R&S®ESR26 EMI test receiver – 26.5 GHz for certification by any standard

A great leap forward – the new R&S®ESR26 pushes the upper frequency limit of the test receiver family to 26.5 GHz. More universal than previous models, the R&S®ESR26 is ideal for relevant certification measurements in line with CISPR, EN, MIL and FCC standards.

Many new applications

The first R&S®ESR EMI test receiver models (Fig. 1) were introduced in 2012 under the slogan "more speed, more insight, more intelligence". With the addition of the R&S®ESR26, the family now covers the frequency range from 10 Hz to 26.5 GHz (Fig. 2). The main focus is on product certification measurements in line with relevant commercial EMC standards. With their integrated preselection, a 20 dB preamplifier and a highly linear frontend, the instruments meet the requirements of the CISPR 16-1-1 basic standard and are ideal for all commercial standard measurements. What makes these instruments truly outstanding is their time domain scan and FFT-based receiver technology that measures electromagnetic disturbances at a speed so far unattained.* EMC measurements which took hours in the past can now be completed in just seconds. The

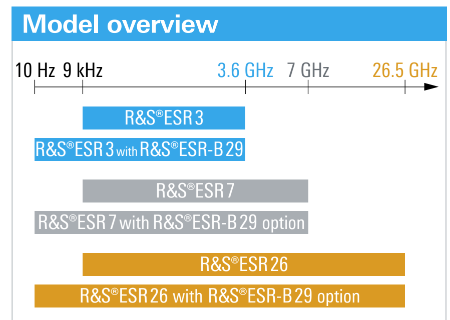


Fig. 2: Models and frequency ranges of the R&S®ESR EMI test receiver family.

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

Fig. 1: The R&S®ESR26 EMI test receiver covers the entire CISPR frequency range as well as key military standards.

optional realtime spectrum analysis with a wide range of diagnostic tools provides new insight into disturbance signals and their history. Besides offering EMC testing functionality, the R&S®ESR is a full-featured, powerful signal and spectrum analyzer for lab applications. It comes with a clearly structured, intuitive touchscreen interface that makes it very easy to operate in any mode.

The right receiver for every standard

Receiver model selection is driven by the EMC standard governing the T&M task at hand. CISPR standards play an important role in the commercial sector, and in Europe, they are part of the European standards (EN). For instance, the CISPR 22 standard for information technology equipment (ITE) is reflected in EN 55022. Many other countries such as China, Russia, Japan and Korea also adhere to CISPR or EN standards. Those seeking to introduce electronic products in these countries must ensure compliance with the EMI limits specified in the CISPR standards.

CISPR 22 (to be replaced by CISPR 32) for information technology equipment, for example, establishes limits up to 6 GHz (Fig. 3) – a range covered by the R&S®ESR7 EMI test receiver. Household microwave devices (CISPR 11) and satellite receiver systems (CISPR 13, to be replaced by CISPR 32) must be tested up to 18 GHz. The R&S®ESR26 is the right T&M instrument for this task.

In North America, Federal Communications Commission (FCC) specifications are the legal standard for telecommunications devices. Section 15 of the Code of Federal Regulations (CFR) 47 differentiates between intentional and unintentional radiators.

Section 15.33 Frequency range of radiated measurements.

(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The CFR requires that intentional radiator signals be measured to the tenth harmonic. In the crucial ISM band (2.4 GHz to 2.5 GHz) where Bluetooth® and WLAN devices, cordless telephones, baby phones and many others operate, this means testing up to 25 GHz.

Computer processors, in contrast, are unintentional radiators and typically have a clock frequency in the range up to 4 GHz. The FCC requires that such devices be tested to the fifth harmonic, i.e. up to 20 GHz. The R&S®ESR26 meets both requirements.

The R&S®ESR-B29 option featuring a frequency extension down to 10 Hz and 6 dB bandwidths in decade steps from 10 Hz to 1 MHz makes the R&S®ESR26 ideal for measurements in line with MIL standards and manufacturer-specific standards in the automotive sector.

New spectrogram display

The release of the R&S®ESR26 was accompanied by new measurement functions for every model of the receiver family. A software update is available free of charge for instruments that have already been delivered. The new functions include a spectrogram display for scan and measurement results – a feature that shows how measured signals change over time. The R&S®ESR also displays all measured spectra as linear overlays with color-coding to indicate their levels (Fig. 4).

Device classes	Product standard	Frequency range
Industrial, scientific and medical (ISM) equipment	11	9 kHz to 18 GHz
Vehicles, protection of broadcast receivers	12	30 MHz to 1 GHz
Sound and television broadcast receivers and associated consumer electronics equipment	13	150 kHz to 18 GHz
Household appliances and electric tools	14-1	9 kHz to 1 GHz
Electrical lighting equipment	15	9 kHz to 300 MHz
Information technology equipment (ITE)	22	150 kHz to 6 GHz
Protection of receivers installed in vehicles, boats and devices	25	150 kHz to 2,5 GHz
Multimedia equipment	32 (will replace CISPR 13 and CISPR 22 on March 5, 2017)	150 kHz to 6 GHz (18 GHz*)

Fig. 3: Device classes covered by CISPR 11 to 32 with frequency ranges.
*Household satellite receiver systems will be covered by CISPR 32.

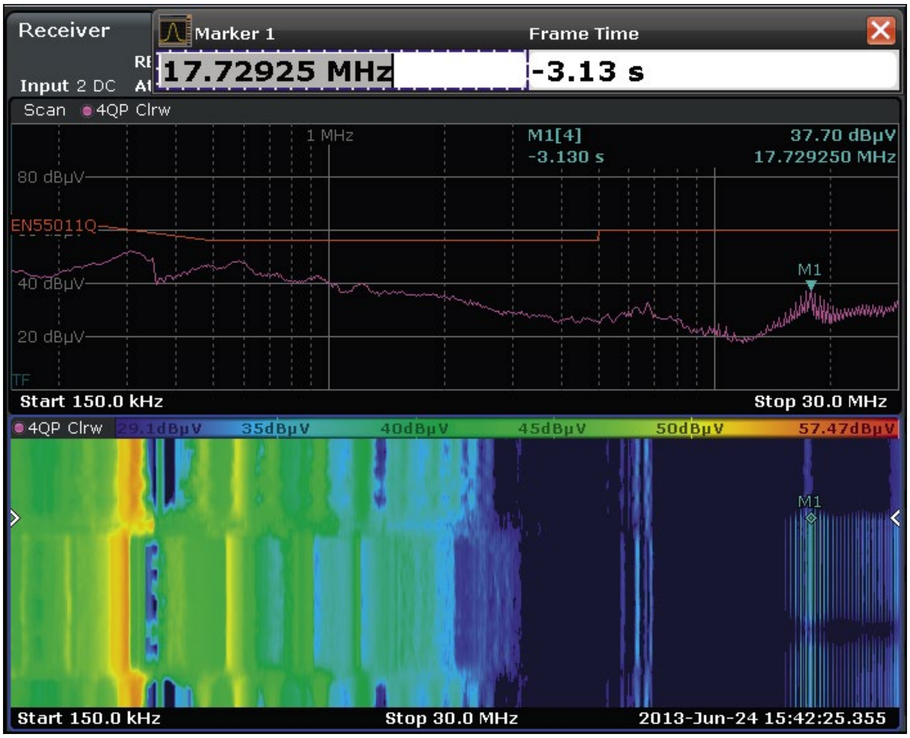
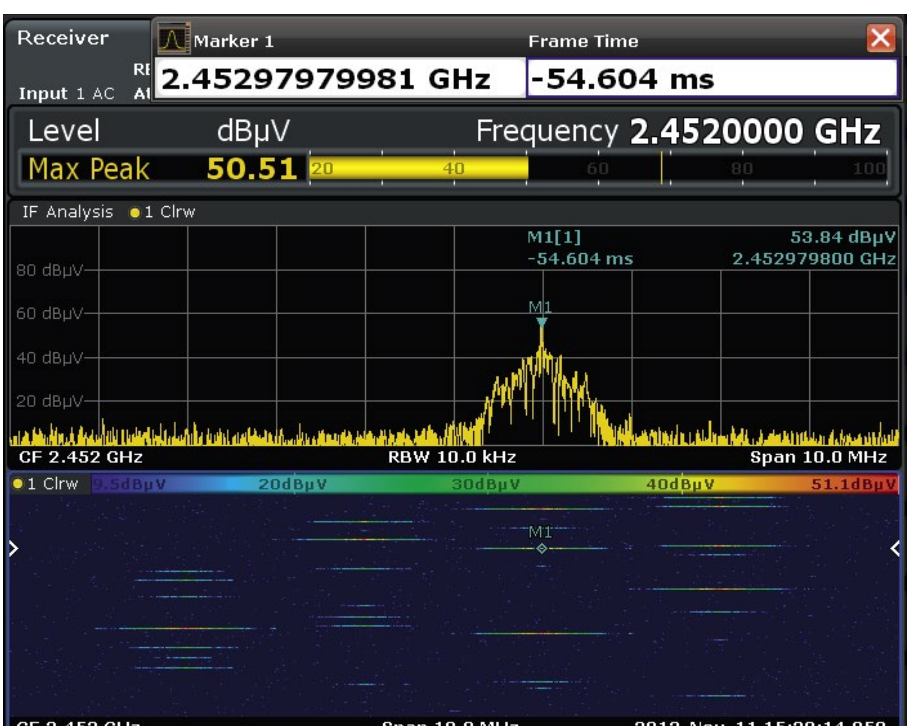


Fig. 4: Seamless spectrogram measured using the quasi-peak detector. The DUT is a computer power supply; the spectrum changes over time due to varying load states.

Fig. 5: IF analysis spectrogram of a Bluetooth® signal – the time domain behavior of the spectrum is visible around the receive frequency.



In this example, the receiver's FFT-based time domain scan is measuring the entire CISPR band B from 150 kHz to 30 MHz at once. In continuous scan mode, this spectrogram delivers a seamless image of signal characteristics over time. Users can stop the scan when unexpected or especially interesting events occur and move the marker backward across the spectrogram chronologically to examine frequency spectra saved by the receiver. Seamless, standard-compliant measurements ensure that no event goes undetected, and various operating modes can be quickly accessed and recorded to provide more reliable measurement results.

Just as with the scan display function, users can also assign a spectrogram to the IF analysis (Fig. 5). The purpose of the optional R&S®ESR IF analysis function is to provide a spectral display of the RF input signal around the receive frequency. It provides a detailed overview of the spectrum occupancy around the measurement channel as well as information about the spectral distribution of a modulated signal. Any signals received can be quickly classified as either disturbance signals or wanted signals. The spectrogram display also shows spectrum changes over time. When used with the digital audio demodulators, this feature allows users to visually and acoustically analyze disturbance signals.

Measuring conducted disturbances in one go

A binding compliance test using a quasi-peak detector requires a minimum measurement time of one second for every frequency point. For the conventional stepped scan, this means a scan time of almost two hours when sampling the frequency range up to 30 MHz at half the measurement bandwidth of 4.5 kHz. This is why at some point in the past, it became common to split the process into preview measurement and final measurement. The peak detector and average detector

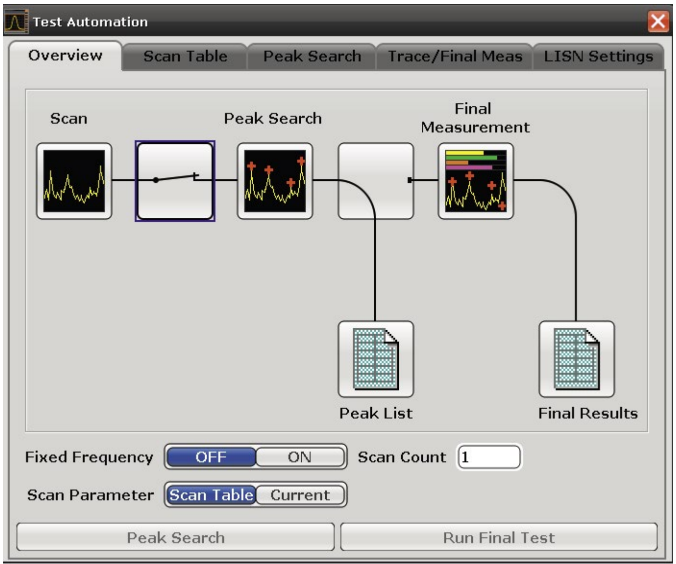


Fig. 6: Test automation dialog box: Thanks to the fast time domain scan, users do not need to split the process into preview and final measurements. Final measurement results are available in the peak list.

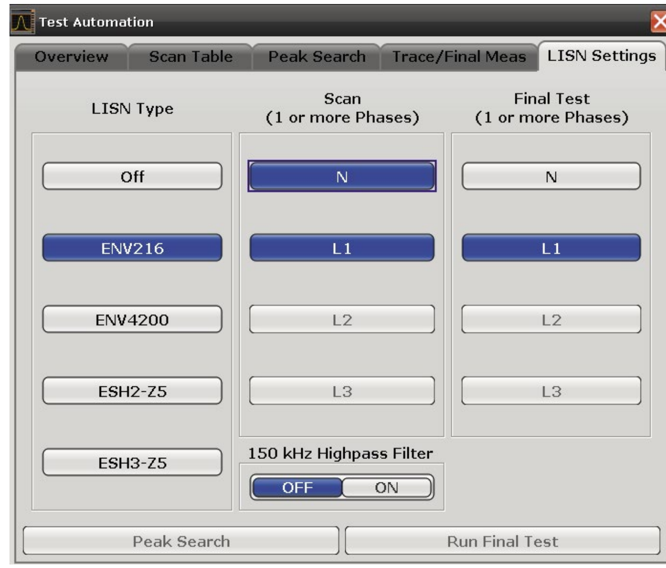


Fig. 7: Users can select multiple phases for a scan sequence, which the receiver carries out automatically. A final measurement is not needed.

are used for the preview measurement. The measurement time per frequency point is 20 ms, for example, and a spectrum is available after two to three minutes. During the final measurement, the receiver uses the standard-compliant quasi-peak and CISPR-average detectors to measure only the 25 frequencies closest to the limit line. The receiver requires two seconds for each measurement. After every frequency change, the instrument requires one second settling time for the detector so that it can measure pulses correctly, and one second measurement time. For two detectors and 25 values each, this is:
2 seconds × 2 detectors × 25 values = 100 seconds.

The final measurement lasts 100 seconds when using the conventional method. The measurement is typically performed with a line impedance stabilization network (LISN) and takes a full 200 seconds for single-phase DUTs (phase and neutral conductor) and 400 seconds for three-phase DUTs.

The R&S®ESR FFT-based time domain scan opens up new possibilities (Figs. 6 and 7). For example, at an FFT bandwidth of 30 MHz, the R&S®ESR delivers standard-compliant measurement results for the entire CISPR band B after two seconds, and that includes the required settling time of one second. Now the calculation is much more palatable:
2 seconds × 2 detectors = 4 seconds
for the complete, standard-compliant measurement of one line. It takes a total of 8 seconds to measure single-phase DUTs and 16 seconds for three-phase DUTs. In addition, the test engineer can already determine during the development phase whether the disturbance signals will fluctuate versus time or whether intermittent disturbance signals with low repetition rates are present. It is now easy to extend the observation period to 5 seconds in order to better capture fluctuating disturbances. Including the required one second settling time, the total is
6 seconds × 2 detectors = 12 seconds
measurement time per line. A small investment in measurement time produces reliable results even for difficult-to-capture signals.

Summary

Thanks to the frequency range extension to 26 GHz, the R&S®ESR26 opens up new applications. It covers the entire frequency range of the CISPR standards and of key military standards and can also be used for FCC-compliant measurements.

Rohde & Schwarz is continuously expanding the functional range of its test receivers. Scan and IF analysis spectrograms and greatly improved conducted disturbance measurements represent significant value added for users. They provide deeper insight into the EMC characteristics of DUTs and produce faster and more reliable results.

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