.
- Screw the cable under test to the measurement cable.

The R&S FSH displays the return loss produced in the cable under test versus the distance.

Checking the spectrum in the span for detecting external interferers

- Press the MEAS MODE softkey.
- Select SPECTRUM using the rotary knob or the cursor keys (^ or v).
- Confirm your selection by pressing the MEAS MODE softkey again or by pressing the ENTER key.

The R&S FSH turns off the tracking generator and displays the spectrum over the span of the DTF measurement.

To indicate that the R&S FSH is in the spectrum mode, DTF SPECTRUM is displayed in the upper right-hand corner of the screen. Otherwise, the R&S FSH uses exactly the same settings as it did for DTF measurements.

Additional measurement of the impedance matching:

Apart from the DTF measurement, the R&S FSH offers the option of also determining the cable impedance matching as a function of the frequency. For this purpose, the R&S FSH must be calibrated with three calibration standards (short-circuit, open circuit and 50 ohm match) instead of with just one. Proceed as follows:

- Press the CALIBRATE softkey.
- Select the DTF + REFLECTION menu item with the rotary knob or the cursor key (\wedge or \vee) and confirm the selection with the ENTER key or the CALIBRATE softkey.

The R&S FSH opens a text box in which it requests the matching of the measuring cable with a short circuit (Short), an open circuit (Open) and 50 ohm match (Load) consecutively.

- Firmly screw on the required calibration standards to the output of the measuring cable one after the other and start the calibration for each with the CONTINUE softkey.

After calibration is finished, the R&S FSH displays DTF REFLECTION (CAL) at the top of the screen.

- Then press the MEAS MODE softkey.
- Select REFLECTION with the rotary knob or the cursor keys (\wedge or \vee).
- Confirm the selection by pressing the MEAS MODE softkey again or by pressing the ENTER key.

With the REFLECTION setting, the R&S FSH changes from the DTF measurement to measuring the impedance matching and displays this via the frequency.

As an indication that the R&S FSH is working in reflection display mode, it displays DTF REFLECTION at the top of the screen.

Otherwise, the R&S FSH uses exactly the same settings as it did for DTF measurements.

3.9 Saving and Recalling Settings and Test Results

The R&S FSH can store measuring results and settings in the internal memory or on a removable SD memory card. Results and settings are always stored together, allowing them to be interpreted in context when recalled. The R&S FSH can store at least 100 data records in the internal memory which are differentiated by their names.

A removable SD card can be used as a memory extension or for data transfer to a PC without a direct LAN or USB connection. The SD memory card (e.g. R&S HA-Z231, 1GB, order no. 1309.6217.00) is inserted into the SD card slot on the right side of the R&S FSH until it audibly clicks into place. To remove the SD card, do not pull the SD card but first release it by pressing it in and then pull it out.



3.9.1 Saving Measurement Results

- Press the SAVE / RECALL key.
- Press the SAVE softkey.

An input box opens and you will be prompted to enter a name for the data set to be saved.

The name for the most recently stored data set is suggested in the ,Name:' entry box, which is highlighted in red. When you press the ENTER key or the SAVE softkey a second time, the data set is saved under the suggested name.

The screenshot shows a 'Save Dataset' screen with a blue header bar containing the title 'Save Dataset' and the date/time '19/05/08 17:42'. Below the header is a table with columns 'Stat', 'Name', 'Size', 'Date', and 'Time'. The table lists six datasets, all with a size of 75 kB and a date/time of 19/05/2008 17:28. The 'Name' column is highlighted in red. Below the table is a 'Save as:' field with 'Dataset006.set' entered. To the right of the field is 'Free: 27 MB'. At the bottom are five softkey buttons: 'Save', 'Sort/Show', 'Internal/SD-Card', and 'Exit'.

Stat	Name	Size	Date	Time
	\Public\.			
	Dataset000.set	75 kB	19/05/2008	17:28
	Dataset001.set	75 kB	19/05/2008	17:28
	Dataset002.set	75 kB	19/05/2008	17:28
	Dataset003.set	75 kB	19/05/2008	17:28
	Dataset004.set	75 kB	19/05/2008	17:28
	Dataset005.set	75 kB	19/05/2008	17:28

Save as: Dataset006.set Free: 27 MB

Save Sort/Show Internal/SD-Card Exit

The INTERNAL/SD-CARD softkey defines whether the measuring results are stored in the internal memory or on an SD memory card.

An existing data record can be selected from the list using the rotary knob or the cursor keys (^ or v). This data record is transferred to the input field by pressing the Enter key. This can then either be overwritten with the current data or saved under a modified name.

A new name can be entered via the numeric keypad. The numeric keypad has the same letter assignment as mobile phone keypads. Enter the letter above the key by pressing the key the appropriate number of times.

The number of free memory locations (FREE) is also displayed.

- Enter a name for the data set using the numeric keypad.
- Confirm with ENTER.

The data record is stored under the name specified in the internal R&S FSH CMOS-RAM or on the SD memory card.

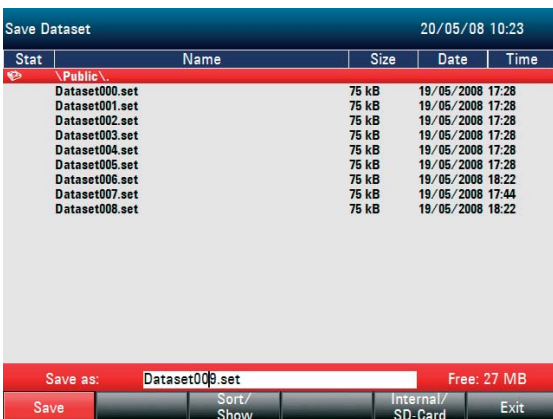
The name of an existing data set can be edited with the cursor keys. It is therefore not necessary to fully enter the name of a new data set.

- Press the SAVE softkey.

The R&S FSH suggests a name for the data set to be saved.

- Press a cursor key (^ or v).

A vertical cursor is positioned at the end of the name for the data set.



The screenshot shows a 'Save Dataset' dialog box with a blue header bar containing the title 'Save Dataset' and the date/time '20/05/08 10:23'. Below the header is a table with columns for 'Stat', 'Name', 'Size', 'Date', and 'Time'. The table lists several dataset files, all 75 kB in size, with dates ranging from 19/05/2008 17:28 to 18:22. At the bottom of the dialog, there is a 'Save as:' field containing 'Dataset009.set' and a 'Free: 27 MB' indicator. Below these are several buttons: 'Save', 'Sort/Show', 'Internal/SD-Card', and 'Exit'.

Stat	Name	Size	Date	Time
	\Public\			
	Dataset000.set	75 kB	19/05/2008	17:28
	Dataset001.set	75 kB	19/05/2008	17:28
	Dataset002.set	75 kB	19/05/2008	17:28
	Dataset003.set	75 kB	19/05/2008	17:28
	Dataset004.set	75 kB	19/05/2008	17:28
	Dataset005.set	75 kB	19/05/2008	17:28
	Dataset006.set	75 kB	19/05/2008	18:22
	Dataset007.set	75 kB	19/05/2008	17:44
	Dataset008.set	75 kB	19/05/2008	18:22

Save as: Dataset009.set Free: 27 MB

Save Sort/Show Internal/SD-Card Exit

- Use the 'v' key to move the cursor to the left.
- Use the '^' key to move the cursor to the right.
- Insert a new letter or number at the cursor position using the alphanumeric keypad.
- Press the BACK key to delete the letter or digit to the left of the cursor.

3.9.2 Recalling Measurement Results

Use the R&S FSH's recall function to review previously saved measurement results and settings.

- Press the SAVE / RECALL key.
- Press the RECALL softkey.

A list of all saved data sets opens. If a measuring result is to be called from the SD card, press the INTERNAL/SD-CARD softkey. All data records on the SD card are displayed.

- Select a data set from the list using the rotary knob or the cursor keys (\wedge or \vee). Confirm your selection by pressing the RECALL softkey.

Recall Dataset 20/05/08 11:23

Stat	Name	Size	Date	Time
	\Public\			
	Dataset000.set	75 kB	19/05/2008	17:28
	Dataset001.set	75 kB	19/05/2008	17:28
	Dataset002.set	75 kB	19/05/2008	17:28
	Dataset003.set	75 kB	19/05/2008	17:28
	Dataset004.set	75 kB	19/05/2008	17:28
	Dataset005.set	75 kB	19/05/2008	17:28
	Dataset006.set	75 kB	19/05/2008	18:22
	Dataset007.set	75 kB	19/05/2008	17:44
	Dataset008.set	75 kB	19/05/2008	18:22

Free: 27 MB

View Recall Sort/Show Internal/SD-Card Exit

3.10 GPS Information Display

(requires HA-Z240 GPS receiver, order no.1309.6700.02)

Locate your exact position with the GPS receiver function. The GPS receiver function is set in the INSTRUMENT SETUP menu.



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

Enable the GPS information

- Press the SETUP key.
- Press the INSTRUMENT SETUP softkey.

The R&S FSH opens a list of general settings.

GPS	
GPS Function	Enabled
Show GPS Information	Enabled
Coordinate Format	ddd° mm' ss"
GPS Receiver Connected	Yes
Position Fix	Valid
Number of Tracked Satellites	8
Signal Quality	Excellent

- Select GPS FUNCTION from the list using the rotary knob or the cursor keys (\wedge or \vee) and confirm with ENTER.
- Select ENABLED and confirm with ENTER.
- Select SHOW GPS INFORMATION from the list using the rotary knob or the cursor keys (\wedge or \vee) and confirm with ENTER.

- Select ENABLED and confirm with ENTER.

Set the coordinate format of the GPS result:

- Select COORDINATE FORMAT from the list using the rotary knob or the cursor keys (\wedge or \vee) and confirm with ENTER.
- Select the desired format and confirm with ENTER.

Display the GPS information

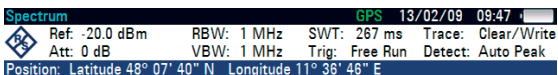
When the GPS receiver (HA-Z240, order no. 1309.6700.02) is connected to the R&S FSH AUX connector on the left side of the instrument, the position is displayed as a measurement result in a blue bar in the numeric result area.




When the satellite lock is lost, the bar turns red and the GPS coordination is in brackets. The last position, however is still shown.

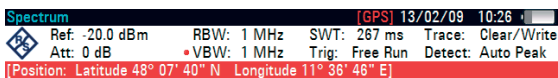
The states of satellite lock is indicated in the titlebar:


When the GPS receiver function is enabled and there is a fix connection with enough satellites for the GPS mouse to provide the location, in the titlebar this symbol is shown: **GPS** and the GPS information bar is blue:

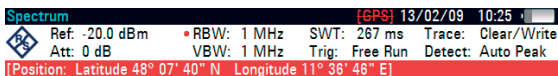


When the GPS Receiver Function is enabled and there is no fix connection, this symbol is shown:

 and the GPS information bar is red:

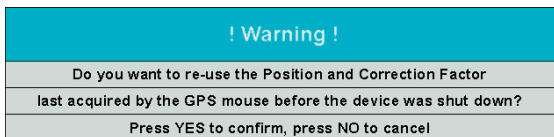


When the GPS Receiver Function is enabled and there is no receiver connected (or not connected properly, or the receiver is defective), this symbol is shown:  and the GPS information bar is red:



When the GPS Receiver is not enabled, no symbol is shown.

When the device is booted with GPS enabled and GPS mouse connected, the user is questioned whether to restore the GPS information (latitude, longitude and correction factor) of the device just before it was shut down, or to flush this data and start with unknown position and correction factor. This is depicted in the messagebox below:





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