

# R&S®ESL

## EMI Test Receiver

### Compact, cost-effective measuring receiver



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# R&S®ESL

## EMI Test Receiver

### At a glance

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

The R&S®ESL is a compact, cost-effective measuring receiver. It includes all of the functions, bandwidths and weighting detectors that are needed to make EMC measurements in accordance with commercial standards. The receiver provides useful support to manufacturers of components, modules and devices who need to detect disturbances at the early stages of product development. They can thus take any required actions and avoid the

expense of having to redevelop completed products. This also saves time and money during the certification process.

The combination of very good RF characteristics and all of the important functions needed for fast, precise measurement and evaluation of the EMC of a device under test in accordance with commercial standards is unmatched in this class of instrument. The diverse analysis capabilities, high measurement speed and time-saving automated test routines make the R&S®ESL the obvious choice for any development lab that needs to prepare for EMC certification tests.

#### Main features

- Frequency range from 9 kHz to 3 GHz or 9 kHz to 6 GHz covering almost all commercial EMC standards
- First-ever combination of an EMI test receiver and spectrum analyzer in the entry-level class
- All major functions of an advanced EMI test receiver, including fully automated test sequences
- Weighting detectors: max./min. peak, average, RMS, quasi-peak as well as average with meter time constant and rms-average in accordance with the latest version of CISPR 16-1-1
- Compact, lightweight instrument, can be battery-powered for mobile applications



# R&S®ESL

## EMI Test Receiver

### Benefits and key features

#### **Precise, reproducible measurement results due to very good RF characteristics**

- ▮ 0.5 dB amplitude accuracy
- ▮ 1 dB compression +5 dBm
- ▮ RF input pulse-resistant up to 10 mWs
- ▮ Displayed average noise level with preamplifier <-152 dBm (1 Hz)
- ▮ Resolution bandwidths 10 Hz to 10 MHz (-3 dB), 200 Hz, 9 kHz, 120 kHz (-6 dB), 1 MHz (impulse)

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#### **Unrivalled price/performance ratio in this class**

- ▮ Two test instruments in one: EMI test receiver and spectrum analyzer
- ▮ Low investment costs
- ▮ Best RF characteristics available in this class of instrument
- ▮ Extensive measurement functions and evaluation features
- ▮ Cost-saving plug&play options

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#### **Intuitive operation – as with all the EMI test receivers from Rohde & Schwarz**

- ▮ Clear SCAN settings in tabular format
- ▮ Capability to perform simultaneous measurement with multiple detectors
- ▮ Predefined antenna factors and limit lines in accordance with commercial standards
- ▮ Selective monitoring of critical disturbances using TUNE to MARKER and MARKER TRACK functions
- ▮ Simultaneous measurement with up to four detectors
- ▮ Large bargraph display with MAX HOLD function for clear presentation of measured values

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#### **Easy expansion, many interfaces**

- ▮ Plug & play addition of options without opening the instrument
- ▮ Additional interfaces for expanding the range of applications of the R&S®ESL (e.g. remote control of line impedance stabilization networks, IF output, video output)

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#### **Lightweight and compact for installation, maintenance and on-site applications**

- ▮ Easy to transport due to small size and low weight
- ▮ AC-independent operation with internal rechargeable battery (option)
- ▮ Power measurements using the R&S®NRP-Zxx power sensors

# Precise, reproducible measurement results due to very good RF characteristics

## Key features

With its very good RF characteristics, the R&S®ESL has set new standards for the lower price class. Examples include an amplitude measurement accuracy of 0.5 dB up to 3 GHz, a displayed average noise level of typically -162 dBm (f = 500 MHz) and a rugged RF input (10 mW). These features ensure reproducible measurements in accordance with commercial EMC standards such as CISPR, EN, ETS, FCC, ANSI, etc. and are normally available only with equipment in higher price classes.

## Spectrum analyzer mode

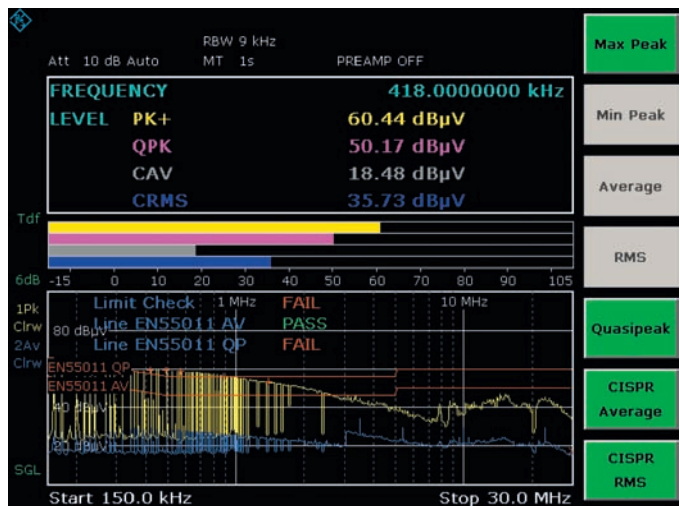
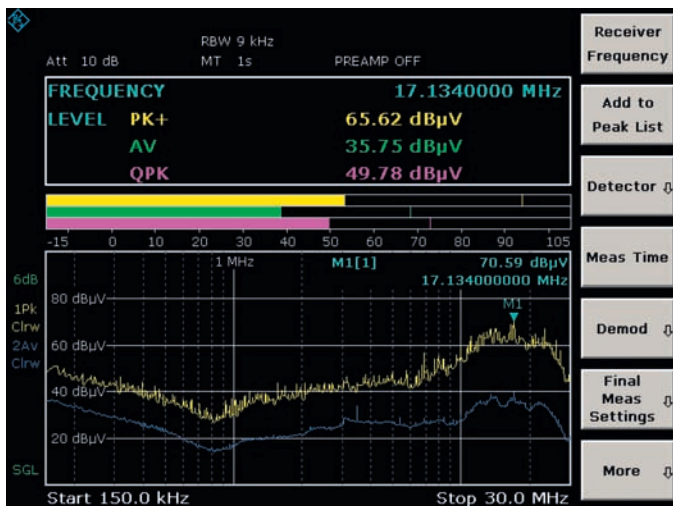
As a high-quality spectrum analyzer, the R&S®ESL can be operated in spectrum mode to produce overview measurements that display the disturbance spectrum with all of the bandwidths stipulated in the standards. The user can choose between CISPR bandwidths and 3 dB bandwidths (10 Hz to 10 MHz). Based on logarithmic scaling, the sweep representation generates traces that are directly comparable to the usual measuring receiver diagrams, including the associated limit lines.

## Receiver mode

In receiver mode, the R&S®ESL measures the emission spectrum with no gaps using user-definable frequency subrange settings. The R&S®ESL performs the measurement at each frequency point in a settled state, thus ensuring reproducible measurements. One trace contains up to 1 million measurement points, and a maximum of six traces can be activated in parallel. All measurement data is available for further analysis, e.g. using the measurement marker while zooming the frequency axis or through data reduction and subsequent final measurement at critical frequencies.

## Detectors

For signal weighting, all of the available detectors comply with the latest standards in accordance with CISPR 16-1-1. The R&S®ESL covers all of the EMC standards with the following detectors: max./min., peak, quasi-peak, RMS, average, average with meter time constant (CISPR average) and rms-average (CISPR RMS).



Menu for selecting the main receiver settings (receiver mode). In the upper window, the SPLIT SCREEN display shows continuously updated level values for the selected detectors (max. 4) and the selected measurement frequency. In the lower window, the emission spectrum measured using the SCAN table settings is displayed. Up to six traces can be simultaneously activated

Menu for selection of weighting detectors. Values produced by a maximum of four different detectors are simultaneously displayed numerically and as an analog bargraph



# Intuitive operation

## User-friendly operation based on a tried-and-tested design

Operation of the R&S®ESL is very convenient. It is based on the concept used for the other successful EMI test receivers from Rohde&Schwarz.

## Clear SCAN settings in tabular format

In RECEIVER mode, the SCAN table provides the basis for a disturbance measurement in the frequency range. Parameters are displayed using a clear tabular format and are individually adapted to the measurement task and the device under test. The SCAN table can be saved and printed, allowing the user to easily keep track of how the measurement results were generated.

The screenshot shows the 'STEPPED SCAN TABLE' window. It contains a table with the following data:

	RANGE 1	RANGE 2	RANGE 3	RANGE 4
Start	150.0000 kHz	30.0000 MHz		
Stop	30.0000 MHz	1.0000 GHz		
Step Size	4.000 kHz	40.000 kHz		
Res BW	9 kHz	120 kHz		
Meas Time	1.00 ms	100 µs		
Auto Ranging	OFF	OFF		
RF Attn	10 dB	10 dB		
Preamp	OFF	OFF		
Auto Preamp	OFF	OFF		

Below the table is a graph showing a stepped scan pattern. The y-axis is labeled '30 dBµV', '20 dBµV', and '10 dBµV'. The x-axis is labeled 'Start 150.0 kHz' and 'Stop 1.0 GHz'. To the right of the table and graph are control buttons: 'Scan Control', 'Edit Scan Table', 'Adjust Axis', 'Insert Range', 'Delete Range', '10 dB Min On Off', and 'Freq Axis LIN LOG'.

In RECEIVER mode, the R&S®ESL is tuned in fixed frequency steps in accordance with the settings in the SCAN table. The SCAN table can be programmed for a maximum of ten frequency subranges with independently selectable parameters (e.g. start/stop frequency, step width, measurement time, resolution bandwidth, input attenuation). Each time a scan is launched by inputting a START and STOP frequency, the parameters that are preset in the SCAN table are automatically loaded. This ensures reproducible, standard-compliant measurements at all times

## Simultaneous measurement of multiple traces possible

Up to six traces can be weighted using different detectors and displayed in the diagram. The benefits are as follows:

- ▮ Saving time through simultaneous measurement with different detectors
- ▮ Traces are clearly labeled in the diagram
- ▮ Assignment to limit lines provides a fast overview
- ▮ All measurement data (up to 1 million measurement points per trace) is saved in memory and can be read out in ASCII format

## Fast, dependable measurements with automated test sequences

Using the tried-and-tested combination of fast preview measurement with peak (and average) detector and automatic final measurement only at the frequencies determined to be critical, disturbance measurements become much faster and simpler. Any exceeding of the limit lines is immediately displayed. This saves valuable test time and is a great help for any user who does not make such measurements on a regular basis.

The screenshot shows the 'Edit Peak List (Prescan Results)' window. It contains a table with the following data:

Trace/Detector	Frequency	Level dBµV/m	DeltaLimit
1 Pos. Peak	126.8000 MHz	43.94	13.9 dB
1 Pos. Peak	127.8800 MHz	44.41	14.4 dB
1 Pos. Peak	131.6800 MHz	50.63	20.6 dB
1 Pos. Peak	132.0000 MHz	45.57	15.6 dB
1 Pos. Peak	132.8000 MHz	48.68	18.7 dB
1 Pos. Peak	133.2800 MHz	50.15	20.2 dB
1 Pos. Peak	133.6000 MHz	47.09	17.1 dB
1 Pos. Peak	134.0800 MHz	45.51	15.5 dB
1 Pos. Peak	134.1600 MHz	45.24	15.2 dB
1 Pos. Peak	135.4800 MHz	44.09	14.1 dB
1 Pos. Peak	138.0000 MHz	44.10	14.1 dB
1 Pos. Peak	138.1200 MHz	46.51	16.5 dB
1 Pos. Peak	138.4000 MHz	46.16	16.2 dB
1 Pos. Peak	138.4800 MHz	45.15	15.2 dB
1 Pos. Peak	140.0000 MHz	49.29	19.3 dB

Below the table are buttons: 'Insert Frequency', 'Delete Frequency', and 'Sort by Delta Limit'. To the right is a sidebar with 'Test Automation' options: 'Peak Search', 'Edit Peak List', 'Run Final Meas', 'Peak List Export', and 'Decim Sep'.

An automated test sequence has three phases: Preview measurement, data reduction and final measurement. The maximum disturbance that occurs is automatically measured along with its distance from the set limit. This speeds up the measurement and simplifies evaluation of data. The final measurement frequencies determined in this manner are saved by the R&S®ESL in a separate table that can be edited (PEAK LIST) for subsequent disturbance weighting and for documentation purposes

## Measurements using line impedance stabilization networks (LISN)

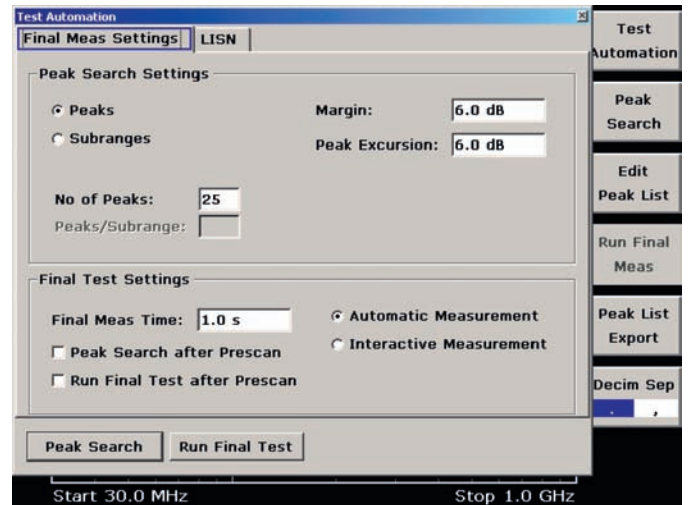
Disturbance voltage measurements on power lines are made using line impedance stabilization networks. For such measurements, Rohde & Schwarz offers the R&S®ENV216 two-line V-network and the R&S®ESH2-Z5 and R&S®ENV4200 four-line V-networks. The R&S®ESL automatically switches the different phases of the LISN (requirements: R&S®FSL-B5 option, additional interfaces and a control cable). This ensures that the highest-amplitude disturbance is actually determined.

## Predefined antenna factors

For disturbance measurements with test antennas, the R&S®ESL includes a selection of typical antenna factors (transducers). Users can also input and save their own correction tables for antennas, cable losses, preamplifiers, etc. Any correction factors that are activated are automatically taken into account by the R&S®ESL in its measurement results with the appropriate unit.



Menu for setting the traces. A maximum of six traces for different weighting detectors can be displayed. The measurement results for the critical frequencies (Final Meas Detector) are indicated using icons



All the parameters needed for the final measurement on the critical frequencies (Final Meas Settings) can be configured quickly and easily in a single window. The final measurement frequencies are determined either for the absolute peaks or as subrange maxima. The relative magnitude of the disturbance (peak excursion), its distance to the limit (margin) and their maximum number can all be set (1 to 500). The actual final measurement is performed fully automatically or interactively

## Library for limit lines

Similar to the antenna factors, the R&S®ESL also includes a selection of important limit lines for commercial standards. You can input and save any relevant changes to the limits or add new limit lines in tabular format.

## Powerful marker functions

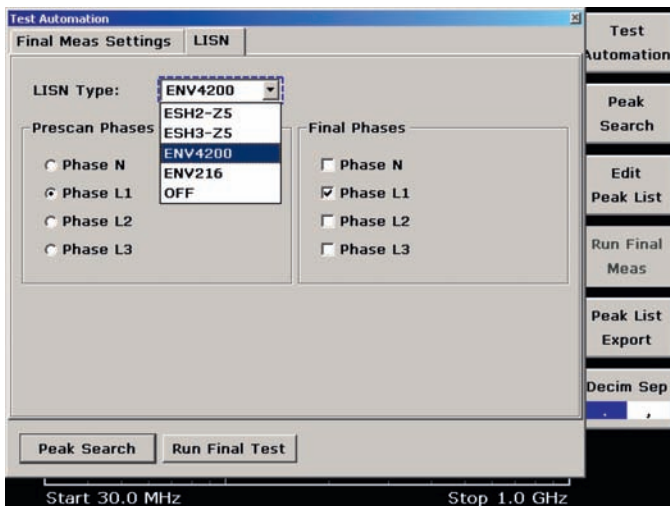
Critical frequencies can be manually selected using a measurement marker. The TUNE to MARKER and MARKER TRACK functions are used to tune the receiver to the marker frequency. Up to four different weighting detectors can be selected with an adjustable measurement time to provide the level at the receive frequency as a numeric value and as an analog bargraph. This allows fast and clear selective monitoring of critical signals with the R&S®ESL.

The MAX HOLD display helps users when searching for the highest-amplitude disturbance, e.g. when dealing with fluctuating or drifting signals.

Critical frequencies discovered during the preview measurement can be transferred directly to the final measurement list using the ADD to PEAK LIST function of the R&S®ESL.

## Easy documentation generation with the R&S®ESL

Measurement results, graphics, scan tables and transducer/limit tables can be conveniently documented using a printer connected to the USB interface. This allows the complete, reproducible evaluation of tests in hardcopy format.



Standard-compliant measurement of conducted disturbance with line impedance stabilization networks (LISN) requires measurement at all phases (worst-case principle). The R&S®ESL supports this measurement with a fully automated test sequence (preview/final measurement) including remote-controlled phase switching for the LISNs available from Rohde&Schwarz

All traces can be precisely evaluated using the marker and zoom functions. The MARKER TRACK and TUNE TO MARKER functions link the frequency tuning and numeric level measurement to the marker position on the trace. This helps to significantly simplify and speed up final measurements on the critical frequencies that were determined



# Easy expansion, many interfaces

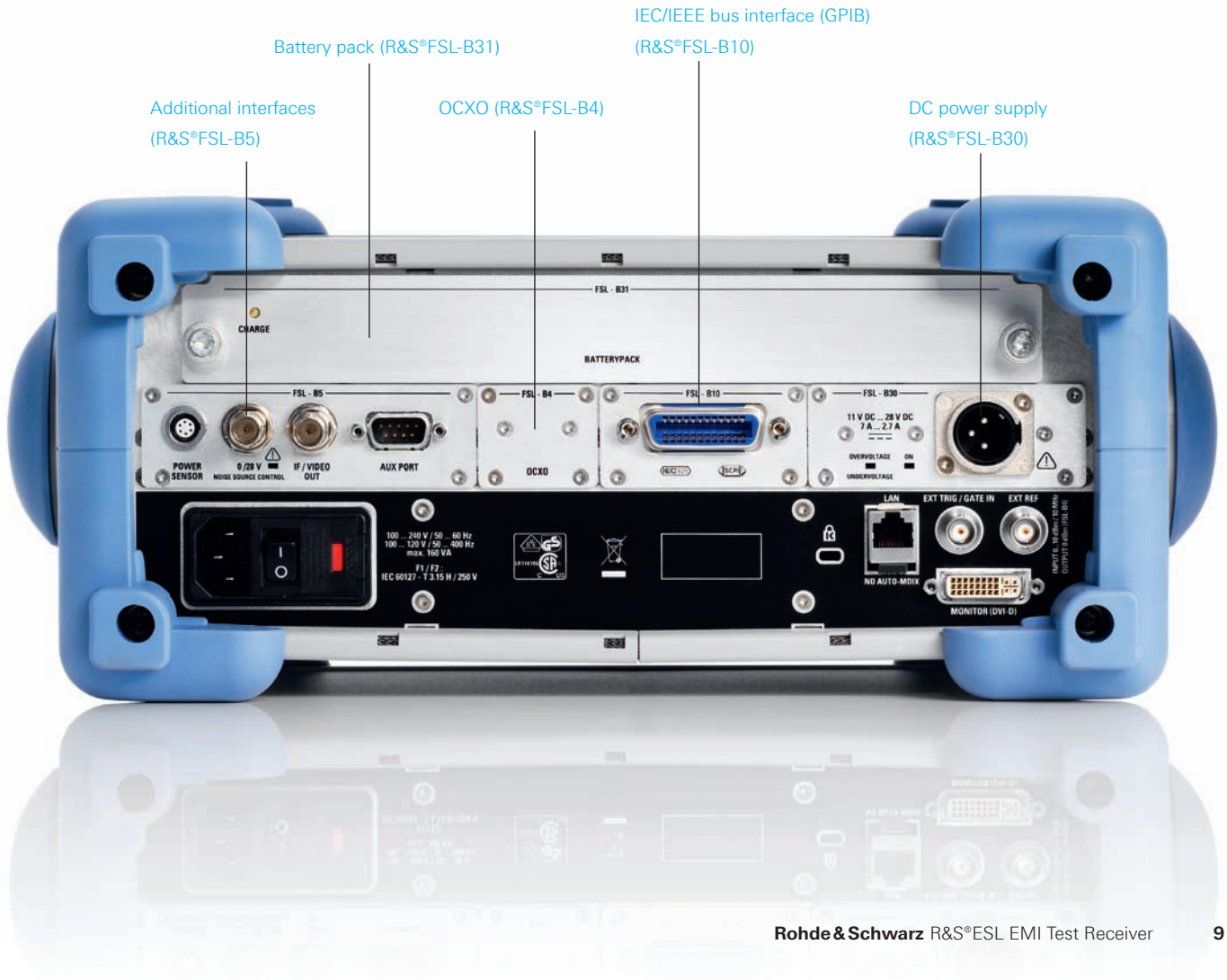
The system of plug & play retrofitting of options is a major benefit of the R&S®ESL. All options can be added without having to open the instrument.

The benefits are as follows:

- No additional alignment required after installation
- No recalibration
- No need to ship off the instrument (i.e. no downtime)
- No installation costs
- Easy enhancement of the instrument to handle additional measurements

A number of additional interfaces are available with the R&S®FSL-B5 option to extend the range of applications of the R&S®ESL:

- Remote control (phase switching) of the LISNs from Rohde&Schwarz
- IF output/video output for connecting additional analysis equipment
- 28 V, switchable for connection of noise sources
- Trigger interface for fast measurement of frequency lists
- Interface for an R&S®NRP-Zxx power sensor (eliminating the need for the USB adapter for the R&S®NRP-Zxx power sensors)



# R&S®ES-SCAN EMI Measurement Software Diagnostic measurements made easy

The R&S®ES-SCAN EMI measurement software is an ideal addition to the R&S®ESL. R&S®ES-SCAN is a cost-effective and user-friendly Windows software that was specially developed for EMC measurements in development.

This easy-to-use software meets the main requirements for disturbance measurements in accordance with commercial standards:

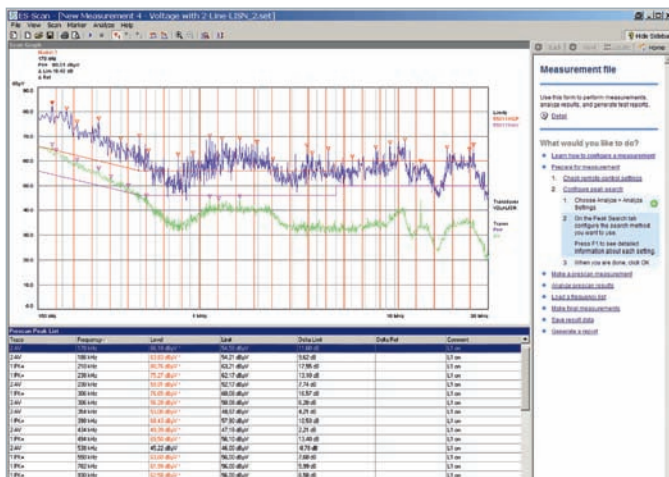
- ▮ Measurement settings and storage
- ▮ Scan data acquisition and display
- ▮ Automatic data reduction
- ▮ Peak search with acceptance analysis
- ▮ Selectable number of critical PEAKS or subranges
- ▮ Final measurement with worst-case selection (e.g. for line impedance stabilization networks with automatic phase switching )
- ▮ Report generation and measurement data storage

A wizard ("Help Side Bar") is available to the user during all phases of operation of the R&S®ES-SCAN EMI measurement software. Online help texts explain all software functions, eliminating the need for a user manual.

The following tools and capabilities provide additional user support:

- ▮ Library of standard limit lines for commercial standards
- ▮ Definition of any number of receiver settings that are saved on the controller
- ▮ Definition and storage of a peak list for final measurements

(For more information about R&S®ES-SCAN, see the product brochure PD 5213.8844.12, or visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com) and enter the search term "ES-SCAN".)



Preview measurement (Pk and Avg) with determination of the local maxima (here, 25 subranges) for subsequent final measurement (QP and Avg)

# Ordering information

Designation	Type	Order No.
EMI Test Receiver, 9 kHz to 3 GHz	R&S®ESL3	1300.5001.03
EMI Test Receiver, 9 kHz to 3 GHz, with tracking generator	R&S®ESL3	1300.5001.13
EMI Test Receiver, 9 kHz to 6 GHz	R&S®ESL6	1300.5001.06
EMI Test Receiver, 9 kHz to 6 GHz, with tracking generator	R&S®ESL6	1300.5001.16

## Optionen

Designation	Type	Order No.	Comment
<b>Hardware</b>			
OCXO Reference Frequency, aging 1 x 10 <sup>-7</sup> /year	R&S®FSL-B4	1300.6008.02	
Additional Interfaces	R&S®FSL-B5	1300.6108.02	video output, IF output, noise source control output, remote-control interface for V-networks, interface for R&S®NRP-Zxx power sensors
GPIB Interface	R&S®FSL-B10	1300.6208.02	
RF Preamp (3/6 GHz)	R&S®FSL-B22	1300.5953.02	
DC Power Supply, 12 V to 28 V	R&S®FSL-B30	1300.6308.02	
NiMH Battery Pack	R&S®FSL-B31	1300.6408.02	requires R&S®FSL-B30
<b>Software/firmware</b>			
EMI Precompliance Software	R&S®ES-SCAN	1308.9270.02	
AM/FM/ϕM Measurement Demodulator	R&S®FSL-K7	1300.9246.02	
Power Sensor Support	R&S®FSL-K9	1301.9530.02	requires R&S®FSL-B5 or R&S®NRP-Z3/4 and R&S®NRP-Zxx power sensor
Application Firmware for Noise Figure and Gain Measurements	R&S®FSL-K30	1301.9817.02	requires R&S®FSL-B5 and preamplifier

## Recommended extras

Designation	Type	Order No.
19" Rackmount Adapter	R&S®ZZA-S334	1109.4487.00
Soft Carrying Bag	R&S®FSL-Z3	1300.5401.00
Protective Hard Cover	R&S®EVS-Z6	5201.7760.00
Additional Charger Unit	R&S®FSL-Z4	1300.5430.02
Matching Pad 50/75 Ω, N connectors	R&S®RAM	0358.5414.02
Matching Pad 75 Ω, series resistor 25 Ω, N connectors	R&S®RAZ	0358.5714.02
Matching Pad 75 Ω, N-to-BNC connector	R&S®FSH-Z38	1300.7740.02
SWR Bridge, 5 MHz to 3 GHz	R&S®ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	R&S®ZRC	1039.9492.52
SWR Bridge, 10 MHz to 3 GHz (incl. open, short, load calibration standards)	R&S®FSH-Z2	1145.5767.02

## Power sensors for the R&S®FSL-K9 option

Designation	Type	Order No.
Average Power Sensor, 10 MHz to 8 GHz, 200 mW	R&S®NRP-Z11	1138.3004.02
Average Power Sensor, 10 MHz to 18 GHz, 200 mW	R&S®NRP-Z21	1137.6000.02
Average Power Sensor, 10 MHz to 18 GHz, 2 W	R&S®NRP-Z22	1137.7506.02
Average Power Sensor, 10 MHz to 18 GHz, 15 W	R&S®NRP-Z23	1137.8002.02
Average Power Sensor, 10 MHz to 18 GHz, 30 W	R&S®NRP-Z24	1137.8502.02
Average Power Sensor, 9 kHz to 6 GHz, 200 mW	R&S®NRP-Z91	1168.8004.02
Thermal Power Sensor, 0 Hz to 18 GHz, 100 mW	R&S®NRP-Z51	1138.0005.02
Thermal Power Sensor, 0 Hz to 40 GHz, 100 mW	R&S®NRP-Z55	1138.2008.02

Your local Rohde&Schwarz sales partner will be glad to help you find the optimum configuration for your requirements.

To find your nearest Rohde&Schwarz representative, visit [www.sales.rohde-schwarz.com](http://www.sales.rohde-schwarz.com)



Interior of the R&S®ESL

# Specifications in brief

	R&S®ESL3	R&S®ESL3	R&S®ESL6	R&S®ESL6
<b>Frequency range</b>	9 kHz to 3 GHz	9 kHz to 3 GHz	9 kHz to 6 GHz	9 kHz to 6 GHz
Frequency accuracy (standard)			1 × 10 <sup>-6</sup>	
With R&S®FSL-B4 (OCXO)			1 × 10 <sup>-7</sup>	
<b>Measurement time</b>				
Receiver mode/scan (per frequency step)			selectable from 100 μs to 100 s	
Analyzer mode/sweep time			selectable from 2.5 ms to 16000 s, zero span 1 μs to 16000 s	
<b>Resolution bandwidth (-3 dB)</b>			10 Hz to 10 MHz in 1/3 sequence	
<b>Resolution bandwidth (-6 dB)</b>			200 Hz, 9 kHz, 120 kHz, 1 MHz (impulse)	
Video bandwidth			1 Hz to 10 MHz in 1/3 sequence	
<b>Level</b>				
Max. RF level (input attenuation ≥10 dB)			+30 dBm (= 1 W)	
Max. pulse energy			10 mWs	
Max. pulse voltage			150 V	
Third-order intercept			typ. +18 dBm	
1 dB compression			+ 5 dBm	
<b>Displayed average noise level</b> (with RBW = 1 Hz FFT filter RBW and R&S®FSL-B22 preamplifier option)				
9 kHz < f < 3 MHz			typ. -115 dBm	
f = 500 MHz			typ. -162 dBm	
f = 3 GHz			typ. -158 dBm	
<b>Detectors</b>				
			pos./neg. peak, auto peak, quasi-peak, RMS, average, sample, average with meter time constant (CISPR average), rms-average (CISPR RMS)	
Level measurement uncertainty			f < 3 GHz (<0.5 dB) f < 6 GHz (<0.8 dB)	
<b>Tracking generator</b>	no	yes	no	yes
Frequency range	-	1 MHz to 3 GHz	-	1 MHz to 6 GHz
Output level	-	-20 dBm to 0 dBm	-	-20 dBm to 0 dBm



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