R&S®ESL
EMI Test Receiver
Compact, cost-effective measuring receiver

70 Years of Driving Innovation

ROHDE&SCHWARZ

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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Unrivaled 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 mWs). 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

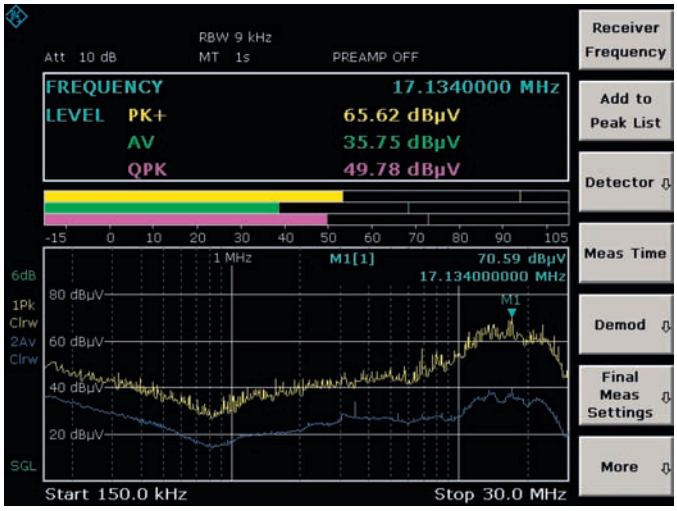
As a high-quality spectrum analyzer, the R&S®ESL can be operated in spectrum mode to produce overview measurements that display the disturbance spectrum with all of the bandwidths stipulated in the standards. The user can choose between CISPR bandwidths and 3 dB bandwidths (10 Hz to 10 MHz). Based on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

Receiver mode

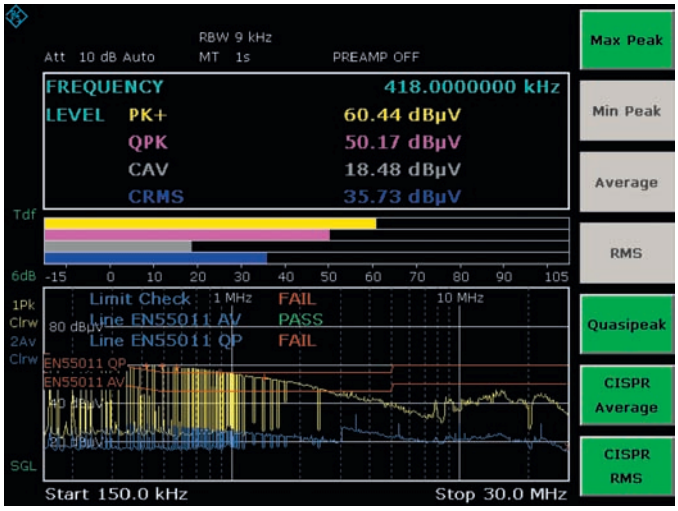
In receiver mode, the R&S®ESL measures the emission spectrum with no gaps using user-definable frequency subrange settings. The R&S®ESL performs the measurement at each frequency point in a settled state, thus ensuring reproducible measurements. One trace contains up to 1 million measurement points, 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

Unrivaled price/performance ratio in this class

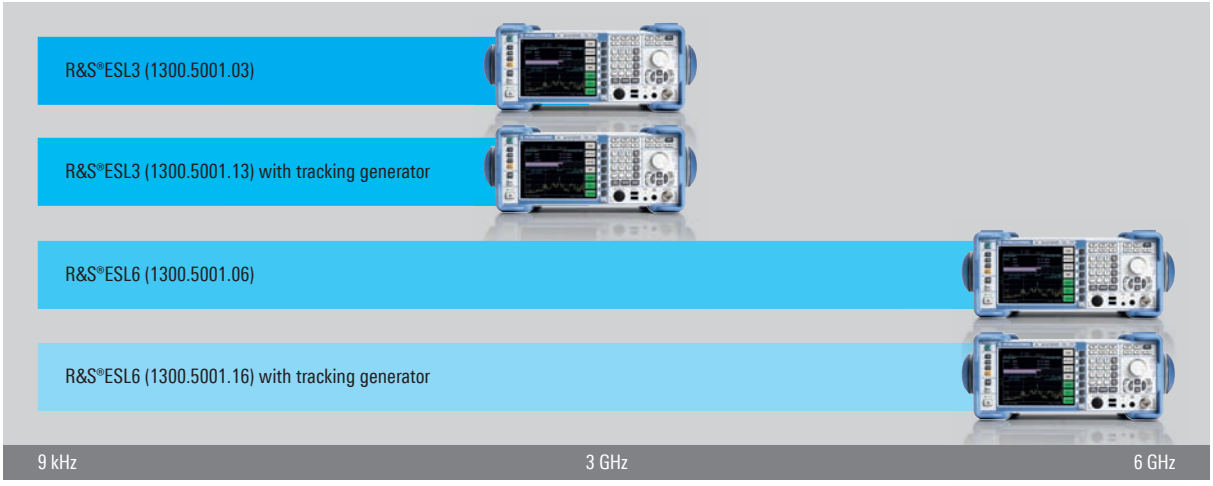
The R&S®ESL is equipped to handle a wide variety of measurement tasks. No matter whether you are working in the lab, on-site in the field, with battery power, or in a production environment, the instrument always delivers precise measurement results that you can rely on.

Two test instruments in one

The combination of an EMI test receiver for diagnostic measurements in development and a universal spectrum analyzer is unique in this price class. The R&S®ESL offers an extraordinary variety of applications. It provides reproducible EMC measurements with preview and final measurements including evaluation of critical signal levels using limit line comparisons, standard laboratory spectrum analysis applications such as channel and adjacent channel power measurements, measurement of occupied bandwidth, intermodulation measurements and noise figure measurements.

A wide range of marker functions and direct measurement functions is available for performing measurements and evaluating results. The R&S®ESL can handle both manual and automatic measurements. For remote control by means of external software applications, the R&S®ESL features a LAN and an IEC/IEEE bus interface (R&S®FSL-B10 option).

The R&S®ESL family



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.

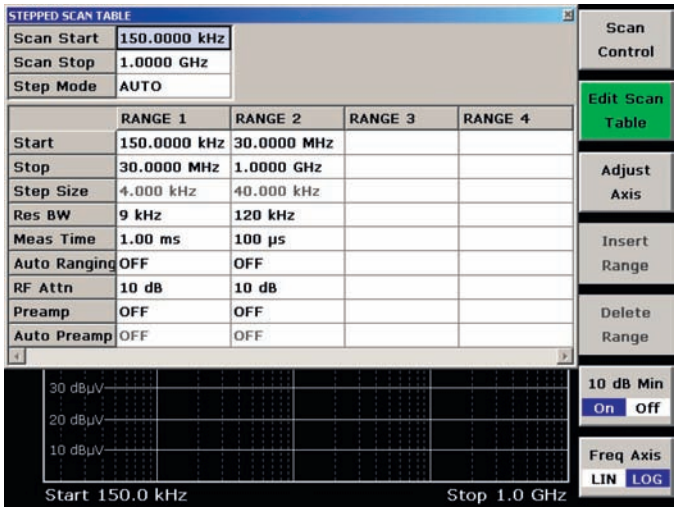
Simultaneous measurement of multiple traces possible

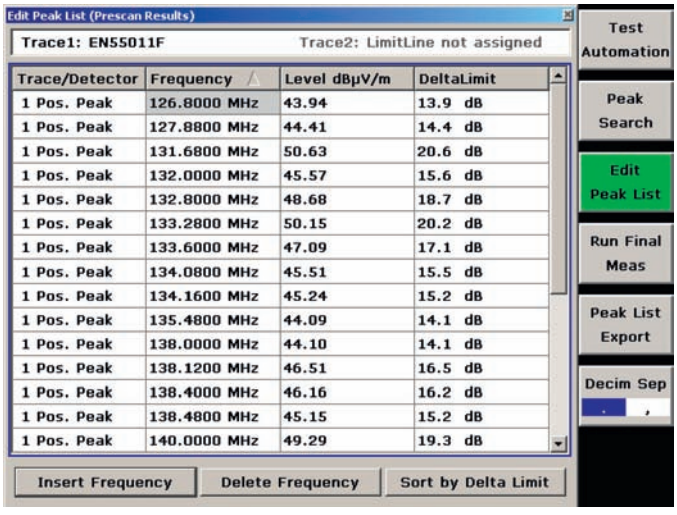
Up to six traces can be weighted using different detectors and displayed in the diagram. The benefits are as follows:

- 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.





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

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

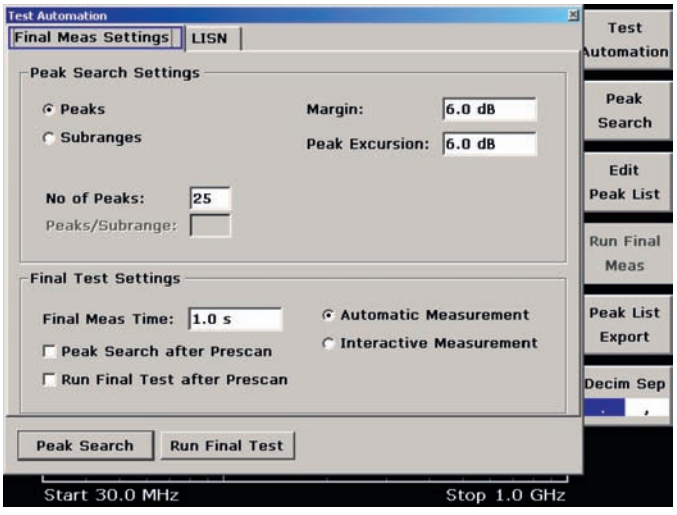
Measurements using line impedance stabilization networks (LISN)

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

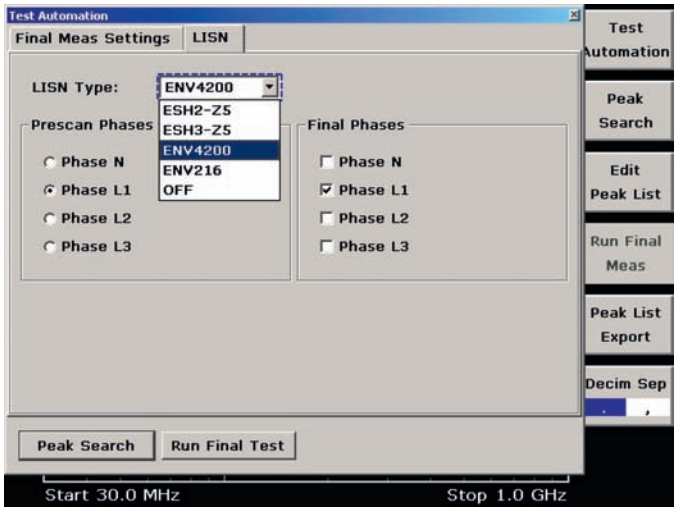
Critical frequencies can be manually selected using a measurement marker. The TUNE to MARKER and MARKER TRACK functions are used to tune the receiver to the marker frequency. Up to four different weighting detectors can be selected with an adjustable measurement time to provide the level at the receive 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

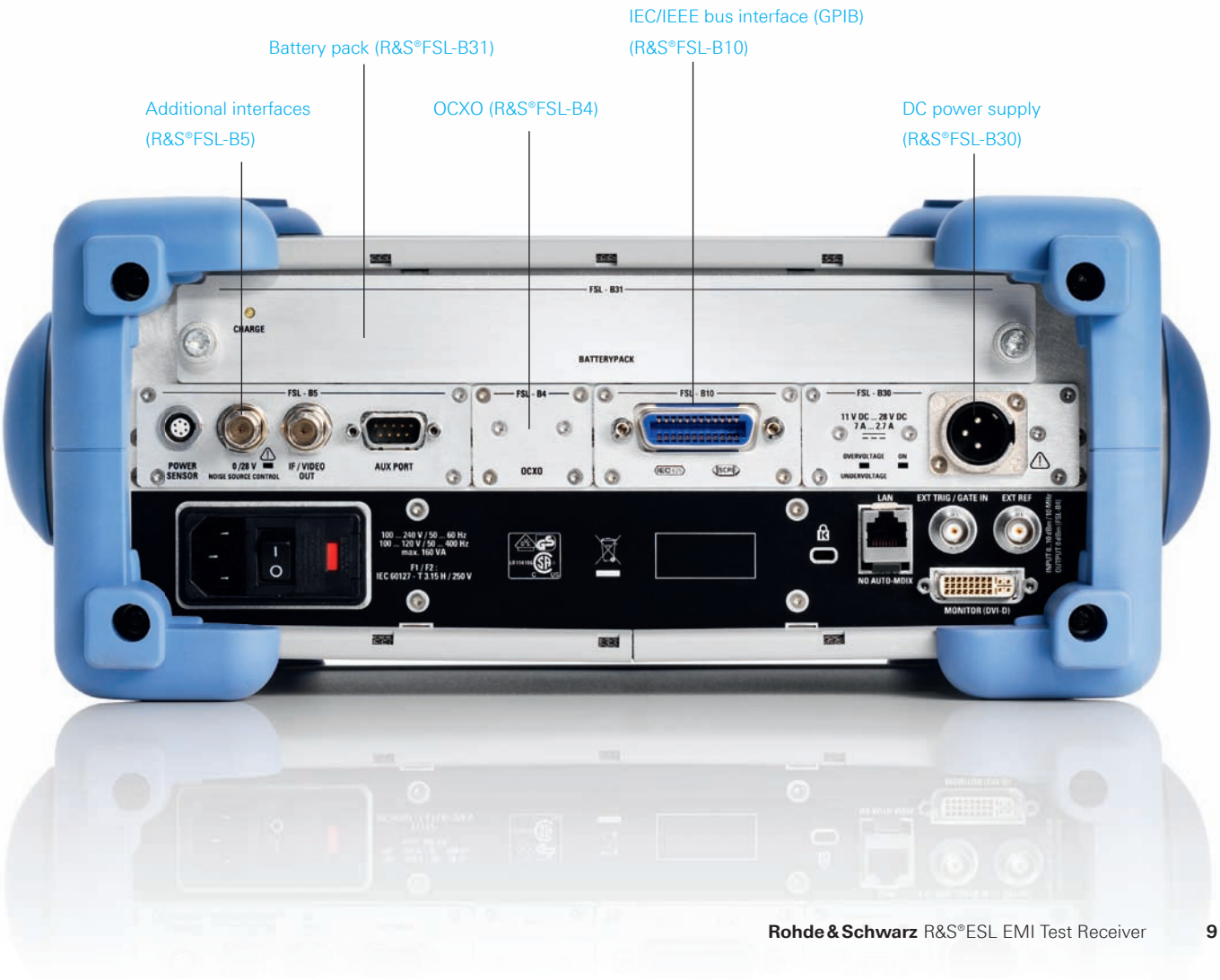
The system of plug & play retrofitting of options is a major benefit of the R&S®ESL. All options can be added without having to open the instrument.

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:

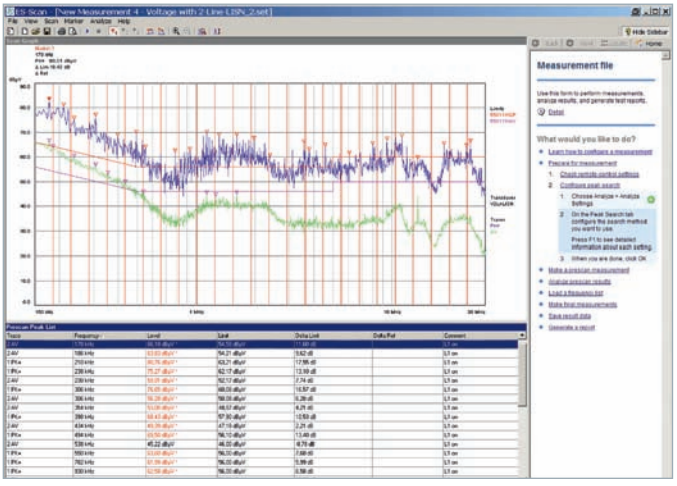
- Measurement settings and storage
- Scan data acquisition and display
- Automatic data reduction
- Peak search with acceptance analysis
- Selectable number of critical PEAKS or subranges
- Final measurement with worst-case selection (e.g. for line impedance stabilization networks with automatic phase 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 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
Hardware			
OCXO Reference Frequency, aging 1 × 10–7/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 Preamplifier (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
Software/firmware			
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

Interior of the R&S®ESL

Specifications in brief

	R&S®ESL3	R&S®ESL3	R&S®ESL6	R&S®ESL6
Frequency range	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^{-6}			
With R&S®FSL-B4 (OCXO)	1×10^{-7}			
Measurement time				
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			
Resolution bandwidth (–3 dB)	10 Hz to 10 MHz in 1/3 sequence			
Resolution bandwidth (–6 dB)	200 Hz, 9 kHz, 120 kHz, 1 MHz (impulse)			
Video bandwidth	1 Hz to 10 MHz in 1/3 sequence			
Level				
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			
Displayed average noise level (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			
Detectors	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)			
Tracking generator	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

Service you can rely on

- In 70 countries
- Person-to-person
- Customized and flexible
- Quality with a warranty
- No hidden terms

About Rohde&Schwarz

Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

For data sheet, see
PD 5214.0430.22
and www.rohde-schwarz.com

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PD 5214.0430.12 | Version 01.00 | July 2008 | R&S®ESL
Data without tolerance limits is not binding | Subject to change

*0.14 €/min within German wireline network; rates may vary in other networks (wireline and mobile) and countries.

R&S®ESL
EMI Test Receiver
Specifications

70 Years of Driving Innovation

ROHDE&SCHWARZ

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Specifications apply under the following conditions:
15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to.
Data without tolerances: typical values only. Data designated 'nominal' applies to design parameters and is not tested.

Rohde & Schwarz equipment is designed for reliable operation up to an altitude of 3000 m above sea level, and for transport up to an altitude of 4600 m above sea level.

Frequency

Frequency range	R&S®ESL3	9 kHz to 3 GHz
	R&S®ESL6	9 kHz to 6 GHz
Frequency resolution		1 Hz

Reference frequency, internal		
Accuracy		(time since last adjustment × aging rate) + temperature drift + calibration accuracy
Aging per year	standard	1×10^{-6}
	with R&S®FSL-B4 OCXO reference frequency option	1×10^{-7}
Temperature drift (+5 °C to +45 °C)	standard	1×10^{-6}
	with R&S®FSL-B4 OCXO reference frequency option	1×10^{-7}
Max. initial calibration accuracy	standard	5×10^{-7}
	with R&S®FSL-B4 OCXO reference frequency option	5×10^{-8}

Frequency readout		
Marker resolution		1 Hz
Uncertainty		±(marker frequency × reference uncertainty + 10 % × resolution bandwidth + ½ (span / (sweep points – 1)) + 1 Hz)
Marker tuning frequency step size	default marker step size = sweep points	span / 500 span / (sweep points – 1)
Frequency counter resolution		1 Hz
Count uncertainty	S/N > 25 dB	±(frequency × reference uncertainty + ½ (last digit))
Frequency span		0 Hz, 10 Hz to 3/6 GHz
Span uncertainty		3 %

Spectral purity SSB phase noise		f = 500 MHz
Carrier offset	1 kHz	typ. –95 dBc (1 Hz)
	10 kHz	<–98 dBc (1 Hz), typ. –103 dBc (1 Hz)
	100 kHz	<–98 dBc (1 Hz), typ. –105 dBc (1 Hz)
	1 MHz	<–115 dBc (1 Hz), typ. –120 dBc (1 Hz)

Receiver scan

Scan		scan with max. 10 subranges with different settings
Measurement time per frequency		100 µs to 100 s
Number of measurement points		100000 per trace

Sweep time

Range	span = 0 Hz	1 µs to 5 µs in 125 ns steps 5 µs to 16000 s in 5 % steps
	10 Hz ≤ span ≤ 3.2 kHz	2.5 ms to 5 s/Hz × span
	3.2 kHz < span ≤ 1.5 GHz	2.5 ms to 16000 s
	1.5 GHz < span ≤ 3 GHz	5 ms to 16000 s
	span > 3 GHz	10 ms to 16000 s
Uncertainty	span = 0 Hz	nominal 0.1 %
	span ≥ 10 Hz	nominal 3 %

IF and resolution bandwidths

IF filter and sweep filters		
3 dB bandwidths		10 Hz to 10 MHz in 1/3 sequence
	receiver mode and zero span	20 MHz additionally
Bandwidth uncertainty		nominal <3 %
Shape factor 60 dB:3 dB		nominal <5 (Gaussian type filters)

EMI filters		
6 dB bandwidths		200 Hz, 9 kHz, 120 kHz, 1MHz
Bandwidth uncertainty		nominal <3 %
Shape factor 60 dB:3 dB		nominal <6

FFT filters (analyzer mode only)		
3 dB bandwidths		1 Hz to 30 kHz in 1/3 sequence
Bandwidth uncertainty		nominal 5 %
Shape factor 60 dB:3 dB		nominal 2.5

Channel filters	
Bandwidths	100, 200, 300; 500 Hz; 1; 1.5; 2; 2.4; 2.7; 3; 3.4; 4; 4.5; 5; 6; 8.5; 9 kHz 10; 12.5; 14; 15; 16; 18 (RRC); 20; 21; 24.3 (RRC); 25; 30; 50; 100; 150; 192; 200; 300; 500 kHz 1; 1.228; 1.28 (RRC); 1.5; 2; 3;3.84 (RRC); 4.096 (RRC); 5 MHz (RRC = root raised cosine)

Video bandwidths (analyzer mode only)	1-pole lowpass RC filters	1 Hz to 10 MHz in 1/3 sequence

Signal analysis bandwidth		nominal 28 MHz

Level

Display range		displayed noise floor to +20 dBm

Maximum rated input level		
DC voltage		50 V
CW RF power		30 dBm (= 1 W)
Peak RF power		36 dBm (= 4 W) <3 s
Max. pulse voltage		150 V
Max. pulse energy	pulse width 10 µs	10 mWs

Intermodulation		
Third-order intermodulation	intermodulation-free dynamic range, level 2 × –20 dBm, reference level –10 dBm	
	f_{in} < 30 MHz	>54 dBc (TOI +7 dBm, typ. +12 dBm)
	f_{in} ≥ 30 MHz	>60 dBc (TOI +10 dBm, typ +18 dBm)
Second harmonic intercept (SHI)	20 MHz ≤ f_{in} ≤ 3 GHz	nominal +35 dBm
1 dB compression of input mixer	0 dB RF attenuation, preamplifier = OFF, f > 200 MHz	nominal +5 dBm

Displayed average noise level (DANL, analyzer mode)		
	0 dB RF attenuation, termination 50 Ω, RBW = 1 kHz, VBW = 1 Hz, sample detector, log scaling, tracking generator OFF, normalized to 1 Hz	
	frequency	preamplifier = OFF
	9 kHz to 1 MHz	<–115 dBm (1 Hz)
	1 MHz to 10 MHz	<–120 dBm (1 Hz)
	10 MHz to 50 MHz	<–130 dBm (1 Hz)
	50 MHz to 3 GHz	<–140 dBm (1 Hz)
	3 GHz to 5 GHz	<–136 dBm (1 Hz)
	5 GHz to 6 GHz	<–130 dBm (1 Hz)
	with R&S®FSL-B22 option	
	frequency	preamplifier = ON
	9 kHz to 1 MHz	<–130 dBm (1 Hz)
	1 MHz to 10 MHz	<–135 dBm (1 Hz)
	10 MHz to 50 MHz	<–145 dBm (1 Hz)
	50 MHz to 3 GHz	<–152 dBm (1 Hz)
	3 GHz to 5 GHz	<–146 dBm (1 Hz)
	5 GHz to 6 GHz	<–140 dBm (1 Hz)
	frequency	preamplifier = ON, typical values
	500 MHz	–162 dBm (1 Hz)
	1 GHz	–160 dBm (1 Hz)
	3 GHz	–158 dBm (1 Hz)
	6 GHz	–147 dBm (1 Hz)

Noise indication (receiver mode, nominal values, calculated from DANL data)		
	RF attenuation = 0 dB, termination = 50 Ω, average (AV) detector, tracking generator = OFF	
	frequency	preamplifier = OFF
	9 kHz to 150 kHz, BW = 200 Hz	<15 dBµV
	150 kHz to 1 MHz, BW = 9 kHz	<32 dBµV
	1 MHz to 10 MHz, BW = 9 kHz	<27 dBµV
	10 MHz to 30 MHz, BW = 9 kHz	<17 dBµV
	30 MHz to 50 MHz, BW = 120 kHz	<28 dBµV
	50 MHz to 1 GHz, BW = 120 kHz	<18 dBµV
	1 GHz to 3 GHz, BW = 1 MHz	<27 dBµV
	3 GHz to 5 GHz, BW = 1 MHz	<31 dBµV
	5 GHz to 6 GHz, BW = 1 MHz	<37 dBµV
	with R&S®FSL-B22 option	
	frequency	preamplifier = ON
	9 kHz to 150 kHz, BW = 200 Hz	<0 dBµV
	150 kHz to 1 MHz, BW = 9 kHz	<17 dBµV
	1 MHz to 10 MHz, BW = 9 kHz	<12 dBµV
	10 MHz to 30 MHz, BW = 9 kHz	<2 dBµV
	30 MHz to 50 MHz, BW = 120 kHz	<13 dBµV
	50 MHz to 1 GHz, BW = 120 kHz	<6 dBµV
	1 GHz to 3 GHz, BW = 1 MHz	<15 dBµV
	3 GHz to 5 GHz, BW = 1 MHz	<21 dBµV
	5 GHz to 6 GHz, BW = 1 MHz	<27 dBµV
	frequency	preamplifier = ON, typical values
	500 MHz, BW = 120 kHz	<–4dBµV
	1 GHz, BW = 120 kHz	<–2 dBµV
	3 GHz, BW = 1 MHz	<9 dBµV
	6 GHz, BW = 1 MHz	<20dBµV
Increase of DANL relative to AV display	max. peak	typ. +11 dB
	RMS	typ. +1 dB
	quasi peak	
	band A	typ. +3 dB
	band B	typ. +4 dB
	bands C and D	typ. +6 dB

Spurious responses		
Image response	f_{in} – 2 × 48.375 MHz	<–80 dBc, typ. –90 dBc
	f_{in} – 2 × 838.375 MHz	<–80 dBc, typ. –90 dBc
	f_{in} – 2 × 7158.375 MHz	typ. –60 dBc
Intermediate frequency response	48.375 MHz, 838.375 MHz, 7158.375 MHz	<–60 dBc, typ. –80 dBc
Residual spurious response	f > 30 MHz, without input signal, RF attenuation = 0 dB, RBW ≤ 10 kHz	<–90 dBm
Local oscillator related spurious response	offset from carrier <100 kHz	typ. –60 dBc
	offset from carrier ≥100 kHz	<–60 dBc
Other interfering signals:		
A/D conversion related spurious response		typ. <–70 dBc
Subharmonic of 1st LO	spur at 7158.375 MHz – 2 × f_{in}	typ. –60 dBc
Harmonic of 1st LO	mixer level <–10 dBm (spur at f_{in} – 3579.1875 MHz)	typ. –60 dBc

Level display (analyzer mode)		
Logarithmic level axis		10 dB to 100 dB
Linear level axis		0 % to 100 %/10 divisions
Number of traces		4
Trace detectors		max. peak, min. peak, auto peak, sample, RMS, CISPR-AV, CISPR-RMS quasi peak, average
Number of measurement points	default value	501
	range	125 to 32001 in steps of about a factor of 2
Trace functions		clear/write, max. hold, average, min. hold, view
Setting range of reference level	logarithmic level display	–80 dBm to 20 dBm in steps of 2 dB, 5 dB or 10 dB
	linear level display	–80 dBm to 20 dBm, 0 % to 100 %
Units of level axis	logarithmic level display	dBm, dBmV, dBµV, dBµA, dBpW
	linear level display	µV, mV, V, µA, mA, A, pW, nW, µW, mW, W

Level display (receiver mode)		
Screen		bargraph display + diagram
Level display	digital	numeric; 0.01 dB resolution
	analog	bargraph display, separately for each detector
Detectors	max. 4 selectable	max. peak, min. peak, RMS, average, CISPR-AV, CISPR-RMS, quasi peak
EMI detectors	quasi peak, CISPR-AV, CISPR-RMS	weighting in line with CISPR 16-1-1
Measurement time	selectable	50 µs to 100 s
Units of level axis	logarithmic level display	dBm, dBµV, dBmV, dBµA, dBpW, dBpT
RF spectrum		
Logarithmic level axis		10 dB to 200 dB, in steps of 10
Frequency axis	selectable	linear or logarithmic
Number of traces		6

Level measurement uncertainty		
	95 % confidence level, +20 °C to +30 °C, S/N >16 dB, 0 dB to –50 dB from reference level	
	10 MHz < f ≤ 3 GHz	<0.5 dB
	3 GHz < f ≤ 6 GHz	<0.8 dB
Absolute uncertainty at 65.83 MHz		<0.3 dB
Frequency response (+20 °C to +30 °C)	9 kHz ≤ f < 30 kHz	nominal 1.5 dB
	30 kHz ≤ f ≤ 3 GHz	<0.5 dB, typ. 0.3 dB
	3 GHz < f ≤ 6 GHz	<0.8 dB, typ. 0.3 dB
Attenuator uncertainty		<0.3 dB
Uncertainty of reference level setting		nominal <0.1 dB

Display nonlinearity		
Logarithmic level display	S/N >16 dB 0 dB to –50 dB	<0.2 dB
Bandwidth switching uncertainty	reference: RBW = 10 kHz	nominal <0.1 dB

Trigger functions

Trigger		
Trigger source		free run, video, external, IF power
External trigger level		TTL level

I/Q data

Interface		LAN
	R&S®FSL-B10	LAN or GPIB
Memory length		max. 512 ksample I and Q
Sample rate		10 kHz to 65.8 MHz
Signal bandwidth	sample rate 65.8 MHz	nominal 28 MHz

Inputs and outputs

RF input		
Impedance		50 Ω
Connector		N female
VSWR	RF attenuation ≥ 10 dB	
	10 MHz ≤ f ≤ 1 GHz	nominal 1.2
	1 GHz < f ≤ 6 GHz	nominal 1.5
Input attenuator		0 dB to 50 dB in 5 dB steps

AF output		
Connector		3.5 mm mini jack
Output impedance		<100 Ω
Open-circuit voltage		up to 1.5 V, adjustable

Tracking generator		
Tracking generator	models .13 and .16 only	N female, 50 Ω
Output level		–50 dBm to 0 dBm in 1 dB steps
Frequency range		1 MHz to 3 GHz/6 GHz
Dynamic range	RF attenuation = 0 dB, source power 0 dBm	
	10 MHz to 2 GHz	nominal 80 dB
	2 GHz to f_{max}	nominal 60 dB
Reverse power		
DC voltage		50 V
CW RF power		30 dBm (= 1 W)
Max. pulse voltage		150 V
Max. pulse energy (10 µs)		10 mWs

External reference		
Connector		BNC female, 50 Ω
Input level		0 dBm to +10 dBm
Output level	with R&S®FSL-B4	typ. 0 dBm
Frequency		10 MHz ±5 ppm

External trigger/gate input		
Connector		BNC female, 50 Ω
Input level		TTL-compatible

Probe power		
		+15 V DC, –12.6 V DC and ground, max. 150 mA, nominal

External monitor		
Connector		DVI-D

General data

Remote control		
LAN interface		10/100BaseT, RJ-45
IEC/IEEE bus (GPIB)	R&S®FSL-B10	SCPI 1997.0

Display		
Resolution		640 × 480 pixels
Pixel failure rate		$<2 \times 10^{-5}$

Mass memory		
Mass memory		flash disk (internal), USB memory stick (not supplied)
Data storage		>500 instrument settings and traces

Temperature		
Operating temperature range		+0 °C to +50 °C
Permissible temperature range		+0 °C to +55 °C
Storage temperature range		–40 °C to +70 °C
Climatic loading		+25 °C/+40 °C at 85 % relative humidity (IEC 60068-2-30)

Mechanical resistance		
Vibration	sinusoidal	IEC 60068-2-6
	random	IEC 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4 procedure 1, IEC 60068-2-27

Power supply		
Input voltage range, AC, nominal		100 V to 240 V
AC supply frequency		50 Hz to 400 Hz
Input current, AC		0.9 A to 0.3 A
Input voltage range, DC, nominal	R&S®FSL-B30	10 V to 28 V
Input current, DC	R&S®FSL-B30	8.0 A to 2.2 A
Power consumption		typ. 45 W, max. 65 W with all options
Safety		IEC 61010-1, EN 61010-1, UL 61010B-1, CSA C22.2 No. 1010-1
Test mark		VDE, GS, CSA, CSA-NRTL
EMC		EMC Directive 2004/108/EC including: EN 61326 class B (emission) CISPR 11/EN 55011/group 1 class B (emission) EN 61326 table A.1 (immunity, industrial)
Dimensions (W × H × D)	with handle	408.8 mm × 158.1 mm × 465.3 mm (16.09 in × 6.22 in × 18.32 in)
	without handle	342.3 mm × 158.1 mm × 367.0 mm (13.48 in × 6.22 in × 14.45 in)
Weight	without options	<7 kg (<15.43 lb)
	with battery pack	<8 kg (<17.64 lb)

Recommended calibration interval		1 year
	operation with external reference	2 years

R&S®FSL-B5 additional interfaces

User port		
Connector		9-pin D-Sub male
Output		TTL-compatible, 0 V/5 V max. 15 mA
Input		TTL-compatible, max. 5 V

Noise source control		
Connector		BNC female
Output		0 V/28 V, max. 100 mA, switchable, supply for noise source

Power sensor		
Connector		6-pin LEMOSA female for supported R&S®NRP-Zxx power sensors

IF/video out		
Connector		BNC female, 50 Ω
IF out		
Bandwidth		nominal 28 MHz
IF frequency	RBW 20 MHz, center frequency >20 MHz, span 0 Hz	17.45833 MHz (nominal) ±2 MHz, dependent on center frequency
Output level (gain versus RF input)	RF attenuation 0 dB, RF preamplifier = OFF, span 0 Hz, RBW 20 MHz	
	center frequency	
	100 MHz	approx. +3 dB
	3 GHz	approx. –1 dB
	6 GHz	approx. –7 dB
Video out		
Bandwidth		equal to VBW setting, max. RBW/2
Output scaling		log scaling with display scale set to log, lin scaling with display scale set to lin
Output level	center frequency >10 MHz, span 0 Hz, signal at reference level and center frequency	
	video 1 V	1 V ±10 % (open circuit) (nominal)
	video 200 mV	200 mV ±10 % (open circuit) (nominal)

R&S®FSL-K7 AM/FM/φM measurement demodulator

Measurement of analog modulation signals		
Demodulation bandwidth		100 Hz to 6.4 kHz, binary steps 12.5 kHz to 1.6 MHz, binary steps 3 MHz, 5 MHz, 8 MHz, 10 MHz, 18 MHz
Recording length	maximum	512 ksample
Recording time	demodulation bandwidth	
	100 Hz	3276.8 s
	6.4 kHz	51.2 s
	12.5 kHz	26.6 s
	1.6 MHz	200 ms
	3 MHz	100 ms
	5 MHz	50 ms
	8 MHz	25 ms
	10 MHz	12.5 ms
	18 MHz	12.5 ms
Display	frequency versus time (FM), amplitude versus time (AM), phase versus time (φM), RF power versus time, RF spectrum (FFT), AF spectrum (FFT), table with numeric values for: modulation deviation (peak, RMS), modulation frequency, carrier offset, carrier power (power of unmodulated carrier), THD, SINAD	

AF (modulation frequency)		
Range		≤9 MHz max. 0.5 × demodulation bandwidth
Resolution		5 digits
Measurement uncertainty		0.1 %
AF filters		
Lowpass		3 kHz, 15 kHz, 150 kHz, 5 %, 10 %, 25 % of demodulation bandwidth
Highpass		50 Hz, 300 Hz
Deemphasis		25 µs, 50 µs, 75 µs, 750 µs

AM demodulation		
Measurement range	modulation depth	0 % to 100 %
Modulation depth uncertainty	AF ≤ 1 MHz	<3 % of reading + residual AM
Residual AM	demodulation bandwidth ≤200 kHz, RMS, RF ≤ 3 GHz, RF input level ≥ (RF attenuation/dB – 30) dBm	0.2 %
Distortion	10 Hz ≤ AF ≤ 100 kHz	0.3 %
FM rejection	AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth	typ. 1 % + residual AM

FM demodulation		
Measurement range	frequency deviation	≤9 MHz
Deviation uncertainty	AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth	<3 % of reading + residual FM
Residual FM	demodulation bandwidth ≤100 kHz, RMS, RF input level ≥ (RF attenuation/dB –30) dBm	
	RF ≤ 1 GHz	150 Hz
	RF = 3 GHz	200 Hz
Distortion	10 Hz ≤ AF ≤ 100 kHz, deviation < 400 kHz	0.3 %
AM rejection	100 Hz ≤ AF ≤ 1 kHz, modulation depth 50 %	30 Hz

φM demodulation		
AF		≤5 MHz, max. 0.5 × demodulation bandwidth
Measurement range	phase deviation	<1000 rad
Residual φM	demodulation bandwidth ≤100 kHz, RMS, RF = 1 GHz, highpass 300 Hz, RF input level ≥ (RF attenuation/dB – 30 dBm)	5 mrad

Carrier power versus time		
Display range		noise floor to +20 dBm
Measurement uncertainty	unmodulated carrier, S/N > 16 dB, RF: 50 kHz to 3 GHz	typ. 1 dB
Maximum dynamic range	demodulation bandwidth 200 kHz	typ. 75 dB
Display linearity	S/N > 16 dB	typ. 0.2 dB

AF spectrum		
Span		≤9 MHz
Resolution bandwidth		1 Hz to 10 MHz

RF spectrum		
Span		≤18 MHz
Resolution bandwidth		1 Hz to 10 MHz
Shape factor	60 dB:3 dB	2.5, nominal

Modulation distortion		
Measurement functions		THD, SINAD
Measurement range		–100 dB to 0 dB
Resolution		0.01 dB
Measurement uncertainty		typ. 0.5 dB
AF frequency range		10 Hz to 5 MHz

Trigger		
Trigger functions		RF level, AM, FM, φM demodulation

R&S®FSL-K30 application firmware for noise figure and gain measurements

Frequency

Frequency range	R&S®ESL3	100 kHz to 3 GHz
	R&S®ESL6	100 kHz to 6 GHz

Measurement bandwidth		10 Hz to 10 MHz (–3 dB) in 1/3 sequence

Noise figure and gain measurement

Noise figure		
Measurement range		0 dB to 35 dB
Resolution		0.01 dB
Accuracy	instrument uncertainty (95 % confidence level)	
	frequency range 100 kHz to 10 MHz	
	measurement with external preamplifier (gain 50 dB, noise figure <5 dB), RBW <10 kHz, DUT noise figure 1 dB to 10 dB and gain >10 dB	0.3 dB
	frequency range >10 MHz to 6 GHz	
	measurement with external preamplifier (gain 30 dB, noise figure <5 dB), RBW 1 MHz, DUT noise figure 1 dB to 10 dB and gain >10 dB	0.3 dB
	R&S®FSL-B22 (internal preamplifier) active, measurement with external preamplifier (gain 20 dB, noise figure <5 dB), RBW 1 MHz, DUT noise figure 1 dB to 10 dB and gain >10 dB	0.3 dB

Gain		
Measurement range		0 dB to 60 dB
Resolution		0.01 dB
Accuracy	frequency range 100 kHz to 10 MHz	
	measurement with external preamplifier (gain 50 dB, noise figure <5 dB), RBW <10 kHz	0.2 dB
	frequency range >10 MHz to 6 GHz	
	measurement with external preamplifier (gain 30 dB, noise figure <5 dB), RBW 1 MHz	0.2 dB

Required hardware

Spectrum analyzer		
Noise source supply	via 28 V connector on rear panel of R&S®FSL	R&S®FSL-B5
Noise source	recommendation	NoiseCom NC346
Preamplifier, external	frequency range 100 kHz to 3/6 GHz	gain approx. 30 dB, noise figure max. 5 dB

Ordering information

Designation	Type	Order No.
Test Receiver, 9 kHz to 3 GHz	R&S®ESL3	1300.1501.03
Test Receiver, 9 kHz to 3 GHz, with tracking generator	R&S®ESL3	1300.1501.13
Test Receiver, 9 kHz to 6 GHz	R&S®ESL6	1300.1501.06
Test Receiver, 9 kHz to 6 GHz, with tracking generator	R&S®ESL6	1300.1501.16
Accessories supplied		
Power cable, quick start guide and CD-ROM (with operating manual and service manual)		
Recommended extras		
Printed manual (includes operating manual and service manual)		1300.5053.32

Options

Designation	Type	Order No.	Retrofittable	Remarks
Options				
OCXO Reference Frequency	R&S®FSL-B4	1300.6008.02	yes	
Additional Interfaces	R&S®FSL-B5	1300.6108.02	yes	video out, IF out, noise source control, AUX port, R&S®NRP-Zx power sensor
Gated Sweep	R&S®FSL-B8	1300.5701.02	yes	
GPIB Interface	R&S®FSL-B10	1300.6208.02	yes	
RF Preamplifier (3/6 GHz)	R&S®FSL-B22	1300.5953.02	yes	
DC Power Supply	R&S®FSL-B30	1300.6308.02	yes	
NiMH Battery Pack	R&S®FSL-B31	1300.6408.02	yes	requires R&S®FSL-B30
Firmware/Software				
AM/FM/φM Measurement Demodulator	R&S®FSL-K7	1301.9246.02		
Power Sensor Support	R&S®FSL-K9	1301.9530.02		requires R&S®FSL-B5 or R&S®NRP-Z3/4
Application Firmware for Noise Figure and Gain Measurements	R&S®FSL-K30	1301.9817.02		requires R&S®FSL-B5 and preamplifier

Recommended extras

Order 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 75 Ω, L section	R&S®RAM	0358.5414.02
Matching Pad 75 Ω, series resistor 25 Ω	R&S®RAZ	0358.5714.02
Matching Pad 75 Ω, L section, N to BNC	R&S®FSH-Z38	1300.7740.02

Power sensors supported by the R&S®FSL-K9

Order 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
Power Sensor Module with Power Splitter DC to 18 GHz, 500 mW	R&S®NRP-Z27	1169.4102.02
Power Sensor Module with Power Splitter DC to 26.5 GHz, 500 mW	R&S®NRP-Z37	1169.3206.02
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
Wideband Power Sensor 50 MHz to 18 GHz, 100 mW	R&S®NRP-Z81	1137.9009.02

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Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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(search term: ESL)

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