

## R&amp;S®EM510/R&amp;S®EM550 Digital Wideband Receivers

## Maximum power from HF to UHF

The R&S®EM510 and R&S®EM550 receivers (FIG 1) cover the frequency ranges from 9 kHz to 32 MHz and 20 MHz to 3.6 GHz, respectively, and offer powerful digital signal processing in addition to excellent RF characteristics.

## A strong duo – also in future signal scenarios

After the VXI-based R&S®EM050 VHF / UHF digital wideband receiver [1] proved its mettle in multichannel systems, many customers soon began expressing an interest in receivers with the same characteristics but in 19" design. The strong demand was not only for receivers covering higher frequency ranges but also for digital receivers in the HF

range due to the rapid increase in digital transmission methods. To meet this demand, Rohde & Schwarz developed the R&S®EM550 VHF / UHF digital wideband receiver and the R&S®EM510 HF digital wideband receiver – two instruments whose excellent RF characteristics, wide dynamic range, and powerful digital signal processing reflect the company's many years of experience in the development of professional radiomonitoring receivers. ▶

FIG 1 A setup consisting of both the R&S®EM550 and the R&S®EM510 receiver as well as a PC provides you with a small system that covers HF to UHF, offers an excellent price/performance ratio, and already meets many requirements.



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### ► Innovation also in the HF range

The aspect that truly makes the R&S®EM510 stand out is that it is designed as a direct receiver, i. e. the received signal goes directly to the A/D converter after it has passed through the instrument's extensive preselection. This adds unrivaled characteristics to the receiver in the HF range. In addition to a wide realtime bandwidth of 10 MHz, this concept significantly improves the reception of weak signals in critical scenarios, and the omission of the synthesizer allows higher scan speeds. Since the R&S®EM510 and R&S®EM550 use the same fast means of digital signal processing (DSP), the two receivers are basically identical with respect to characteristics and functions.

### Dynamic range and sensitivity also in wideband operation

During the development of the two receivers, great importance was placed on excellent large-signal characteristics and high sensitivity – two aspects that are decisive in today's signal density when being able to clearly identify strong and weak signals is a must in critical scenarios. Thus, you can quickly find the right settings for successful radiomonitoring even under poor reception conditions. Furthermore, optimum reception conditions are ensured by matching preselection ranges with tracking or fixed bandpass, highpass, or lowpass filters.

While different applications often required different receivers in the past, the new receivers can process both narrowband and wideband transmissions without any performance loss.

### Powerful digital signal processing

All IF processing is handled by powerful signal processors and field programmable gate arrays (FPGA). This technology allows the implementation of functions that are indispensable in modern radiomonitoring. The two new receivers provide many filters, various evaluation methods for level measurement, user-definable measurement times, a series of standard demodulators, functions for modulation and bandwidth measurements – to name only the most important features. Another advantage of this technology is the simultaneous availability of the demodulated signals in various formats and at different interfaces – both analog and digital. Moreover, the hardware used for signal processing provides ample room for future expansions.

### Searching – detection

Since not all transmissions and their frequencies are always known beforehand, it is often necessary to first search for unknown signals in the frequency range. To do this, both receivers are equipped with extensive scan functions. Particularly noteworthy is the high-speed FFT scan (panorama scan), which offers scan speeds up to 34 GHz/s, irrespective of channel occupancy. The synthesizer is tuned in steps of 10 MHz and the FFT is calculated at each step. This allows unrivaled scan speeds even at high resolution. The FFT scan is especially advantageous when it is necessary to search for unknown signals, short-duration signals, or frequency-agile transmissions (e. g. hoppers, FIG 2). Particularly low probability of intercept (LPI) signals require maximum scan speeds. If the user-definable measurement time is also activated during the FFT scan (FIG 3), even interference signals with their mostly nonperiodic behavior can be reliably detected. This is particularly important

when unwanted signals are causing interference to radio or navigation services that are relevant to security and the source of interference must be eliminated immediately.

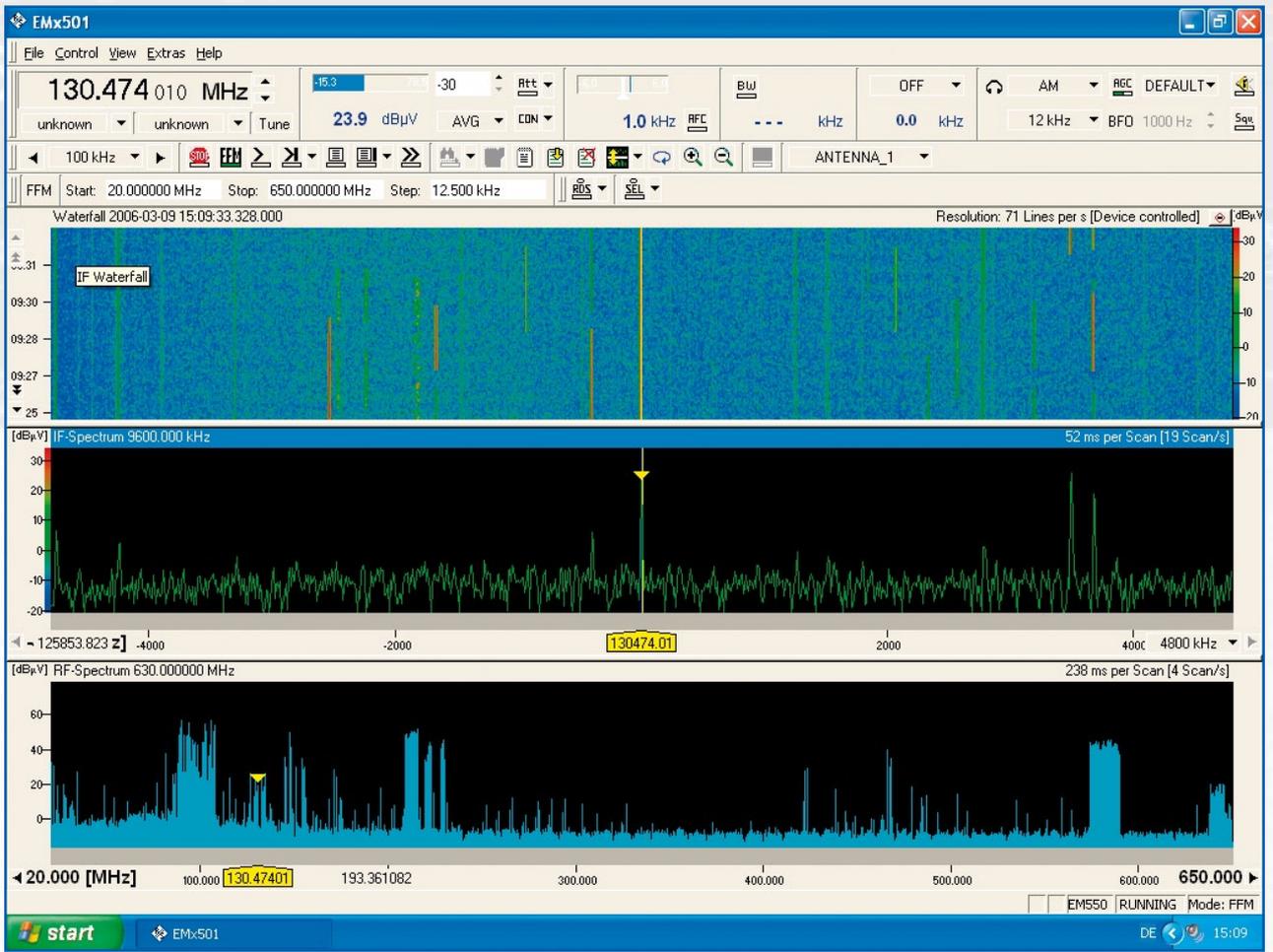
Moreover, the receivers feature even further scan functions such as channel scan and memory scan. Channel scan (or frequency scan) is primarily used when you need to perform searches in a specific frequency range with fixed channel spacing, as is the case for example in tactical radio services or also in the classic FM broadcast band. Memory scan is applied to frequency lists that are user-programmable.

### Demodulation – analysis

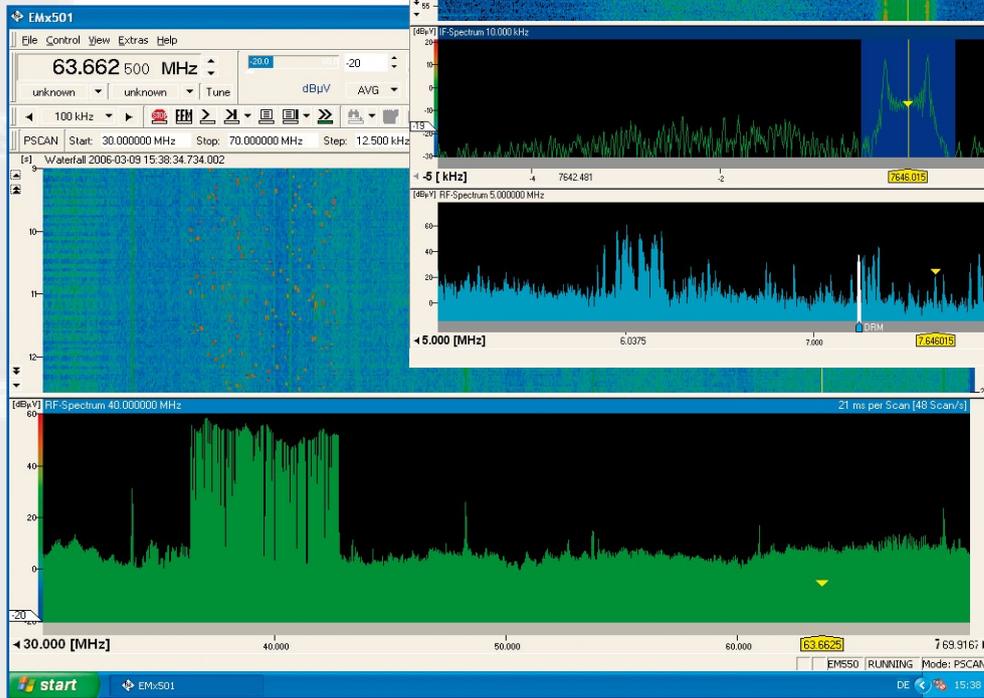
Featuring filter bandwidths from 100 Hz (150 Hz with the R&S®EM550) to 10 MHz and the capability to also demodulate up to the maximum bandwidth of 10 MHz, the receivers are already well prepared for many signals. For example, FDM signals can be analyzed, and in the area of air traffic communications, all signals within the 10 MHz window are simultaneously audible. For civil services such as regulatory authorities, special functions such as the decoding of radio data service (RDS) content or the demodulation of analog TV transmitters (as bitmap picture on the PC) are available. Since the original sound is also audible, a TV transmitter can be quickly identified.

For further analyses, the receivers additionally provide IF panorama and video panorama. With IF panorama, the marked signal is located in the center, and the IF panorama is basically a zoom function with a user-definable span. This enables you to see the spectrum of the modulated signal (FIG 4) or, when a large span is involved, the signal environment. Even narrow pulses such as transmitted by radar systems can be dis-

**FIG 2**  
 PC user interface  
 of the R&S®EM 510  
 and R&S®EM 550  
 receivers showing  
 FFT spectrum and  
 IF spectrum with  
 waterfall display.



**FIG 3**  
 Detection of a  
 hopper transmission.



**FIG 4**  
 Spectrum of an FSK  
 transmission, displayed  
 in the IF panorama of  
 the R&S®EM 510.

▶ played and measured. The IF panorama can also be used when the bandwidth of a signal is to be measured.

The video panorama makes the spectrum of the demodulated signal visible. Since the results are displayed in normal or squared format, diverse applications are possible. For example, baud rates in digital methods, chip rates in DSSS transmissions, and many other parameters can be reliably measured. Moreover, the visual assessment of the signal spectrum allows you to draw conclusions about the modulation type.

To analyze digital transmission methods, Rohde & Schwarz has developed a PC analysis software tool that opens up the full scope of digital signal processing capabilities when used together with the R&S®EM510 and / or R&S®EM550 receiver(s). Classification (detection of

modulation type), vector analysis, bit stream analysis, and decoding are just a few of the many capabilities available. Measurements of new digital services such as DVB and DAB can also be performed on the basis of the new ITU recommendation SM 1600. Since, no hardware other than the receiver and PC is required, you enjoy the benefit of a small system that offers an excellent price/performance ratio and already meets many requirements.

**Online – offline**

Performing an online analysis of the received signals is not always possible or useful. In such cases, the digital baseband data can be recorded externally for later offline analysis where the recording time is only limited by the capacity of the storage medium. Of course, the PC analysis software mentioned earlier can use the recorded data for further processing. Data compatibility also allows access to the R&S®AMMOS analysis system [2].

**Use in customer-specific systems**

The receivers come with comprehensive control software for installation on a PC. Of course, you can also integrate the instruments into a monitoring system yourself. The necessary interfaces and commands are largely standardized and documented in the manual. A major customer benefit here is that all functions – even the fast panorama scan – run on the instrument.

The R&S®EM510 and R&S®EM550 are two powerful receivers that will do an excellent job of handling the tasks at hand for many years to come. Since internal signal processing can be adjusted via software, the receivers are also well prepared for future signal scenarios.

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**More information and data sheet at**  
[www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
 (search term: EM510 / EM550)



**REFERENCES**

[1] VHF/UHF Receiver R&S®EM050: Digital, VXI-based receiver for 20 MHz to 3.6 GHz. News from Rohde & Schwarz (2003) No. 178, pp 61–63

[2] Automatic Modular Monitoring System R&S®AMMOS: Seeing clearly through the thicket of signals. News from Rohde & Schwarz (2003) No. 178, pp 56–60

Condensed data	R&S®EM510	R&S®EM550
Frequency range	9 kHz to 32 MHz	20 MHz to 3600 MHz
Realtime bandwidth	10 MHz	10 MHz
3rd order intercept point	≥30 dBm, typ. 35 dBm	≥17 dBm (20 MHz to 300 MHz) ≥20 dBm (300 MHz to 3600 MHz)
Noise figure	≤15 dB, typ. 12 dB	≤12 dB (f < 2000 MHz) ≤15 dB (2000 MHz to 3000 MHz)
Digital filters for demodulation	30 filters, 100 Hz to 10 MHz	21 filters, 150 Hz to 10 MHz
Demodulation modes	AM, FM, CW, φM, pulse, LSB, USB, ISB, I/Q	AM, FM, CW, φM, pulse, LSB, USB, ISB, I/Q, TV (analog)
Scanning modes		
HF spectrum (panorama scan)	up to 34 GHz/s	up to 34 GHz/s
Frequency and memory scan	up to 1500 channels/s	up to 850 channels/s
Outputs / data output	FFT, IF, video spectrum; digital I/Q baseband; analog and digital video; analog and digital audio; IF controlled/uncontrolled (R&S®EM550 only)	