

# R&S®FSH4 / FSH8: next generation of handheld spectrum analyzers

FIG 1 Testing a wireless communications base station with the new R&S®FSH8 handheld spectrum analyzer.



The first generation of R&S®FSH handheld spectrum analyzers has become very popular among users. The analyzers are highly valued all-purpose instruments especially for the installation and maintenance of RF transmitter systems in the field. The new R&S®FSH4 and R&S®FSH8 analyzers offer the same first-rate performance as their predecessors. In addition, they have been enhanced and expanded in a variety of ways in response to customer requirements. The R&S®FSH4 / FSH8 analyzers thus prove even more valuable instruments when it comes to performing efficient measurements in mobile use.

### New, yet familiar

Users will immediately be familiar with the new R&S®FSH4 and R&S®FSH8 handheld spectrum analyzers as they feature the characteristic design of the R&S®FSH family (FIG 1). They are ergonomic, easy to operate, designed to withstand the rigors of field use and, at just under 3 kg, they are among the lightest portable spectrum analyzers available. Prominent features that are visible at a glance include the 6.5" color display (now even larger and with higher resolution than in the previous generation), an SD memory card slot, USB/LAN interfaces, and a cover protecting the easy-to-replace battery. The new analyzers also have been enhanced with respect to their "inner qualities": better RF characteristics, an expanded range of functions and a built-in VSWR bridge to name just a few.

### Superior RF characteristics provide dependable results

Offering very good RF characteristics, the R&S®FSH4 and R&S®FSH8 are among the best in their class. With a displayed average noise level (DANL) of  $-163$  dBm (1 Hz) at 2 GHz, for example, and a switchable preamplifier implemented in all models, even extremely weak signals can be reliably measured. In test scenarios involving several strong signals, the analyzers' excellent large-signal immunity prevents the formation of intermodulation products. And, featuring a third-order intercept point of 15 dBm in the common mobile radio bands, the instruments compare with high-grade benchtop units. Level measurement uncertainty is low, i.e. max. 1 dB up to 3.6 GHz and max. 1.5 dB up to 8 GHz.

### Display of results – straightforward, detailed, reliable

The display has a resolution of  $640 \times 480$  pixels. The screen can be split, e.g. for the simultaneous display of two traces for the magnitude and phase in the vector network analysis mode (FIG 2). With a total of 631 test points, the analyzer detects signals reliably and provides a detailed representation of results. Poor lighting conditions are no problem for the R&S®FSH – it features adjustable color, brightness and contrast plus a monochrome mode to ensure optimal readability of the display under any circumstances.

### Operating philosophy: versatility – yet focused on the essentials

New hardware and software control elements and an even more straightforward menu structure further simplify operation. For example, you can now directly access limit lines and important marker functions. The selected function can be activated immediately by pressing the Enter key in the rotary knob. The MODE key makes it easy to switch between operating modes, e.g. spectrum analyzer, vector network analyzer or power meter mode. Due to the instrument's vertical design, you can securely hold it in both hands and yet easily reach all control elements. Pressing the "camera" key will produce a screenshot of any desired content and store it as a graphics file for the purpose of documentation. New customers can quickly learn how to operate the R&S®FSH, and customers who already use a first-generation analyzer can easily find their way around in a familiar environment.

FIG 2 Simultaneous display of magnitude and phase in split-screen mode.



## Built-in VSWR bridge and a wealth of additional functions

In addition to the base models, models with a tracking generator and a built-in VSWR bridge for vector network analysis are available. Adding a power sensor from Rohde&Schwarz turns the analyzer into a precision power meter. Equipped with these features, the R&S®FSH is a single-box solution offering complete functionality for installing and maintaining radio transmitter systems: transmit spectrum analysis, detection of interferers, transmit power measurement, measurement of antenna matching and testing of the amplifiers on the antenna. Plus, it can measure the quality of the cable to the antenna.

## Battery supply and extensive storage capacity for standalone operation

The new R&S®FSH runs on a lithium-ion battery that offers high capacity at low weight. The battery operates for up to 4.5 hours. Thus, by changing the battery only once, you can operate your analyzer for a full workday. The battery can be conveniently changed on site.

The internal memory of the R&S®FSH4 and R&S®FSH8 models stores 256 results together with the associated instrument settings. Storage capacity can be expanded by means of an SD memory card. A 1 Gbyte card can hold at least 5000 data records; a PC is therefore needed only for subsequent result processing or archiving of data.

## Up-to-date remote control

The analyzer is connected to a PC via the LAN or USB interface. Virtually all functions of the R&S®FSH can be remotely controlled, allowing the analyzer to be integrated into user-specific programs. The SCPI-compatible command set facilitates programming. For remote monitoring tasks, the R&S®FSH4 and the R&S®FSH8 can easily be integrated into a network via the LAN interface.

## Main innovations at a glance

- Frequency range 9 kHz to 3.6 GHz or 8 GHz
- High sensitivity (<-141 dBm (1 Hz), with preamplifier <-163 dBm (1 Hz ))
- Low measurement uncertainty (<1 dB)
- Internal tracking generator and VSWR bridge with built-in DC voltage supply (bias)
- Two-port network analyzer
- Easy-to-replace lithium-ion battery for up to 4.5 h of operation
- 6.5" color display with VGA resolution
- Optimized operating concept
- All connectors protected against contamination, dust and splash water (FIG 4)
- SD card for storage of results
- LAN and USB interfaces
- Built-in loudspeaker

## The right base unit for every application

Six R&S®FSH models are available to meet individual requirements in terms of frequency range and functionality. The R&S®FSH4 and the R&S®FSH8 perform measurements up to 3.6 GHz and 8 GHz, respectively. Models with a built-in tracking generator can additionally determine the transmission characteristics of cables, filters, amplifiers, etc. Models with a built-in tracking generator plus an integrated VSWR bridge are the right choice for carrying out measurements on antenna systems, including distance-to-fault measurements on cables. All models contain a switchable preamplifier that provides enhanced sensitivity. FIG 3 lists the main functionalities provided in the various models.

Model	Frequency range	Preamplifier	Tracking generator	Built-in VSWR bridge
<b>R&amp;S®FSH 4</b> model .04	9 kHz to 3.6 GHz	✓	–	–
model .14	9 kHz to 3.6 GHz	✓	✓	–
model .24	100 kHz to 3.6 GHz	✓	✓	✓
<b>R&amp;S®FSH 8</b> model .08	9 kHz to 8 GHz	✓	–	–
model .18	9 kHz to 8 GHz	✓	✓	–
model .28	100 kHz to 8 GHz	✓	✓	✓

FIG 3 R&S®FSH4 / R&S®FSH8 models at a glance.

## Ideal for installing and servicing transmitter systems

Providing reliable coverage is the main concern of operators of mobile radio, broadcasting and radiocommunications networks. Continuous checking of the transmitter systems is, therefore, essential. With their comprehensive range of functions, the R&S®FSH4 / FSH8 handheld spectrum analyzers are ideally suited for performing the required measurements, whether in the startup phase, during operation or after repairs of transmitter systems. The analyzers carry out all important measurements at high speed and with high accuracy, providing the following functions:

- Distance-to-fault (DTF) measurements on cables
- One-port cable loss measurements
- Two-port vector network analysis
- Assessment of signal quality
- Detection of interferers
- Precision power measurements using power sensors

## Efficient testing of antenna systems

If a transmitter system does not operate properly or if transmitter power is too low, various causes are possible. The most frequent ones include antenna mismatch, defective amplifiers and high cable loss. The R&S®FSH determines the properties of RF cables quickly and precisely by means of a distance-to-fault measurement and a one-port cable loss measurement. Using the DTF measurement, the analyzer determines the distance up to a fault, which may be caused by a pinched cable or loose or corroded cable connections (FIG 5). A built-in threshold function ensures that only true cable faults, i. e. faults that exceed a tolerance limit, will be displayed. This greatly simplifies measurement evaluation.

By means of the one-port cable loss measurement, you can determine the loss of installed cables with a minimum of effort. It is sufficient to connect one end of the cable to the R&S®FSH test port. The other end is either short-circuited or left open.

If all cables are found to be in order, antenna mismatch or defective power amplifiers may be the cause of a malfunction. In a subsequent step, the transmit filter can be tested. A faulty filter may cause the base station to operate outside the required band.

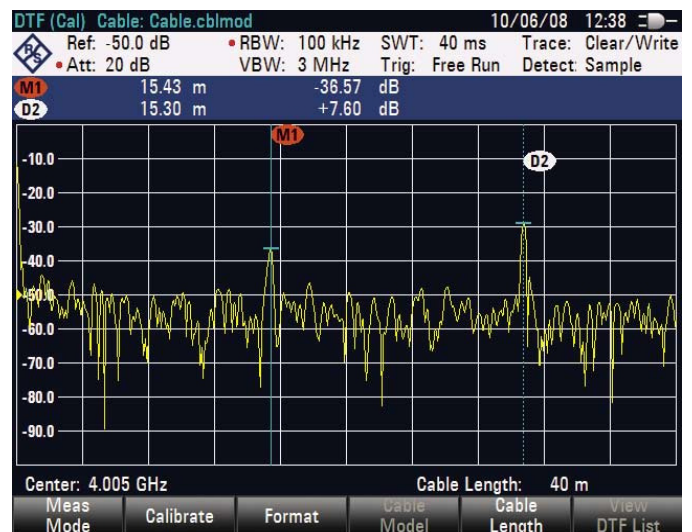
To check the antenna matching and the power amplifiers, the analyzer models with a tracking generator and a VSWR bridge can be converted to a vector network analyzer simply by installing the relevant software option. Antenna matching and the transmission characteristics of filters and amplifiers can thus easily be determined in the forward and reverse



FIG 4 Additional connectors, e.g. for LAN and USB, are protected by caps.

direction. The system error correction involved in the vector network measurement provides a maximum of accuracy. A built-in DC bias powers active DUTs such as amplifiers via the RF cable. This feature proves especially useful in the case of mast-mounted amplifiers on a wireless communications base station.

FIG 5 Distance-to-fault (DTF) measurement on a cable.



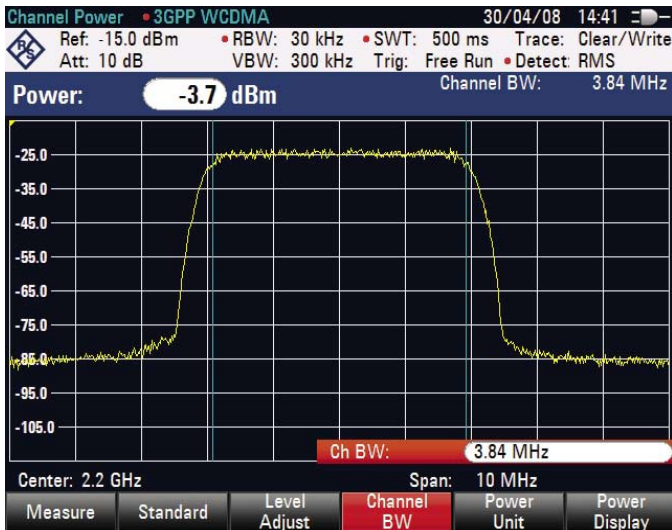


FIG 6 Channel power measurement on a 3GPP WCDMA signal.

## Checking the signal quality

The R&S®FSH offers all test routines required for assessing signal quality. Using the TDMA power measurement function, for example, the analyzer determines the power of a GSM burst within a timeslot in a time-domain measurement. It can thus be verified whether the power mask of a base station complies with specifications and with stipulated minimum and maximum values.

The power of a user-definable transmission channel can be determined by means of the channel power measurement function. The R&S®FSH performs a channel power measurement for the 3GPP WCDMA, cdmaOne and CDMA2000® digital mobile radio standards at the press of a key (FIG 6).

## Precision power meter

Measuring the transmitter output power is essential after the installation, re-installation or repair of a transmitter system, or if the transmitter output stages appear not to be operating at full power. For transmitter systems with an integrated power coupler, the power is coupled out and measured with one of the terminating power sensors available as accessories. For transmitter systems without a power coupler, directional power sensors are available. These power sensors enable the simultaneous measurement of the output power and the antenna matching during operation.

## Detection of interferers

Even if the transmitter and the antenna are operating properly, nearby interfering signals may still have a detrimental effect on the system. Due to their high sensitivity of up to  $-163$  dBm (1 Hz) and low phase noise ( $-95$  dBc (1 Hz) at 10 kHz carrier offset), the R&S®FSH4 and the R&S®FSH8 easily detect interferers close to the carrier.

## Measuring electromagnetic fields

The R&S®FSH also reliably detects electromagnetic fields. With its wide frequency range of up to 8 GHz, it covers all common wireless communications services, including mobile radio (GSM, CDMA, UMTS, DECT and the upcoming LTE standard), Bluetooth®, WLAN (IEEE 802.11a, b, g, n), WiMAX™, and sound and TV broadcasting. The maximum field strength is determined by means of directional antennas. The analyzer takes into account the antenna factors of the connected antenna and displays the field strength directly in dB $\mu$ V/m. The non-directional resultant field strength is measured by means of the R&S®TS-EMF isotropic antenna. The R&S®FSH offers two user-definable limit lines with automatic limit monitoring for simple result analysis.

## Useful also in the lab

With its stand folded out, the R&S®FSH turns into a benchtop analyzer for use in the lab. It can be used for a variety of tasks including frequency and level measurements, precision power measurements up to 18 GHz, vector network analysis to determine the characteristics of amplifiers and filters, and for running remote-controlled, automatic test sequences via LAN or USB. In conjunction with the R&S®HZ-15 near-field probes, the analyzer becomes a cost-effective diagnostics tool for locating EMC trouble spots on printed boards, integrated circuits, cables and shieldings.

## Convenient documentation and archiving

The documentation and archiving of results are major aspects when performing installation and maintenance tasks. To facilitate these tasks, the R&S®FSH is supplied with the powerful R&S®FSH4View Windows® software for data processing on a PC (FIG 7). The software also helps you manage instrument settings, allowing you, for instance, to configure instrument pools in a minimum of time.

Key functions of the R&S®FSH4View software:

- Further processing of results by means of data export in ASCII or Excel® format
- Storage of graphics data in standard formats
- Comparison of results
- Automatic result storage at selectable intervals
- Remote signal monitoring via LAN by means of permanent and continuous transfer of sweeps
- Result analysis by showing / hiding and shifting markers as well as subsequent display of limit lines
- Editor for generating limit lines, antenna factors, channel lists and cable data for distance-to-fault measurements
- Transfer of instrument settings

## Summary

Mobility, ease of operation, superior measurement characteristics, versatility – these are the outstanding features that make working with the new R&S®FSH handheld spectrum analyzers very easy. With a weight as low as 3 kg, including the battery, and compact in size, the analyzers are ideal for mobile use. Yet, they run for up to 4.5 h on a single battery charge. To extend the operating time, the battery can easily be replaced on site. Featuring splash- and dust-proof connectors and IP51 protection, the analyzers are designed to operate reliably even under rough environmental conditions.

All these features and performance characteristics open up virtually unlimited applications for the new R&S®FSH4 and R&S®FHS8 handheld spectrum analyzers.

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FIG 7 Evaluation of results on a PC by means of the R&S®FSH4View software.

