Favorably priced EMI measuring r

The new R&S®ESL EMI test receiver combines two instruments in one, measuring disturbance in accordance with the latest standards and also serving as a full-featured spectrum analyzer for diverse lab applications – the ideal instrument for low budgets.

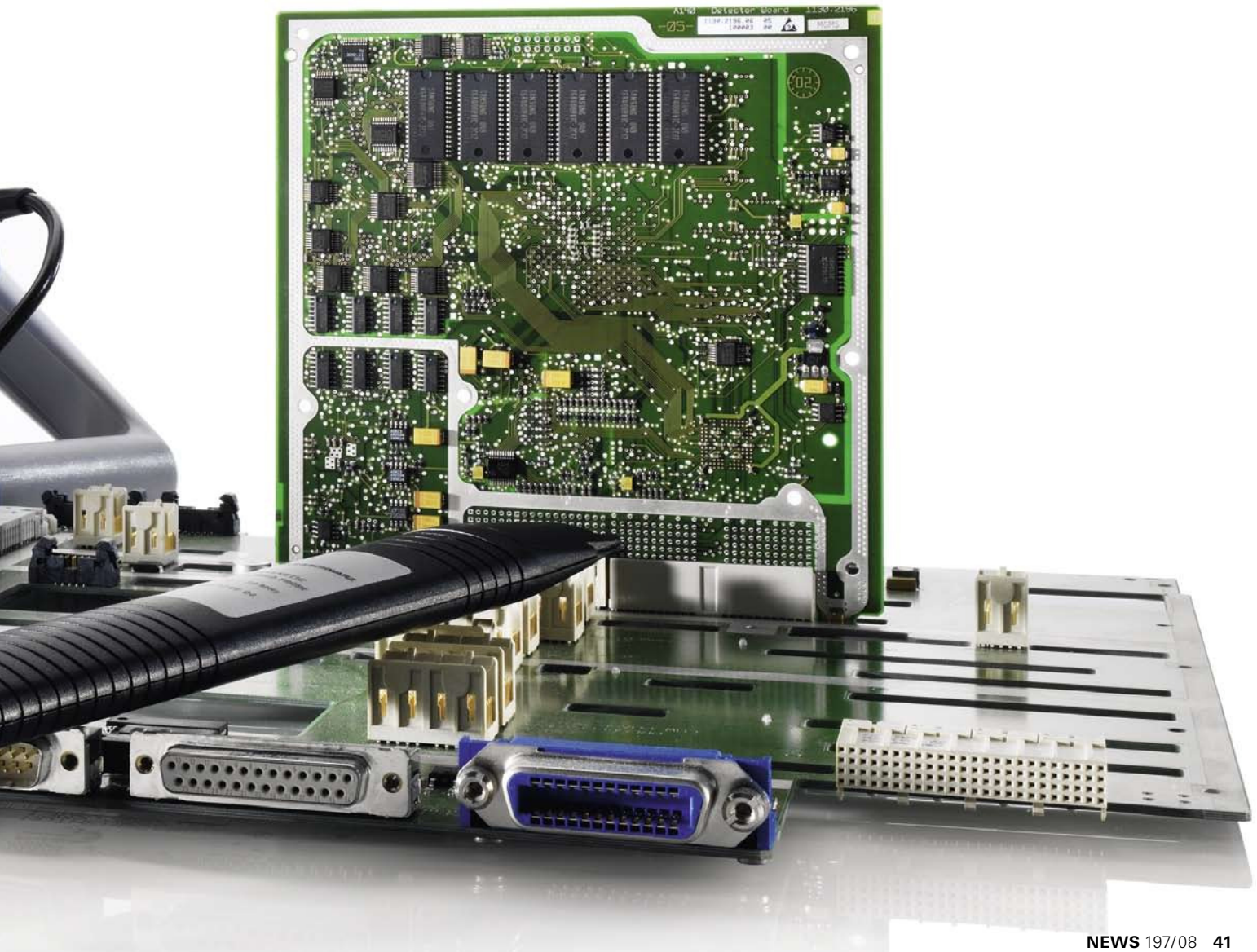
eceiver for the development lab

Lots of test and measurement for low budgets

All electrical devices – PCs, household appliances, control units for cars, etc. – must be tested for electromagnetic compatibility. Experience shows that taking EMC requirements into account at an early stage and checking the EMC measures in the development phase makes it easier to certify the finished product and helps to avoid expensive redevelopment work.

Compliance EMI test receivers such as the R&S®ESU or the R&S®ESCI are often overdimensioned and too costly for diagnostic or overview measurements. This is where a favorably priced instrument such as the R&S®ESL (FIG 1) is ideal, for in addition to its function as an EMI test receiver it can also be used as a full-featured spectrum analyzer. FIG 2 lists the different models.

FIG 1 Diagnostic measurements in development with the R&S®ESL and the R&S®HZ-14 near-field probe set.



Fast, dependable measurements with automated test sequences

The R&S®ESL carries out EMI tests on a DUT, either manually or by means of fully automatic or semi-automatic test sequences. Automatic test sequences ensure reproducible results, save a considerable amount of measurement time and make measuring easier for users who do not regularly perform EMI tests. Regardless of whether disturbance voltage, disturbance power or disturbance field strength is measured, an automated test sequence has three phases:

- A fast overview measurement with peak (and average) detector, based on a user-programmable scan table that defines the frequency ranges and receiver settings such as bandwidth and measurement time
- Determination of the frequencies with levels near or above the specified limits (data reduction)
- Automatic final measurement using the CISPR detectors only on these critical frequencies

All the parameters needed for data reduction and final measurement on the critical frequencies can be configured quickly and easily in a single window (FIG 3)

Model	Frequency range	Tracking generator
R&S®ESL3, model 03	9 kHz to 3 GHz	–
R&S®ESL3, model 13	9 kHz to 3 GHz	1 MHz to 3 GHz
R&S®ESL6, model 06	9 kHz to 6 GHz	–
R&S®ESL6, model 16	9 kHz to 6 GHz	1 MHz to 6 GHz

FIG 2 The different R&S®ESL models.

Remote control of line impedance stabilization networks (LISNs) with the R&S®ESL

Disturbance voltage measurements detect disturbances that occur on power lines in the lower part of the RF spectrum. To measure these conducted signals, an LISN/V-network is normally used as a coupling device to which the power and measurement signal lines are connected. Limit lines, e.g. in accordance with the CISPR product standards, exist for the range from 9 kHz or 150 kHz to 30 MHz (FIG 4). To determine the maximum disturbance, measurements must be performed on all phases of the power line.

For this measurement, Rohde&Schwarz provides the R&S®ENV216 two-line V-network as well as the R&S®ESH2-Z5 and R&S®ENV4200 four-line V-networks. The R&S®ESL automatically switches the different phases of the V-network via a control cable (FIG 5).

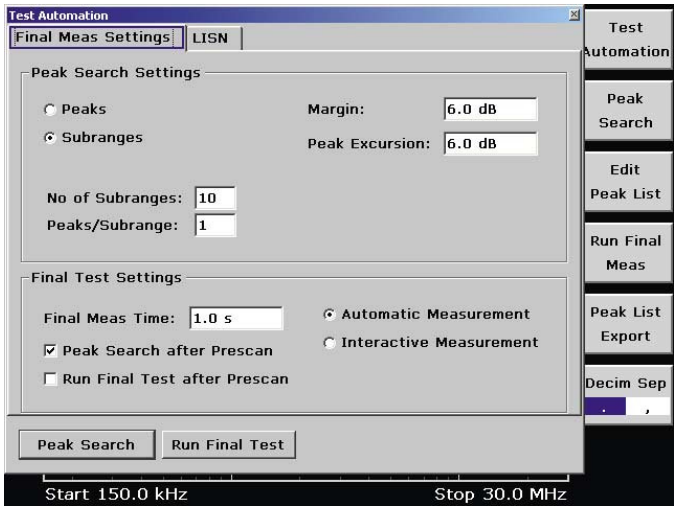


FIG 3 Setting window for data reduction and final measurement. The final measurement frequencies are automatically determined either for the absolute peaks or as subrange maxima. The relative magnitude of disturbance (peak excursion), its distance to the limit (margin) and the maximum number of subranges/peaks can all be set (1 to 500). The final measurement on the determined frequencies is performed either automatically or interactively.

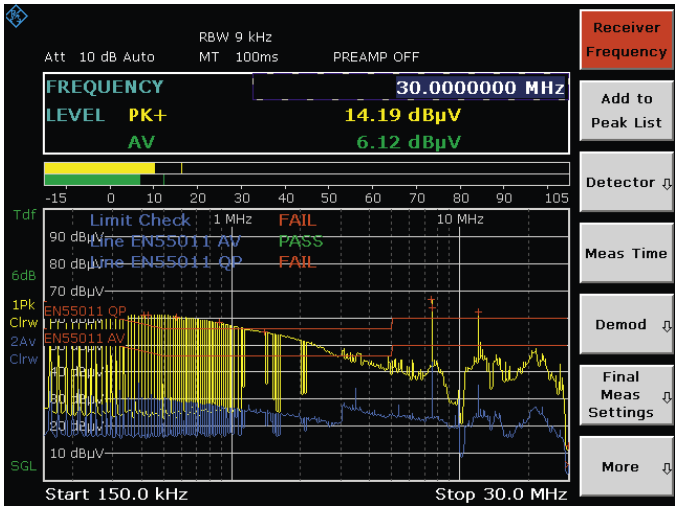


FIG 4 Result of an overview measurement of disturbance voltage with simultaneous peak weighting (yellow trace) and average weighting (blue trace). The critical frequencies for the final measurement that were determined by way of data reduction are indicated by appropriate symbols. The R&S®ESL can simultaneously display up to six traces with different weighting detectors; each trace can have max. 1 million measurement points in receiver mode.

In the final measurement, the R&S®ESL determines the disturbance levels on the selected phases and subsequently finds the disturbance maximum. It shows violations of the selected limit lines in the results table of the final measurement (FIG 6). It measures disturbance voltage fully automatically. Active overload detection with an autorange function ensures that the input level is in the optimal range so that valid results are obtained.

The R&S®ESL features a selection of important limits (LIMIT LINES) for disturbance voltages, disturbance powers and disturbance field strengths in line with commercial standards. New limit lines can be entered and stored in tabular form.

Disturbance field strength measurements with the R&S®ESL

Besides the disturbance voltage measurement at low frequencies, measurement of disturbance field strength starting at 30 MHz is the prescribed method for assessing disturbance in accordance with most product standards. During development, the simplest way of doing this is to use, in a first step, near-field probes to uncover hotspots at the module level. The R&S®HZ-11, R&S®HZ-14 and R&S®HZ-15 probe sets for E and H field measurements do the job well (FIG 1).

In the next step, to get a good picture of the radiated disturbance of the entire DUT on an open-field test site or in a shielded chamber, all you need is an R&S®ESL together with a broadband antenna. Here too, autoranging and overload detection deliver reproducible and reliable results. With its frequency range up to 6 GHz, the R&S®ESL6 covers most commercial standards such as CISPR 22 for IT equipment, which was expanded to 6 GHz in 2005.

Universal spectrum analyzer for daily use in the lab

As a full-featured spectrum analyzer, the R&S®ESL is also ideal for general-purpose applications in the lab and in development and for service applications. In spectrum mode, it is handled and controlled in the same way and has the same operating functions as the analyzers of the R&S®FSL family. Like these instruments, the R&S®ESL offers numerous complex measurement functions for a variety of typical analyzer applications – including preconfigured and user-configurable measurements of channel and adjacent-channel power, of occupied bandwidth, as well as functions for measuring burst power, intermodulation (FIG 7) and noise figure.

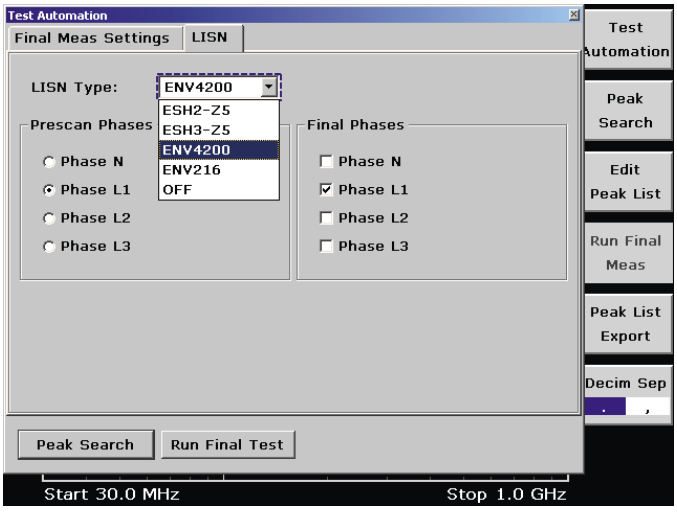


FIG 5 Window for selecting a connected LISN/V-network from Rohde&Schwarz and for remote-controlled phase switchover for the automatic overview and final measurement.

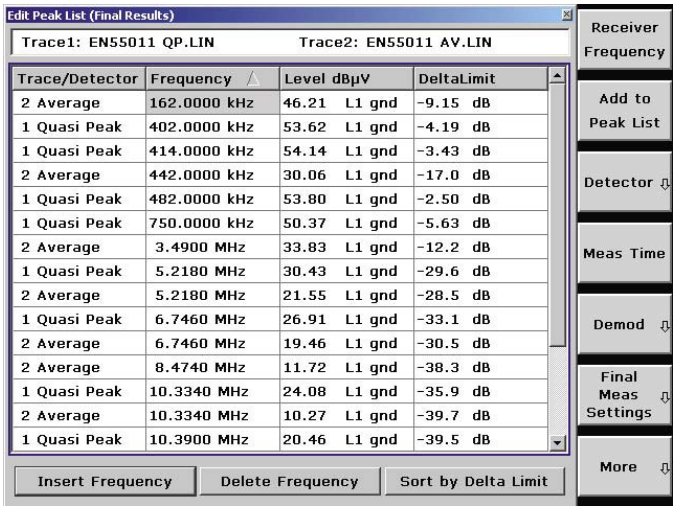


FIG 6 Final result of an automatic disturbance voltage measurement. The final measurement with quasi-peak and average weighting is performed on the critical frequencies determined by the fast overview measurement. The phase of the disturbance maximum and the margin (delta) relative to the limit are displayed directly.

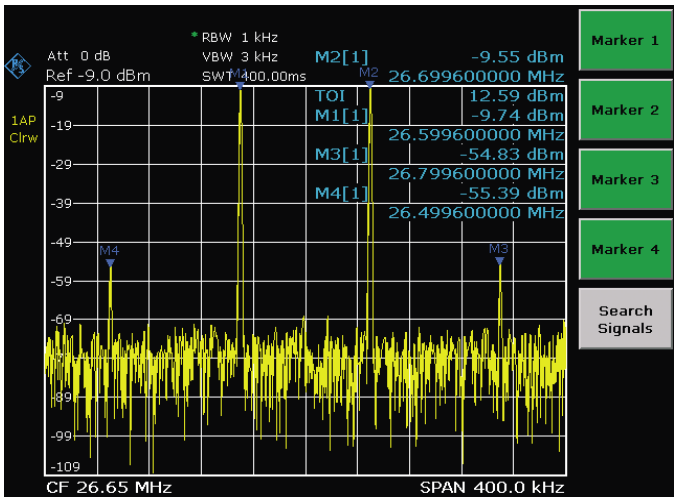


FIG 7 Intermodulation measurement with the R&S®ESL: The third-order intercept point (IP3) can be determined from the spectrum at the press of a button. The data carriers, from which the intermodulation sidebands are determined, are detected automatically. With max. 95 dB, the receiver offers a very good dynamic range. RF attenuation can be set in 5 dB steps, which facilitates optimal level setting.

Overview measurements of the disturbance spectrum with all available bandwidths can also be displayed in spectrum analyzer mode. Users can choose between the standard-compliant CISPR bandwidths (including 1 MHz impulse bandwidth) and 3 dB bandwidths (10 Hz to 10 MHz). When switched to logarithmic frequency scaling, traces that are directly comparable to the usual test receiver diagrams, including the associated limit lines, are generated in the sweep mode. In analyzer mode, the number of measurement points can be set over a wide range (125 to max. 32,001 points per trace).

The two R&S®ESL base models are also available with a built-in tracking generator that covers the full frequency range of the respective test receiver model. The R&S®ESL can thus be used to perform quick and easy measurements of frequency response and attenuation on filters or cables. The n-dB marker determines, for example, the 3 dB bandwidth of a bandpass filter at the press of a button. Using an external SWR bridge, the receiver measures return loss and impedance matching.

FIG 8 Diagnostic measurement with the R&S®ESL on unshielded telecommunications ports using the R&S®ENY81 eight-wire impedance stabilization network (ISN) and the R&S®ES-SCAN EMI precompliance software.

When equipped with the R&S®FSL-K9 option, the R&S®ESL supports highly accurate power measurements. Users can connect all the sensors of the R&S®NRP power meter directly to the receiver and do not need a separate power meter.

Diagnostic measurements made easy with the R&S®ES-SCAN EMI precompliance software

The R&S®ES-SCAN EMI precompliance software is an ideal addition to the R&S®ESL. It is favorably priced and user-friendly Windows® software specially designed for EMC measurements in development (FIG 8). Plus, it is easy to use and meets the main requirements for disturbance measurements in accordance with commercial standards:

- Measurement settings and storage
- Scan and sweep data acquisition and display
- Automatic data reduction
- Peak search with acceptance analysis
- Selectable number of critical peaks or subranges
- Final measurement with worst-case selection (e.g. for LISNs/V-networks with automatic phase switching)
- Report generation and measurement data storage

Summary

Powerful, compact and favorably priced, the R&S ESL is ideal for versatile and mobile use in development departments as well as for precertification measurements in EMC test labs and test houses. It supports users with a full-featured analyzer mode, automated test sequences and the latest weighting detectors in line with CISPR 16-1-1.

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Options for the R&S®ESL

- R&S®FSL-B4: OCXO reference frequency, aging 1×10^{-7}/year
- R&S®FSL-B5: Additional interfaces (video output, IF output, noise source control output, remote control interface for LISNs, interface for R&S®NRP-Zxx power sensors)
- R&S®FSL-B8: Gated sweep
- R&S®FSL-B10: GPIB interface
- R&S®FSL-B22: RF preamplifier (3/6 GHz)
- R&S®FSL-B30: DC power supply, 12 V to 28 V
- R&S®FSL-B31: NiMH battery pack

Software/firmware

- R&S®ES-SCAN EMI precompliance software
- Measurement demodulators for AM, FM, φM
- Power measurements with R&S®NRP-Zxx power sensors
- Application firmware for noise figure and gain measurements

Condensed data of the R&S®ESL3/R&S®ESL6

Frequency range	R&S®ESL3	9 kHz to 3 GHz
	R&S®ESL6	9 kHz to 6 GHz
Resolution bandwidths (–3 dB)		10 Hz to 10 MHz in 1/3/10 sequence, additionally 20 MHz (in zero span and receiver mode)
EMI bandwidths (–6 dB)		200 Hz, 9 kHz, 120 kHz, 1 MHz (impulse bandwidth)
Level measurement uncertainty		
10 MHz < f ≤ 3 GHz		<0.5 dB
3 GHz < f ≤ 6 GHz		<0.8 dB
1 dB compression point		nominally +5 dBm
Immunity to pulses		150 V / 10 mWs (10 µs)
Displayed average noise level (DANL)		
With preamplifier 50 MHz to 3 GHz		<–152 dBm (1 Hz)
	500 MHz	typ. –162 dBm (1 Hz)