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FIG 1

The R&S FSH3 is designed as a portable, robust spectrum analyzer for field operation.

**Fast, cost-efficient and highly accurate**

**signal characterization: These are the**

**strengths of the R&S FSH3 – the ideal**

**instrument for the installation or main-**

**tenance of mobile radio base stations,**

**on-site analyses of faults in RF cables**

**or a thousand and one other applica-**

**tions in service and development.**

**Handheld Spectrum Analyzer R&S FSH3**

**New mobility in spectrum analysis**

**Universal measuring instrument for RF technicians**

Experience gained from the progressive digitization of the high-end and general-purpose Spectrum Analyzers R&S FSU [1] and R&S FSP [2] as well as the integration of various complex functions into ICs led to the development of the Handheld Spectrum Analyzer R&S FSH3 (FIGs 1 to 3). The R&S FSH3 provides

outstanding features that you would usually expect only from desktop models. Its low weight, robust design, long operating time per battery charge and numerous measurement functions make the R&S FSH3 a versatile RF measuring instrument for simple lab applications, service and on-site field use.

The R&S FSH3 is available in two versions:

- ◆ Pure spectrum analyzer for 100 kHz to 3 GHz
- ◆ Spectrum analyzer with tracking generator for scalar network analysis

Various add-ons transform the R&S FSH3 into a power meter or a cable analyzer that can be stowed in a carrying bag with all its accessories. The key functions required by RF technicians for everyday use are thus available in a compact and mobile unit.

### Sophisticated interior – highly integrated

With the R&S FSH3, Rohde & Schwarz has created a high-end spectrum analyzer in handheld format that is distinguished by low weight, low power consumption for long battery time, excellent

RF performance and operation so simple that even non-experts can use it. These characteristics could only be achieved through high and thorough integration of the analog RF section, the detector circuits and the processor.

The R&S FSH3 is enclosed in a sturdy housing without air openings (as protection against environmental effects) to ensure that it will function properly even under extreme ambient conditions. Despite the enormous variety of functions this compact spectrum analyzer offers, power consumption is limited to max. 7 W to prevent the internal temperature from exceeding tolerable levels even at a maximum ambient temperature of 50 °C. This low power consumption also enables an operating time of up to 4 h with just one battery charge, and this time can be extended by means of the power down mode which ensures automatic shutdown of the unit either



**FIG 2** For optimal display viewing angle, the R&S FSH3 is equipped with a fold-out stand for placement on a desktop.

5 or 30 minutes after the last operation and displays the last settings when the unit is switched on again. If the battery is depleted before the work day is over, it can easily be recharged from a cigarette lighter socket in a vehicle.

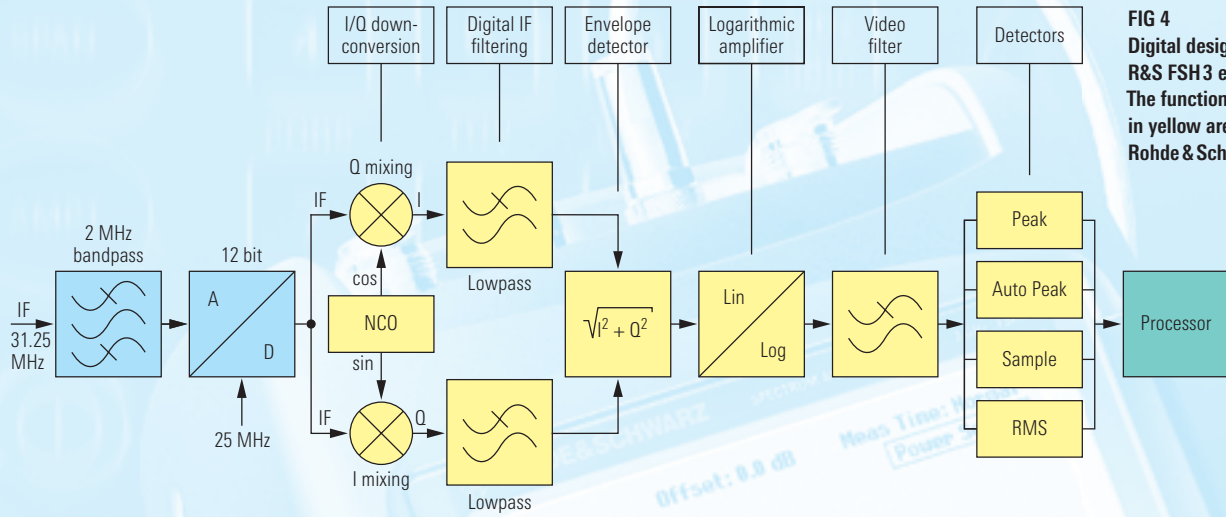
Key to the compact design and low power consumption are six different Rohde & Schwarz application-specific integrated circuits (ASIC). Two synthesizer ICs, a prescaler and a divider for fractional division factors determine the frequency processing of the first local oscillator. The receive path of the R&S FSH3 is designed as a three-fold converting superheterodyne receiver with high first intermediate frequency and a superimposed local oscillator (approx. 4 GHz to 7 GHz). The synthesizer ICs ensure a frequency sweep synchronized to the internal TCXO reference frequency. The analyzer thus represents the measurement signals at the correct frequency even in the case of large spans, e.g. 3 GHz. The frequency inaccuracy is solely a function of the pixel resolution of the display.

The RF input is particularly well protected by a combination of overvoltage arrester, PIN diodes and capacitive cou-

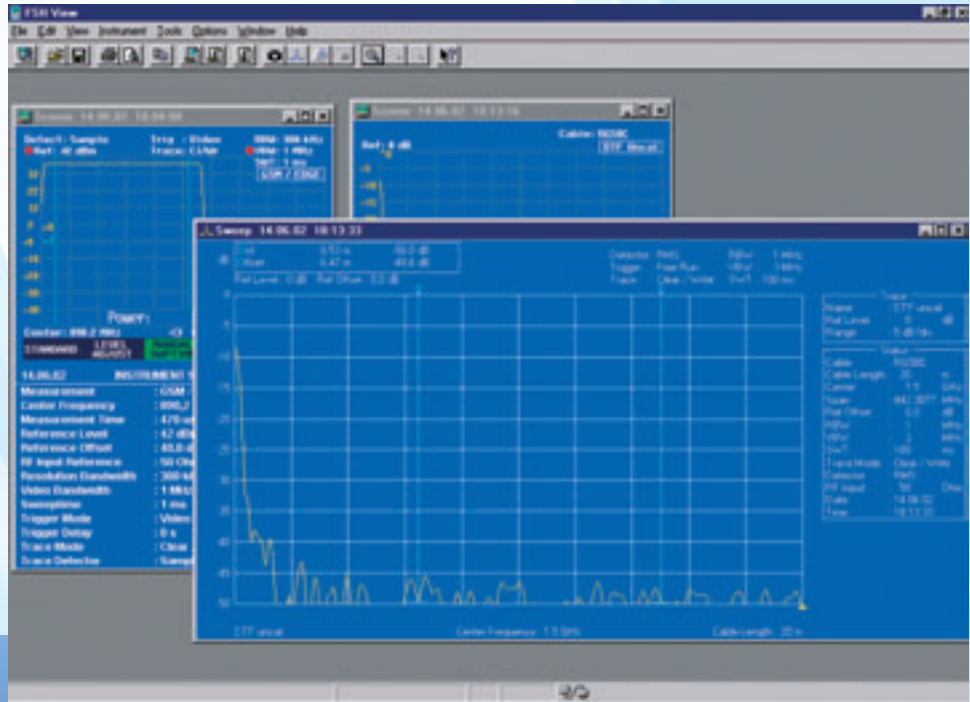
**FIG 3** Connectors in the carrying handle (left to right): AC power supply connector, generator output, power sensor connector, trigger input, RF input



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**FIG 4**  
Digital design of the R&S FSH3 evaluation section. The functions highlighted in yellow are implemented in Rohde & Schwarz-specific ICs.



**FIG 5** Powerful Control Software R&S FSH View.



**FIG 6**  
R&S FSH3, an all-in-one instrument for installation and on-site maintenance. Top left: measurement with Power Sensor R&S FSH-Z1, bottom left: measurements on mobile radio equipment.

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▶ pling so that the electronic attenuator or the input mixer will not be damaged if high voltage is inadvertently applied or if electrostatic discharge occurs. Despite low power consumption, the R&S FSH3 achieves remarkable dynamic range characteristics easily comparable to lab desktop models. The third-order intercept point is 15 dBm typ. at a noise figure of approx. 32 dB. High overload immunity ensures that inherent intermodulation products of high-level signals do not simulate signals from the DUT.

Signal processing starting at the last intermediate frequency is purely digital (FIG 4). An A/D converter digitizes the 31.25 MHz IF signal. Integrated circuits perform all further processing steps such as IF filtering, IF envelope detection, logarithmation, video filtering and signal detection in realtime. The main processor, also an ASIC-integrated RISC processor, retrieves and displays the configured data.

Because of this concept, functions and characteristics usually provided only in desktop units are implemented on a small footprint:

- ◆ Resolution bandwidths from 1 kHz to 1 MHz in 1/3 sequence as common with spectrum analyzers
- ◆ Video bandwidths of 10 Hz to 1 MHz also in 1/3 sequence
- ◆ Different detectors for signal weighting (Auto Peak, Peak, Sample and the RMS detector, which is ideal for the power measurement of modulated signals)

The digital design concept makes these functions stable and reproducible. Thus, the error that occurs when switching the bandwidth is negligible, for example. The display linearity depends exclusively on the linearity of the A/D converter, whose linearity error is also inconsequential in practice. The level measurement uncertainty is almost exclusively a function of the absolute gain of the IF

section and of the frequency response of the attenuator and the input mixer. The R&S FSH3 corrects both parameters during measurement. The frequency response to all settings of the RF attenuator is stored in the analyzer and the display level is corrected for each frequency. The analyzer also monitors its internal temperature and corrects the total gain accordingly. All these measures ensure a total level measurement uncertainty of max. 1.5 dB.

Another advantage of the integrated digital design concept is the relatively high measurement speed in spite of low power consumption and the resulting limitation of processor power. Compared to the analog design concept, the ASICs process IF data in realtime despite the relatively low power consumption. The minimum sweep time of the R&S FSH3 when displaying the entire frequency range is only 100 ms, with measurements in the time domain (0 Hz span) only 1 ms.

### On-site documentation of measurement results

Documenting and archiving measurement results play a pivotal role – particularly in regular on-site maintenance (FIG 6) – when determining changes over time. The analyzer is able to store up to 100 measurement results and their settings internally and output the screen content and the associated measurement settings via a printer. Control Software R&S FSH View (FIG 5), which is included with the equipment supplied, communicates with the PC via an optical RS-232-C interface and offers convenient functions for documenting and archiving the measurement results:

- ◆ Transfer of the measurements stored in the R&S FSH3 to the controller; all results are either transferred together, or the user selects individual results

- ◆ Transfer of measurement settings from the PC to the analyzer; for example, all service staff can be furnished with identical settings (which can be blocked against modifications in the unit)
- ◆ Storage of measurement results in common graphics formats (BMP, WMF, PCX, PNG), as text files or in Windows™ Excel format
- ◆ Easy definition of parameters for distance-to-fault measurements on the PC and their subsequent transfer to the R&S FSH3
- ◆ Display of an in-progress measurement on the PC screen

### Functional versatility

To handle the diverse measurement tasks in RF technology, the R&S FSH3 offers all RF measurements important in everyday work – in addition to spectrum analysis. Particular emphasis was placed on the installation and maintenance of RF transmission equipment (FIG 6).

Spectrum measurement provides an active and a reference trace. The level is measured by means of a marker and a delta marker. At the position of the marker, the R&S FSH3 can also measure the signal frequency with a resolution of 1 Hz or the noise power in dBm/(1 Hz) or demodulate the input signal via the AM/FM demodulator.

Equipped with the Power Sensor R&S FSH-Z1, the R&S FSH3 becomes a highly accurate power meter up to 8 GHz (FIG 7). A wide dynamic range (–67 dBm to +26 dBm) ensures low sensor level error (<2%).

The R&S FSH3 supports selective power measurements on modulated signals by means of functions for channel power measurement or power measurement over a specified time section, e.g. a timeslot in TDMA systems such as GSM ▶



▶ or EDGE. The measurement parameters are set by selecting the transmission standard.

The R&S FSH3 sets the optimum level at a keystroke (FIG 8). The internal video trigger or an external trigger signal is responsible for triggering in response to a TDMA burst. For channel power measurements, the R&S FSH3 uses the RMS detector, which is ideal for providing reproducible measurement results in a single sweep.

The applications of an R&S FSH3 with tracking generator include scalar network analysis. The analyzer measures the transmission characteristics of two-ports without requiring any other accessories. Fitted with the VSWR Bridge and Power Divider R&S FSH-Z2, it can also measure return loss or VSWR of antennas, for example.

Controlled by the analyzer, the R&S FSH-Z2 can be switched to a 6 dB power splitter. The optional distance-to-fault measurement transforms the R&S FSH3 into a cable analyzer, measuring faults of cables with a length of up to 300 m with the aid of the frequency domain reflectometer (FDR) method and displaying them graphically or in a table (FIG 9).

All RF measurements required for the installation of transmission equipment are bundled into a single unit. The R&S FSH3 does not need to be recalibrated every time the measurement mode is changed, e.g. after switchover from antenna VSWR measurement to distance-to-fault measurement. A single calibration covers both measurements.

## Easy operation for field engineers

Under difficult conditions, e.g. maintenance and service in the field, operation should be simple and straightforward. Due to the ergonomically arranged keys and direct access to all basic functions at a keystroke without softkey control, the R&S FSH3 is very user-friendly. If you hold the instrument with both hands, you can effortlessly reach all keys and the rotary knob with your thumbs. All measurement information is clearly displayed on the 14 cm colour display (5.7"), which can easily be read even from a longer distance. All messages and instructions, e.g. for scalar network analysis calibration, are available in nine different languages. The R&S FSH3 can store up to 100 settings together with their measurement results. The names of the measurement settings or results can easily be entered by means of the numerical keypad, which carries the same lettering as mobile phones. For adjustment tasks, the R&S FSH3 can be hung on the door of a rack by means of its stable handle. For desktop use, the fold-out stand ensures optimum access to control elements (FIG 2).

## Summary

The R&S FSH3 is the ideal spectrum analyzer for fast, cost-efficient and highly accurate signal characterization. The versatile measurement functions of the analyzer offer a broad scope of applications – ranging from installation or maintenance of a mobile radio base station and on-site analyses of faults in RF cables to applications in development and service.

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More information, data sheet and analyzer simulation can be downloaded at [www.rohde-schwarz.com](http://www.rohde-schwarz.com) (search term: FSH3)



## REFERENCES

- [1] Spectrum Analyzer R&S FSP – Medium class aspiring to high end. News from Rohde & Schwarz (1999) No. 166, pp 4–7
- [2] Spectrum Analyzer R&S FSU – Best RF performance – third generation of high-end analyzers. News from Rohde & Schwarz (2001) No. 171, pp 20–25