



Fast and straightforward:  
diagnostic and precompliance  
measurements with the R&S®ESRP

Many of the requirements – such as speed, functionality and ease of use – imposed on EMI test receivers for certification measurements also play a major role in everyday laboratory applications as well as in the runup to final certification. The new R&S®ESRP EMI test receiver for the precompliance class has been optimized to meet these requirements. This instrument vastly accelerates EMI measurements that could otherwise take hours to execute.

### High speed now also in precompliance

Following last year's launch of the world's fastest EMI test receiver – the R&S®ESR\* – for compliance measurements, Rohde&Schwarz has now spared users a long wait for a comparable instrument for diagnostic measurements during development and in laboratories. Like the R&S®ESR, the R&S®ESRP (Fig. 1 on left) also performs an FFT-based time domain scan, speeding up precompliance measurements by orders of magnitude. The R&S®ESRP is intended primarily for EMI diagnostic measurements during development as well as all measurements in the runup to product certification, and covers commercial EMI standards as well as military test specifications up to 7 GHz.

The receiver is available in two models for the frequency range from 9 kHz to 3.6 GHz / 7 GHz. The lower frequency limit can be extended down to 10 Hz in each model using the R&S®ESRP-B29 option (Fig. 2). The instrument is operated using a convenient touchscreen.

### Basic EMC publication supports FFT-based receiver technology

The publication of Amendment 1:2010-06 to the 3rd edition of the CISPR 16-1-1 basic standard for radio disturbance measuring apparatus has generated significant activity. The next editions and revisions of commercial product family standards such as EN 55011 to EN 55032 will reference – if not already the case – the latest edition of this important basic EMC publication. Accordingly, measurement results generated using FFT-based receiver technology are now admitted. These measurements can be implemented through baseband conversion (Fig. 3) or using broadband intermediate frequency (IF) stages. In this way, the required measurements can be completed much faster while maintaining the same accuracy and, very importantly, the same reproducibility.

### Time domain scan speeds up measurements

The R&S®ESRP-K53 time domain scan option affords an impressive acceleration of measurements thanks to its powerful FFT algorithms. In time domain scan mode, the R&S®ESRP completes measurements many times faster than in conventional stepped frequency scan. The time domain signal is recorded with a 128 MHz sampling rate and digitized with a 16-bit A/D converter for further processing. Fig. 4 shows just how much faster measurement results are generated (difference between stepped frequency scan and time domain scan in CISPR bands B and C/D).

The overall measurement times marked red in Fig. 4 are example values for typical measurements in CISPR band C/D that automotive suppliers and manufacturers must perform in line with the CISPR 25 product family standard up to 1 GHz at a measurement bandwidth of 9 kHz (–6 dB). In stepped frequency scan mode, 4 kHz steps are used to provide seamless measurements, and for a measurement time of 10 ms, even pulses with a repetition rate of approx. 100 Hz are recorded.

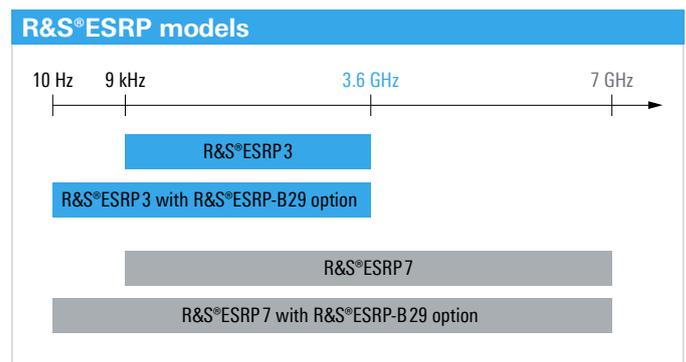


Fig. 2 R&S®ESRP EMI test receiver models and frequency ranges.

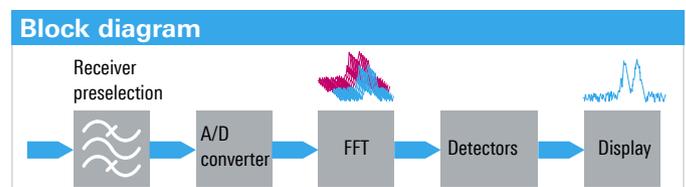


Fig. 3 Block diagram of the R&S®ESRP with baseband conversion up to 30 MHz.

\* The world's fastest EMI test receiver drastically reduces testing times. NEWS (2012) No. 207, pp. 22–27.

The time domain scan delivers results about 500 times faster, even though this mode – with a step size of 2.25 kHz – nearly doubles the number of test points. As seen in Fig. 4, considerable time can also be saved with measurements in other bands, thereby substantially reducing the expenditures involved in readying a product for industrial production.

### Seamless recording of electromagnetic disturbances

Using the time domain scan, performing EMI measurements in the CISPR bands is now a matter of seconds. The R&S®ESRP records the spectral signal components without any time gaps using a bandwidth of up to 30 MHz. With a virtual step size of 1/4 of the resolution bandwidth and Gaussian FFT windows overlapping by more than 90 %, the receiver achieves very good level measurement accuracy for pulsed

disturbances (Fig. 5). The total measurement uncertainty therefore meets the CISPR 16-1-1 requirements also for pre-compliance measurements.

Speed is also crucial when testing devices that can be operated, or measured, only during a short period of time – either because they change their behavior (fluctuating or drifting disturbances), or because extended operation might be destructive, or because their operating cycle calls for high speed (as in the case of electric window lifters in motor vehicles). The time domain scan function in the R&S®ESRP makes it easy to handle such scenarios.

Users can also increase the measurement time in order to reliably detect narrowband intermittent interferers or isolated pulses.

Frequency range	Detector, measurement time, IF bandwidth	R&S®ESRP overall measurement time	
		Stepped frequency scan	Time domain scan (optional)
CISPR band B 150 kHz to 30 MHz	peak, 100 ms, 9 kHz	7462 test points: 755 s	13 267 test points: 2 s
CISPR band B 150 kHz to 30 MHz	quasi-peak, 1 s, 9 kHz	7462 test points: 12 960 s	13 267 test points: 60 s
CISPR band C / D 30 MHz to 1000 MHz	peak, 10 ms, 120 kHz	24 250 test points: 254 s	32 334 test points: 6 s
CISPR band C / D 30 MHz to 1000 MHz	peak, 10 ms, 9 kHz	242 500 test points: 4310 s	431 112 test points: 8 s
CISPR band C / D 30 MHz to 1000 MHz	quasi-peak, 1 s, 120 kHz	24 250 test points: approx. 600 min	32 334 test points: approx. 33 min

Fig. 4 Comparison of overall measurement times obtained with stepped frequency scan and with time domain scan using typical measurement settings. Marked red: examples of overall times for typical measurements that automotive suppliers and manufacturers must perform in line with the CISPR 25 product family standard up to 1 GHz at a measurement bandwidth of 9 kHz (-6 dB).

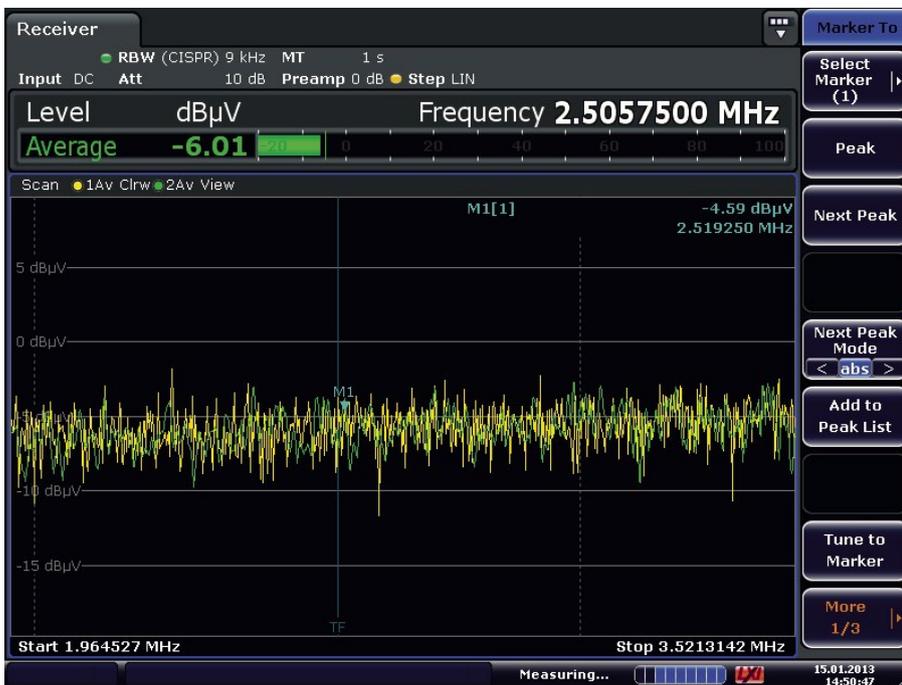


Fig. 5 Level error: stepped frequency scan (yellow) vs. time domain scan (green).

The optional R&S®ESRP-B2 preselection and RF preamplifier module contains 16 filters and a 20 dB preamplifier for a maximum frequency of 7 GHz. Equipped with this module, the R&S®ESRP performs measurements of intermittent disturbance signals with pulse repetition rates of 10 Hz or higher in line with the CISPR 16-1-1 basic standard. Featuring a pre-selection filter bandwidth from 150 kHz to 30 MHz, the test receiver measures conducted disturbances in a single step simultaneously on 13267 frequencies using the time domain scan (Fig. 6).

### IF analysis function for higher-resolution spectral display

Critical signal amplitudes in the spectrum can be analyzed in greater detail using the IF analysis function of the R&S®ESRP. This function provides a spectral display of the RF input signal in a selectable range (up to 10 MHz) around the EMI receiver frequency. The IF spectrum display can be coupled to the bar-graph display for the current receive frequency. Alternatively, the IF spectrum display can be coupled to the marker position,

Fig. 6 In a single step: conducted disturbance measurement in CISPR band B.

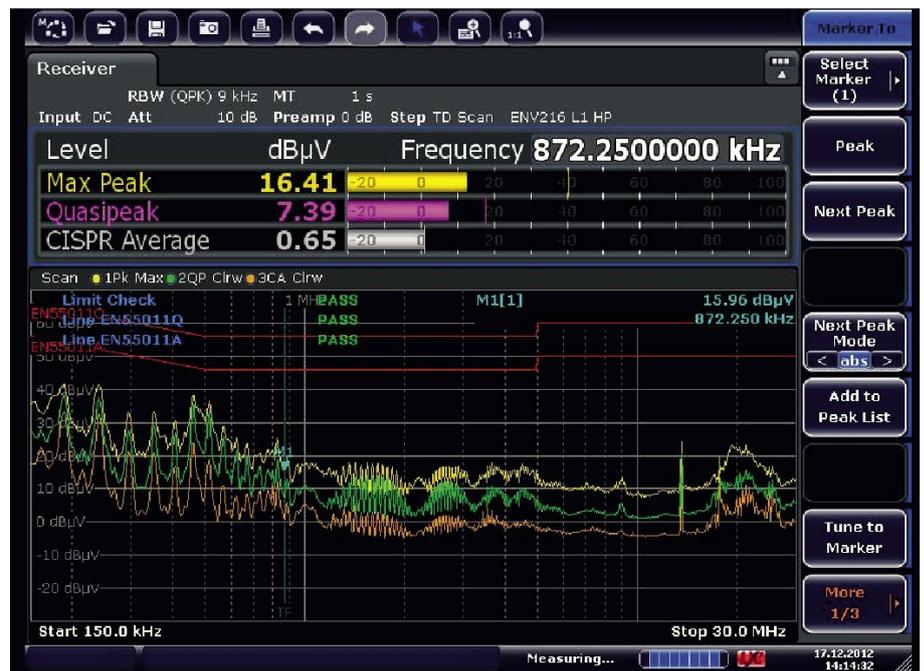
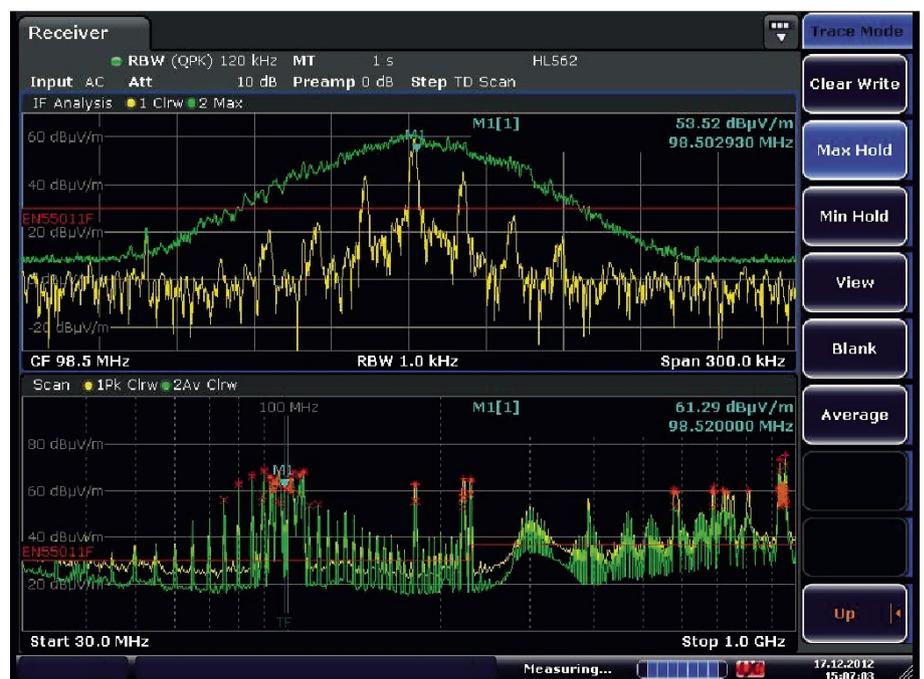


Fig. 7 IF spectrum with IF center frequency coupled to position of marker in preview measurement spectrum (marker track function).



e.g. in a preview measurement using the marker track function (Fig. 7); in this way, the center frequency of the IF spectrum is always equal to the instrument's current receive frequency. This enables very accurate and fast tuning to the signal of interest. In addition, the IF spectrum display provides a detailed overview of the spectrum occupancy around the signal of interest and – with sufficiently wide IF bandwidth – information about the spectral distribution of a modulated signal in the measurement channel. Any signals received can be quickly classified as disturbance signals or wanted signals. AM or FM audio demodulation can be activated in parallel, making it easier to identify detected signals, for example in order to find and exclude ambient signals in open area measurements.

### Spectrum analyzer functions and EMI measurements in spectrum analyzer mode

The frequency range from 9 kHz to 3.6 GHz / 7 GHz can be extended down to 10 Hz using the R&S®ESRP-B29 option. If preselection is deactivated in spectrum analyzer mode, the separate R&S®FSV-B22 RF preamplifier option can be used to increase the sensitivity of the R&S®ESRP. Featuring low displayed average noise level (–168 dBm (typ.) at 1 Hz bandwidth with preamplifier switched on), the R&S®ESRP measures even low-level signals precisely. Due to its very wide dynamic range, the instrument meets the special requirements of CISPR 16-1-1 Ed. 3 (use of spectrum analyzers without preselection for standard-compliant disturbance measurements), relating to disturbance signals with a pulse repetition rate of 20 Hz or higher.

RF disturbance measurements can be performed in spectrum analyzer mode either with or without preselection activated. The number of test points is selectable. For a conclusive evaluation, up to 200 001 points can be specified. By contrast, up to 4 million points per trace are available in test receiver mode. Diagnostic measurements during development also require high accuracy and reproducibility. “Normal” resolutions of 8000 or 32 000 points, as typically used in conventional spectrum analyzers, quickly hit critical limits and are not adequate for EMI measurements.

Up to 16 configurable markers can be placed on the frequencies of disturbance signals to carry out targeted analysis. Markers can be coupled with a CISPR weighting detector to enable direct comparison with limit values. The spectrum can also be displayed along a logarithmic frequency axis, which simplifies result analysis across a wide frequency range and displays limit lines in compliance with relevant standards. Critical frequencies are presented in a peak list, enabling fast comparison of disturbance signals with limit lines.

### Tracking generator for scalar network analysis

An internal tracking generator (R&S®FSV-B9 option) enhances the R&S®ESRP to operate as a scalar network analyzer in the frequency range from 9 kHz to 7 GHz. With this option, users can quickly and easily determine the frequency-dependent insertion loss of test cables or filters, for example, and store the results as correction tables (transducers) in the R&S®ESRP.



Fig. 8 The R&S®ESRP in a ruggedized housing with corner guards and carrying handle for field use.

## Ready for field use

For field applications in a vehicle or an open area, the R&S®ESRP can be extended with the R&S®FSV-B30 DC power supply (12 V to 15 V) and supplied in a ruggedized housing with corner guards and carrying handle (Fig. 8). During open area measurements, the test receiver will reliably operate for several hours when equipped with the R&S®FSV-B32 lithium-ion battery pack, e.g. for recording series of measurements.

In the standard version, the R&S®ESRP comes equipped with a hard disk drive for data storage. The hard disk drive can be replaced with a solid state drive to handle scenarios with above-average fluctuations of the operating temperature, or when the instrument is exposed to strong shock and vibration loads, for example in vehicles.

## Automated measurements and software support

The R&S®ESRP has an integrated test automation function to support configurable, automated test sequences including preview measurement, data reduction and final measurement (Fig. 9). The number of frequencies for final measurement and the margin relative to one or more limit lines are specified here. The test sequence is launched with a keypress and then runs fully automatically. It is also possible to carry out the final measurement interactively. Touching the peak list icon opens a list of previously detected frequencies. The number of final measurement frequencies can be adjusted, to be followed by final evaluation with quasi-peak, CISPR-average or CISPR RMS-average weighting. The trace wizard is used to assign the appropriate detectors.

Moreover, the R&S®ES-SCAN and R&S®EMC32 EMC application software packages are available for automated and semi-automated EMI test execution under external computer control. The R&S®ES-SCAN EMI software is cost-effective, user-friendly Windows software created especially for disturbance measurements during development. It ideally complements the R&S®ESRP.

The R&S®EMC32 EMC measurement software can also be used with the R&S®ESRP. The software has a modular design and supports manual, semi-automated and fully automated electromagnetic interference and immunity measurements in line with commercial and military standards. The software provides reliable recording, analysis, documentation and traceability of measurement results and offers remote control capability for a wide variety of accessory components such as mast and turntable systems.

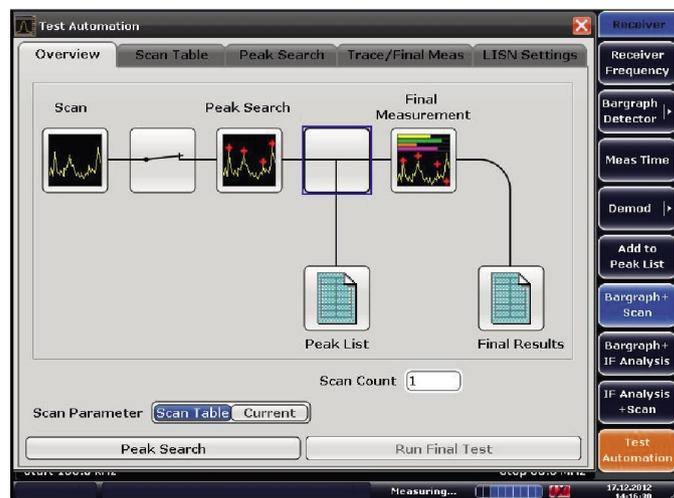


Fig. 9 Test automation menu for configuring automated test sequences.

The R&S®ESRP can be remotely controlled via GPIB or LAN with user-created programs via standard IEC 625-2 (IEEE 488.2) interfaces or LAN interfaces (10/100/1000BaseT). For integration of the R&S®ESRP, drivers for LabVIEW, LabWindows/CVI and VXI Plug & Play are available free of charge on the Rohde&Schwarz website.

## Summary

The R&S®ESRP EMI test receiver for the frequency range from 10 Hz to 7 GHz has been designed for diagnostic measurements during development and for precompliance measurements in the runup to final certification testing. Due to its outstanding RF specifications, high speed and wealth of measurement functions, the instrument is ideal for applications during development as well as in laboratories. It has been optimized to execute EMI measurements as fast as possible and with the required level of accuracy. Using an FFT-based time domain scan, the instrument measures electromagnetic disturbances at high speed. At the same time, the R&S®ESRP is a full-featured, powerful signal and spectrum analyzer for lab applications. The instrument comes with a clearly structured, intuitive touchscreen interface and is very easy to use – a tremendous advantage considering its wide range of applications. This multipurpose instrument helps users to obtain the desired results faster and ready their products for final certification and industrial production.

Volker Janssen

## References

Amendment 1:2010-06 to CISPR 16-1-1:2010-01 (Edition 3): Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus

For more information about the R&S®ESRP, visit:

[http://www.rohde-schwarz.com/en/product/esrp-productstartpage\\_63493-35077.html](http://www.rohde-schwarz.com/en/product/esrp-productstartpage_63493-35077.html)