

R&S®ESMD monitoring receiver evolves into a system-in-a-box



Fig. 1: The R&S®ESMD search and monitoring receiver is the ideal choice for monitoring tasks in difficult signal scenarios. All information is displayed either on its display or on an external PC that is connected via LAN.

The R&S®ESMD wideband monitoring receiver now offers more functions to better support signal recording, analysis and documentation. The new options upgrade it to a versatile system-in-a-box.

The R&S®ESMD wideband monitoring receiver (Fig. 1) is used in many radiomonitoring systems worldwide as a reliable and fast search receiver to detect short-time signals, or as a hand-off receiver that provides high-quality I/Q data from wideband signals for subsequent signal analysis or demodulation. New options extend its application range to include tasks not performed by conventional monitoring systems, making it a virtually autonomous small system. For example, real signal scenarios can be recorded for in-depth offline analysis at a later point in time. The recorded signals can be used to test radar and communications systems.

Displaying signals in the time domain

All Rohde & Schwarz radiomonitoring receivers process signals based on the same principle: the signal received is simultaneously processed in realtime on two different paths – the spectrum and the demodulation path. The demodulation path is used to accurately measure the levels and to demodulate analog signals. The fast Fourier transform (FFT) for displaying the realtime spectra takes place in the spectrum path. In these spectra, it is easy to distinguish between emissions on different frequencies. The additional waterfall diagram makes it easy to monitor the signal behavior over time.

Especially in the case of pulsed and TDMA signals, looking at the signals in the frequency domain is not sufficient to determine whether signals overlap or if a transmission system within a channel is disturbed. The new [R&S®ESMD-ZS zero span option](#) provides this type of insight by displaying the signals in the time domain in parallel with the realtime

spectrum (Fig. 2). The calculation is performed in the demodulation path. The user can choose the section of the realtime spectrum that should be displayed in the time domain. Thanks to the parallel signal processing channels, the

center frequency of the demodulation path can be placed anywhere within the 80 MHz realtime bandwidth. The demodulation bandwidth can be used to adjust the bandwidth for the time domain display up to maximum 20 MHz.



Fig. 2: Time domain display of a GSM signal. A GSM channel is selected from the realtime spectrum (top). The time domain display shows the amplitude (center left) and current modulation bandwidth in a timeslot (center right), and their historical values in the waterfall diagrams underneath.

R&S®ESMD: optimized for best reception on wideband, sensitive antennas

From the outset, the R&S®ESMD was developed with the aim of achieving optimal receive characteristics in the 8 kHz to 26.5 GHz frequency range for sensitive, wideband antennas. The entire signal processing functionality is optimized for a compromise between large-signal immunity and sensitivity so that low-level signals are not lost in strong signals such as those transmitted by base stations or broadcast transmitters.

The R&S®ESMD processes signals in realtime up to a bandwidth of 80 MHz and can therefore detect emissions even in the nanosecond range. An acquisition rate of up to 8 million spectra per second leaves no event undetected. This is one of the reasons for the popularity of the R&S®ESMD. The new functions make it even easier to record, analyze and document signals.

In the time domain, the user can choose between displaying the modulation bandwidth (in % of the set channel bandwidth) or the amplitude over time. The latter is equivalent to an oscilloscope function. A level trigger that responds to a rising or falling edge within the demodulation bandwidth stabilizes the display. TDMA signals in particular can be thoroughly analyzed for interference in the time domain since this view allows detailed insight into the individual channels. All signals with special time-related characteristics, for instance radar or pulsed signals, can be measured in detail with this function – without any additional software.

Recording of all data streams

Thanks to its realtime signal processing capability, the R&S®ESMD can seamlessly output the information obtained from the received signals in a data stream (trace). This trace (with the exception of wideband I/Q data) contains realtime spectra, spectra from a fast panorama scan, level measurements, GPS information, DF results and demodulated audio signals, for example. The information is displayed either on the R&S®ESMD or on an external PC that is connected via LAN (Fig. 3).

With the new R&S®ESMD-IR option, which is controlled via the R&S®ESMD user interface, this data can be recorded in the 4 Gbyte internal memory and replayed from there. For example, during a drive test, the realtime spectrum, GPS information (from the internal R&S®ESMD-IGT GPS module) and bearings (if the R&S®ESMD is equipped as a direction finder) are recorded continuously. The internal map display (R&S®ESMD-MAP) shows the route during the drive test or when the recording is replayed (Fig. 4). For long recordings, the user navigates either on the time axis or via the moving profile. This georeferenced data facilitates documentation and helps with coverage measurements or when investigating major malfunctions.

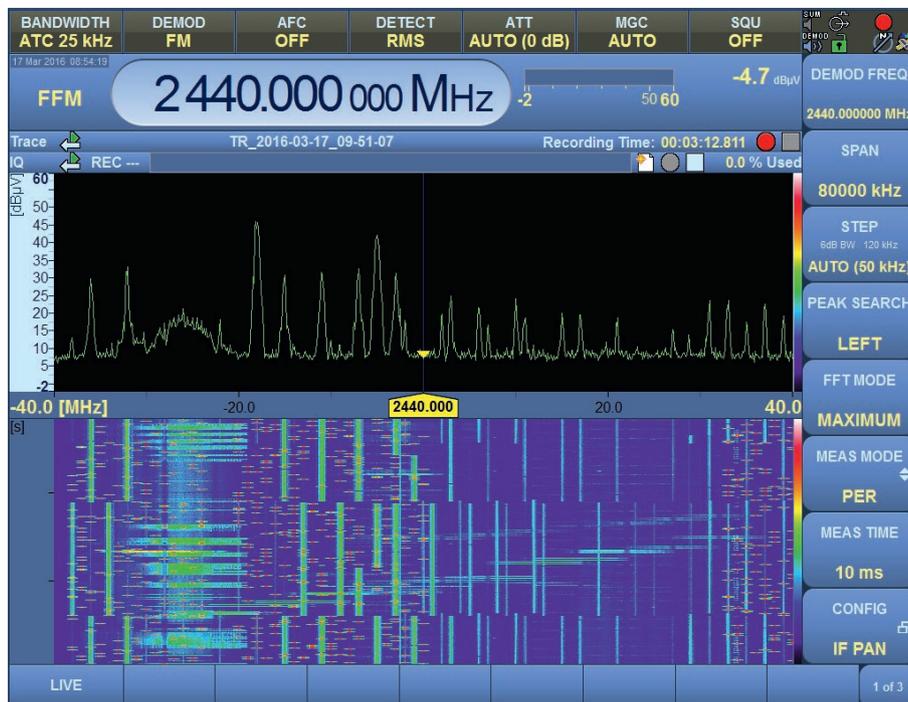
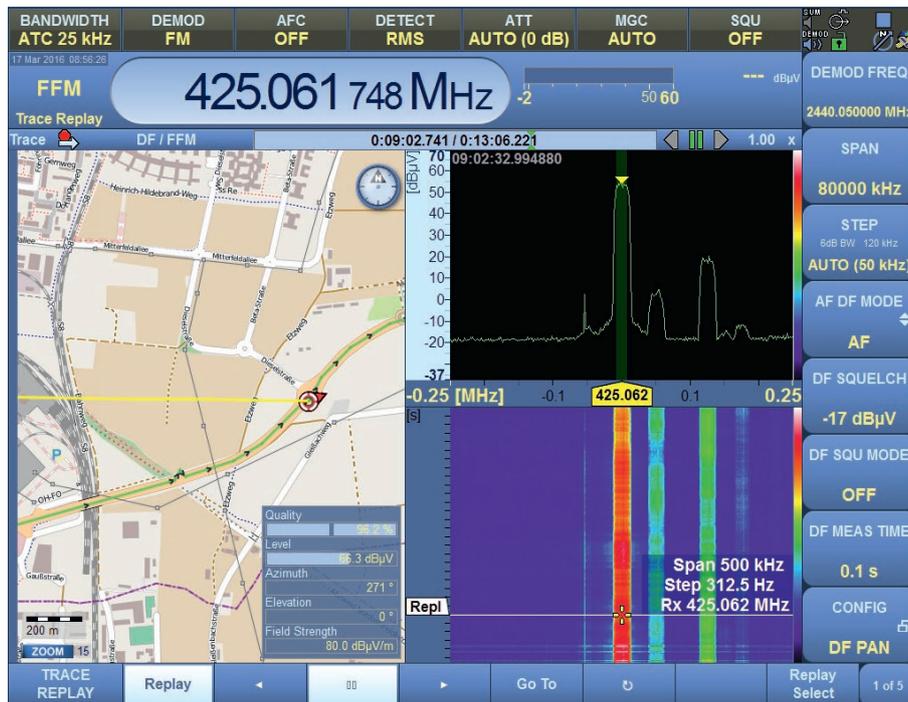


Fig. 3: Recording of a data stream from the 2.4 GHz ISM band in the fixed frequency mode with many Bluetooth® and WLAN signals.

Fig. 4: Replay of a drive test recording. Display of the route with DF results on the map and the recorded realtime spectrum over time in the waterfall diagram.



Extended wideband streaming options

Using the well-established R&S®ESMD-RR option, the R&S®ESMD can record I/Q data in its 4 Gbyte RAM, replay it and export it for later processing*. Thanks to the realtime event capture (REC) trigger that comes with the option, memory is more efficiently used because the trigger starts and stops recording according to adjustable criteria so that only the signals that triggered the recording are stored in memory (Fig. 5).

When replaying recorded I/Q data, the R&S®ESMD behaves as if it were in live mode. All functions, such as level measurement, demodulation and setting the center frequency and bandwidth, are available. In contrast to the live mode, the R&S®ESMD achieves a time resolution of just a few nanoseconds so that all signals can be precisely evaluated and measured in detail (Fig. 6).

The R&S®ESMD can stream this internally generated I/Q data to external recipients in realtime up to the full bandwidth of 80 MHz. Since the standard 1 Gbit LAN interface cannot stream such amounts of data, the new R&S®ESMD-DIQ option is recommended for this application. This option equips the receiver with an additional field programmable gate array (FPGA) board that accelerates the transmission and conversion for interfaces with higher transmission rates to external devices.

The R&S®ESMD is now able to stream data via the 10 Gbit Ethernet interface (R&S®RX-G10 option) or via the Rohde & Schwarz I/Q interface (included on the FPGA board). Both interfaces support bandwidths up to 80 MHz.

* This option is described in detail in NEWS (2014) No. 211, pp. 63–65.

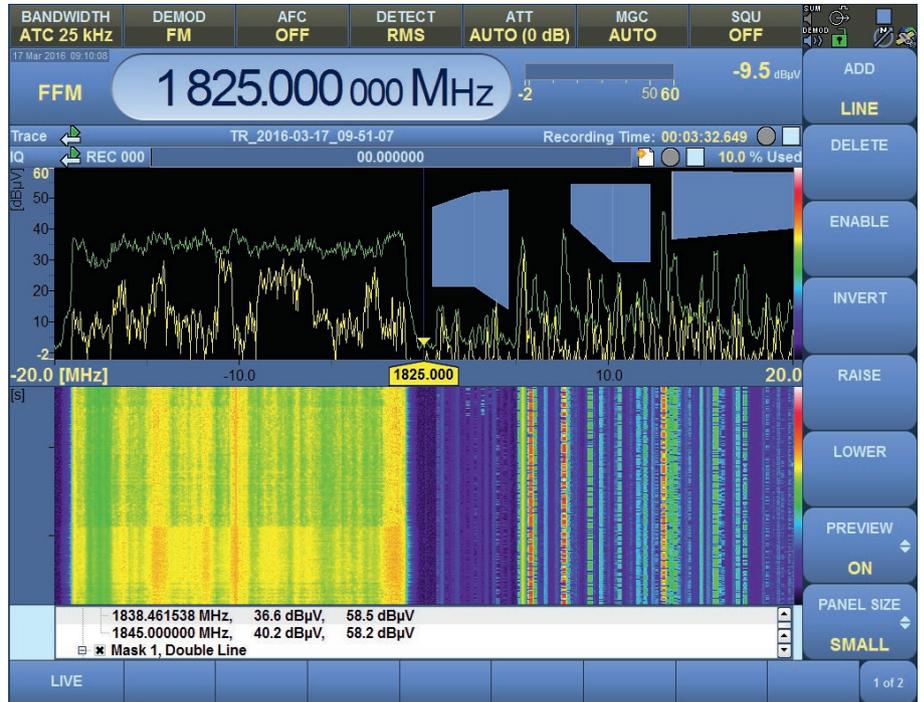
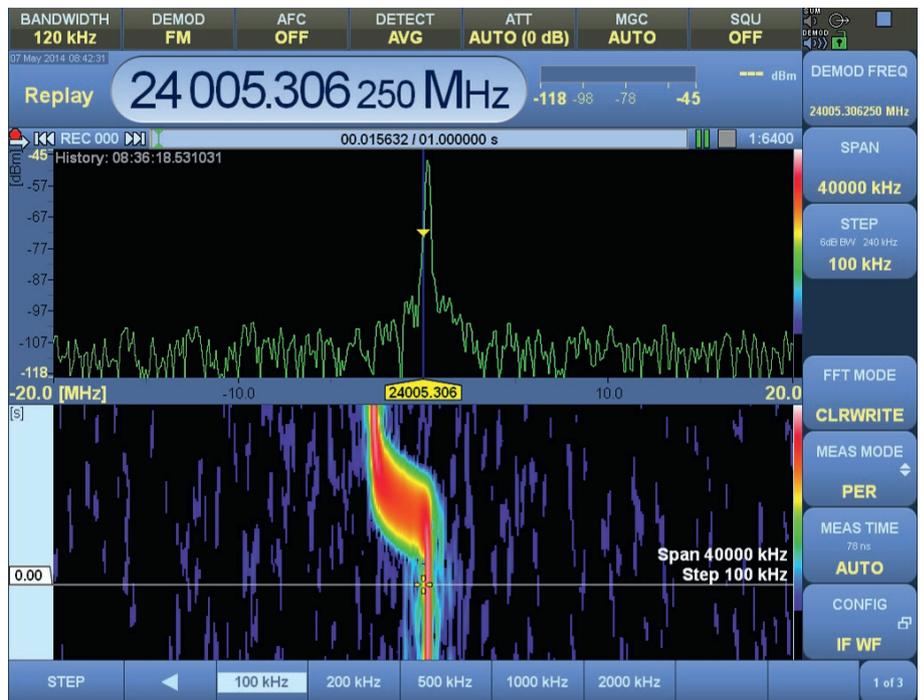


Fig. 5: Definition of a REC trigger in the LTE band (blue areas at top). The receiver displays the real-time spectrum (green) and at the same time the spectrum (yellow) that touches the trigger mask.

Fig. 6: Replay of recorded I/Q data of an FSK radar. The change in frequency is shown in the waterfall diagram with a time resolution of approx. 70 ns per line.



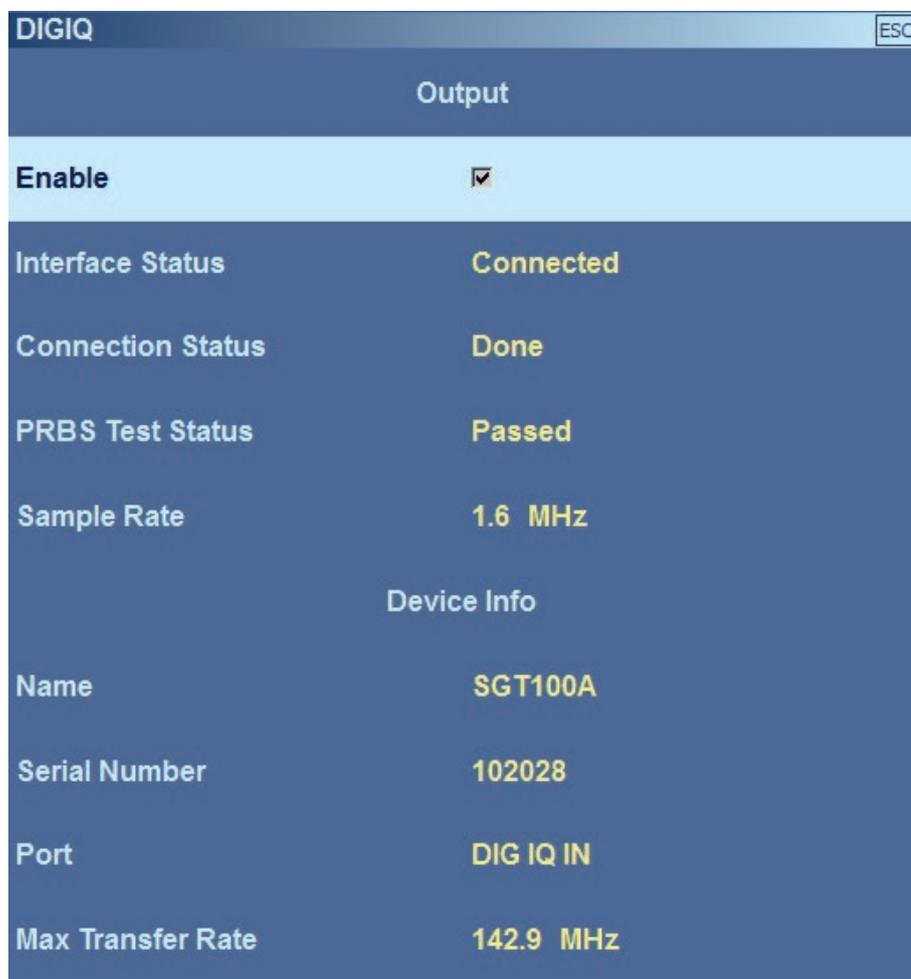


Fig. 7: Configuration dialog of the Rohde&Schwarz I/Q data interface when the R&S®SGT100A generator is connected to the R&S®ESMD. The two devices automatically coordinate the maximum data rate.

A recorder or a vector signal generator, such as the R&S®SMW200A or R&S®SGT100A, is connected to the I/Q interface (Fig. 7). When a generator is connected, it operates as an external IF output. An IF recording device or a signal analysis system for analog IF data can be connected to this output.

Thanks to the 10 Gbit Ethernet interface, the R&S®ESMD can be integrated into customer systems. Rohde&Schwarz offers suitable recording devices, such

as the R&S®GX465 wideband recorder. What makes this interface special is its bidirectionality, which allows the R&S®ESMD to stream and receive wideband I/Q data up to the full bandwidth in realtime. This is advantageous when using the above-mentioned R&S®ESMD-RR option, which can then output/read data to/from an external memory. The recording capacity is effectively increased from just a few seconds to several hours.

R&S®ESMD, the versatile radiomonitoring solution

The new functions turn the R&S®ESMD into a universal radiomonitoring tool. Fast recording and replaying of various data, as well as in-depth data analysis in both the time and frequency domain qualify it as a full-fledged system-in-a-box for numerous tasks. The R&S®ESMD is a powerful tool for all users who perform measurements via an antenna, either in stationary or mobile use.

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