Handheld Spectrum Analyzer R&S®FSH 3

Numerous expansions and a new model

Since introducing the Handheld Spectrum Analyzer R&S®FSH 3 (FIG 1) in July 2002, Rohde & Schwarz has added many new functions and features as well as a new model. The R&S®FSH 3 is now the most versatile instrument in this segment.

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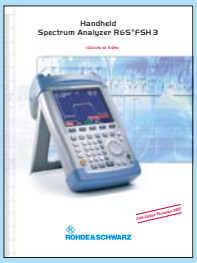
FIG 1 Vector reflection measurement with the R&S®FSH 3 and the VSWR Bridge and Power Divider R&S®FSH-Z2.

More information and data sheet at www.rohde-schwarz.com (search term: FSH 3)



REFERENCES
[*] Handheld Spectrum Analyzer R&S®FSH 3 – New mobility in spectrum analysis. News from Rohde & Schwarz (2002) No. 175, pp 20–25

Success through versatility

High market acceptance and feedback from numerous customers prompted Rohde & Schwarz to transform the Handheld Spectrum Analyzer R&S®FSH 3 [*] into an RF multifunctional analyzer: It now also functions as a power meter, cable and antenna analyzer as well as a vector network analyzer. It thus provides the four most important RF analysis functions that developers, service technicians and installation and maintenance crews need in their day-to-day work. For example, it can be used in the maintenance or installation of transmitter systems (e.g. checking cables and antennas), in the assessment of signal quality in broadcasting, private mobile radio and service (e.g. measuring electric field strength) or in simple lab applications. The R&S®FSH 3 can handle any of these tasks quickly and reliably because of its simple operation, high measurement accuracy and robustness.

New model with preamplifier

The R&S®FSH3 is now available in three models. Model 03 with resolution bandwidths from 100 Hz to 1 MHz is the basic analyzer. Since February 2004, it includes a preamplifier as standard. This preamplifier increases sensitivity by approx. 15 dB. Model 13 offers resolution bandwidths from 1 kHz to 1 MHz plus a tracking generator, which is a prerequisite for network analysis and distance-to-fault measurements. Top-of-the-line model 23 additionally includes a 20 dB preamplifier, resolution bandwidths from 100 Hz to 1 MHz and a selectable output level for the tracking generator (–20 dBm/0 dBm). The integrated adjustable preamplifier ensures a displayed average noise level of typically less than –135 dBm, which is useful for displaying very weak signals. Dense signals are reliably selected by means of the additional bandwidths of 100 Hz and 300 Hz. The higher 0 dBm output power of the tracking generator also allows interference-proof distance-to-fault measurements.

Vector reflection and transmission measurements

The R&S®FSH3 can also handle measurement tasks that are normally possible only with a vector network analyzer. In reflection measurements, the analyzer displays the results in a Smith chart and allows the user to perform a detailed analysis of DUT matching (FIG 2). In addition, it uses vector system error correction in calibration. This procedure offers significant advantages with regard to measurement uncertainty particularly in the case of well matched DUTs, as shown in the following example. At 900 MHz, the return loss of an antenna is approx. 20 dB. In scalar measurements, the measurement uncertainty is between +2 dB and –2.6 dB. In vector measurements, it is only 0.6 dB. In the first case, the high measurement uncertainty may lead to unnecessary replacement or repair of the antenna.

This method also comes in handy with transmission measurements, because the dynamic range can be increased from 60 dB in scalar measurements to 80 dB for vector measurements by reducing the internal crosstalk.

Higher resolution in distance-to-fault measurements

With the R&S®FSH3, the horizontal resolution (distance) in the case of distance-to-fault (DTF) measurements is determined by the display resolution of 301 pixels. For a 30 meter cable, this yields a maximum resolution of 10 cm. A zoom function allows significantly higher resolution and uses an expanded FFT algorithm that calculates 1024 pixels. The resolution of a 30 meter cable is 2.9 cm in this case. FIG 3 shows the zoom function activated for precise analysis of a cable fault. In addition to the actual reflection location, a second one is seen that is caused by a line connector of approx. 10 cm in length.

FIG 2 Vector reflection measurement of a multicircuit bandpass filter.

FIG 3 Application of the zoom function with distance-to-fault measurement.

FIG 4 The R&S®FSH3 with the new Directional Power Sensor R&S®FSH-Z44.

Additional new features

- Limit lines with limit monitoring (FIG 7)
- Positive or negative frequency offset for measurements on frequency-converting DUTs
- Multimarker mode, six markers or delta marker
- Standard measurement routine for determining the occupied bandwidth with modulated signals
- One-port cable loss measurement
- External reference input
- Minimum sweep time 20 ms (previously 100 ms)
- Minimum marker and minimum peak detektor
- Storing of antenna factors, cable models and limit lines together with all settings and measured values
- Higher resolution of the VSWR display (1 to 1.1 and 1 to 1.5) for extremely well matched DUTs
- High-resolution level display 1 dB/div
- Switchover to monochrome display and transreflective display for better contrast in the case of strong solar radiation in the field

FIG 6 Field strength measurement with the R&S®FSH3 and the active Directional Antenna R&S®HE200.

FIG 5 Simultaneous display of the transmitter output power and the antenna matching.

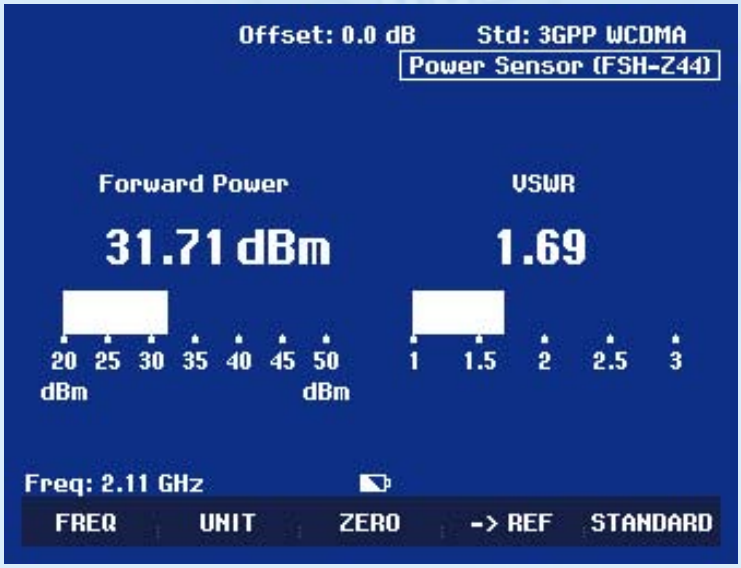
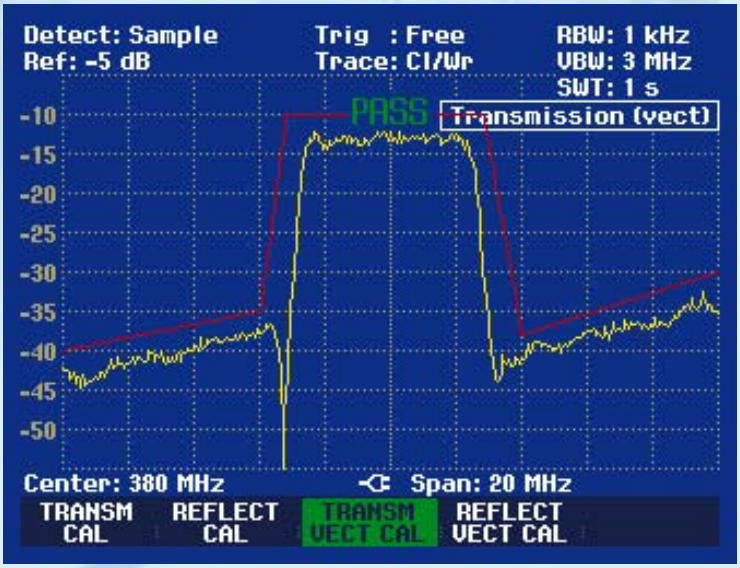


FIG 7 Testing of a bandpass filter by using a limit line.



Selectable frequency range for distance-to-fault measurements

With the method used by the R&S®FSH3 for distance-to-fault measurements, the frequency range required for the measurement is significantly dependent on the cable parameters (length and velocity factor). In the case of DUTs with an operating frequency range smaller than that required for the measurement, the R&S FSH3 allows the user to specify the frequency range. It adapts the length resolution to the specified frequency values. It is therefore possible, for example, to measure a cable that is specified only up to 1 GHz without exceeding the cable's operating frequency range.

Simplified use in the field

To minimize the time required for calibration in scalar network analysis and distance-to-fault measurements, the user can store the calibration data together with the measurement results. After the stored data set is reactivated, the measurement is started immediately without recalibration.

The additional analysis of the phase information in the DTF measurement reduces the number of calibration steps by 50% because calibration is performed only with a short circuit. To ensure the quality of the calibration, the R&S®FSH3 constantly monitors the instrument temperature. If the temperature has changed significantly between calibration and measurement, the analyzer indicates this change, thus helping rule out unnoticed measurement errors.

Handling of the cable parameters for the DTF measurement was simplified further. The required cable models are usually generated, modified and loaded into the analyzer by using Control Software R&S®FSH View on the PC. The most commonly used cable types are predefined and are supplied with the R&S®FSH. However, if field use reveals that the cable type to be measured is not included in the R&S®FSH3 cable model list, the cable parameters can also be entered directly on the R&S®FSH3 without a PC.

Power measurements

In addition to the power sensor for up to 8 GHz (R&S®FSH-Z1) which was made available at market introduction, the analyzer can measure power down to the microwave range with high accuracy and dynamic range by using the 18 GHz Power Sensor R&S®FSH-Z18. But it is also possible to simultaneously measure output power and matching of RF transmitters from 200 MHz to 4 GHz by using the new Directional Power Sensor R&S®FSH-Z44 (FIG 4). Connected directly at the transmitter output, the analyzer, equipped with the R&S®FSH-Z44, shows the power that is output by the transmitter in W or dBm as well as the return loss or the VSWR of the antenna under operating conditions (FIG 5). Because the maximum load is 120 W, it is usually not necessary to have a power attenuator. To enable the power display for modulated signals to be corrected, the R&S®FSH3 allows the most common transmission standards to be specified, i.e. GSM/EDGE, 3GPP WCDMA, cdmaOne, cdma2000 1X, DVB-T and DAB.

Field strength measurement

The R&S®FSH3 is also ideal for measuring electric field strength. It takes into account the specific frequency-dependent antenna factors for the individual antenna and displays the field strength directly in dBµV/m or V/m. The antenna factors for the Directional Antenna R&S®HE200 (FIG 6) are supplied as standard. An additional 200 kHz filter is provided for EMF measurements on GSM signals. Together with the RMS detector, this filter allows the implementation of standard-compliant measurements as required by various countries such as Switzerland. For quick and easy analysis of the emission spectrum, the R&S®FHS3 provides two user-definable limit lines with automatic limit monitoring.

Easy documentation of results

To make it easy to document results, a macro for Microsoft® Word is provided in addition to Control Software R&S®FSH View, which is supplied with the R&S®FSH3. With just a few mouse clicks, the user can add the results and instruments settings to an existing measurement report. If the results need to be further analyzed at some point later, the user can shift markers and activate additional markers with the software.

Remote control as a retrofit

Experience has shown that a handheld analyzer primarily intended for use in the field needs to be remote-controllable with user-specific programs. Every R&S®FSH3 can now be retrofitted with this capability as an option.

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