

EMI Test Receivers ESBI and ESMI

ESBI: 20 Hz to 5 GHz

ESMI: 20 Hz to 26.5 GHz

EMI test receiver and spectrum analyzer all in one



ESMI (photo 39551)

Brief description

EMI Test Receivers ESBI and ESMI combine the top-class specifications of Rohde&Schwarz EMI test receivers with the speed of Rohde& Schwarz spectrum analyzers. The integral measurement and analysis functions simplify and speed up all measurements to the relevant commercial and military standards such as CISPR, VDE, FCC, EN, VCCI, MIL-STD, VG, DEF-STAN, BS, DO 160, GAM-EG13.

All these test receivers satisfy the exacting requirements of CISPR standard 16-1 (08.93) and VDE standard 0876. They are thus highly suitable for

all compliance tests in line with commercial standards.

ESBI and ESMI provide excellent characteristics for EMI measurements. They can however also be used as top-class spectrum analyzers for general laboratory applications (further typical characteristics see data sheets PD 756.4808/.8384 and .7120).

Main features

- RF attenuation switchable in wide range and small steps
- Refined preselection
- Very large frequency range for EMI measurements

- Low-noise preamplifier with wide dynamic range
- High-level mixer for IF conversion
- Additional filters ahead of IF preamplifier to avoid overloading due to broadband interference in IF section
- Highly linear envelope detector with dynamic range of 70 dB in addition to 110 dB logarithmic converter in analyzer path
- Five parallel detectors for peak, minimum, quasi-peak, average and RMS weighting
- DC logarithmic converter with dynamic range of 70 dB
- Overload detectors at the mixers and in the test channel to avoid incorrect measurements

EMI Test Receivers ESBI and ESMI

Measurement capabilities

RF dynamic range

The EMI test receivers feature a large dynamic range and high sensitivity.

Moreover, the test receiver settings completely conform to CISPR requirements, ie the dynamic range is large enough in all CISPR ranges to allow correct weighting of single pulses.

Refined preselection filtering provides the required large dynamic range for wideband signals. A low-noise preamplifier, which can be switched after the preselector, is used to increase sensitivity. To measure high-energy pulses, a second input is provided which can handle pulses in the frequency range from 20 Hz to 200 MHz. An automatic overload detector checks sensitive points in the signal path.

Signal analysis

EMI test receivers have a variety of maximum, minimum, average, rms and quasi-peak detectors for simultaneous signal analysis. Built-in AM/FM demodulators allow audio monitoring of interference signals.

A pulse calibration source for checking the CISPR weighting curves is provided in addition to the built-in sine calibration source, thus ensuring extremely high measuring accuracy. A tracking generator for all kinds of EMC measurements is also provided.

Operation

OVERVIEW mode

In this mode, the whole interference spectrum is displayed on the screen of the test receiver. The IF resolution bandwidths can be adjusted to CISPR standards; the IF selectivity has also a quasi-analog setting mode to optimize the sweep time. The interference spectrum can be displayed on the screen using a linear or logarithmic frequency scale. A maximum of eight different limit lines can be displayed on the screen. Out-of-limit values are automatically detected and displayed.

Fast, flexible scan

In the SCAN mode, ESBI and ESMI are directly comparable with a conventional test receiver:

- In addition to measurements at the selected frequency, a scan can be started
- Measurements are made automatically between start and stop frequency and at a selectable step size
- Manual adjustments while the scan is in progress and repeat measurements over selectable subranges reduce the time required for measurements

To conform to relevant standards, measurements over various frequency ranges and bandwidths have to be made. For this purpose, the user can define a variety of frequency ranges in a configuration table. Measurements are then made over these subranges using the selected bandwidth, measurement time, step size, etc.

Split-screen display

The results are output in two windows obtained by splitting the screen display horizontally. Different trace memories, and so the results from different detectors, can be displayed in the upper and the lower window. The split-screen display is ideal for showing narrowband and broadband signals separately.

Automatic compensation for transducers

The test results are always displayed with correct units. The transducers designed for the Rohde & Schwarz test receivers are, of course, suitable for use with ESBI or ESMI. Correction factors entered in a transducer table are used to automatically compensate for the frequency dependence of the transducer factor. A maximum of four such tables are available and can also be combined.

Documentation on printers and plotters

A wide range of commercially available monochrome and colour hardcopy devices including laser printers is supported.

EMI Test Receivers ESBI and ESMI

Specifications in brief

Frequency

Frequency ranges	
ESBI	20 Hz to 5 GHz
ESMI	20 Hz to 26.5 GHz, up to 110 GHz with external mixers

Frequency setting	with spinwheel or keys
Resolution	1 Hz
Reference frequency drift	$<1 \times 10^{-7}$
Frequency axis	LIN or LOG selectable
Frequency display	
Accuracy (for span >5 MHz, sweep time <100 ms)	$<8 \times 10^{-3}$ x span

Frequency span	10 Hz to 2/5.2/26.5 GHz
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Frequency counter	
Scan mode	<1000 x resolution bandwidth
Resolution	0.1 Hz to 10 kHz
Accuracy	reading $\times 10^{-7} \pm 2$ x resolution

Spurious responses at discrete frequencies

n x mains frequency	>70 dBc
m x line frequency (29.4 kHz)	>80 dBc
100 kHz (span ≤ 5 MHz)	>90 dBc
-10.7 MHz	>90 dBc
Other for $\Delta f > 1$ MHz	>75 dBc

Filters

RF preselector	
Selectable filters	(except YIG filter in ESMI), automatically switched
All models	1 lowpass, 9 fixed bandpasses, 4 tunable bandpasses
ESBI	plus 1 additional bandpass
ESMI	plus 2 additional fixed bandpasses and 1 YIG filter

IF filters	
Overview mode	
3 dB bandwidths	from <10 Hz (typ. 6 Hz) to 3 MHz in 5% steps (except in range 30 to 80 kHz)

EMI receiver mode	
6 dB bandwidths	10 Hz, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, 1 MHz

Video filter	
Bandwidths (-3 dB)	1st order RC lowpass after IF rectifier 1 Hz to 3 MHz in 1/3/10 steps

Amplitude

Maximum input signals

DC voltage	
DC-coupled	0 V
AC-coupled	20 V
AC voltage (sinewave)	
RF attenuation 0 dB	20 dBm (100 mW; 127 dB μ V)
RF attenuation ≥ 10 dB	30 dBm (1 W; 137 dB μ V)
Pulse spectral density with RF attenuation 0 dB	
RF preselector on	
Frequency setting <150 kHz	130 dB(μ V/MHz)
for 150 kHz to 1 GHz	90 dB(μ V/MHz)
Frequency setting ≥ 1 GHz	61 dB(μ V/MHz)
RF preselector off	61 dB(μ V/MHz)
Maximum pulse voltage (RF attenuation ≥ 10 dB)	
Input 1	150 V
Input 2	50 V

Maximum pulse energy ($t = 10 \mu$ s), RF attenuation ≥ 10 dB

	ESBI	ESMI
Input 1	<1 mWs (100 W/10 μ s)	<10 mWs (1 kW/10 μ s)
Input 2	<1 mWs (100 W/10 μ s)	<1 mWs (100 W/10 μ s)

Level compression

Pulse spectral density for 1 dB compression (RF attenuation 0 dB, RF preselector on, RF preamplifier off)

Frequency	1 dB compression at
<150 kHz	ESBI, ESMI: >110 dB(μ V/MHz)
0.15 to 5 MHz	ESBI, ESMI: >86 dB(μ V/MHz)
5 to 30 MHz	ESBI, ESMI: >80 dB(μ V/MHz)
30 to 300 MHz	ESBI, ESMI: >76 dB(μ V/MHz)
300 to 1000 MHz	ESBI, ESMI: >75 dB(μ V/MHz)
>1000 MHz	ESBI, ESMI: >50 dB(μ V/MHz)

Maximum displayed noise floor in CISPR bands

RF preamplifier off, RF attenuation 0 dB, discrete spurious excepted

Frequency range	CISPR band/ bandwidth	Model	Display mode (in dBmV)		
			Average	Quasi-peak	Peak
9 to 150 kHz	A/200 Hz	ESBI, ESMI	-7	-5	+4
0.15 to 5 MHz	B/9 kHz	ESBI, ESMI	0	+3	+11
5 to 30 MHz	B/9 kHz	ESBI, ESMI	-5	-2	+6
30 to 300 MHz	C/120 kHz	ESBI, ESMI	+5	+9	+16
0.3 to 1 GHz	D/120 kHz	ESBI, ESMI	+8	+12	+19

In the frequency range from 20 Hz to 1 MHz a limited temperature range from 15 to 35°C applies to the displayed noise; outside this temperature range the specified values may vary by max. 10 dB. The guaranteed sensitivity in the CISPR bands is improved by 9 dB with the preamplifier on.

Spectral sensitivity

Resolution bandwidth 1 MHz, $f > 30$ MHz, peak detector

	preamplifier: 0 dB	preamplifier: 10 dB
ESBI	<30 dB μ V	<21 dB μ V
ESMI (<18 GHz)	<32 dB μ V	<23 dB μ V

Level measurement error after internal calibration

Sum error in display range and in temperature range

15 to 35°C <1.5 dB ($f = 9$ kHz to 1 GHz)

IF rejection and image-frequency rejection

IF rejection >100 dB, typ. >110 dB

applies to all intermediate frequencies used, with the following exception:

ESMI: 221.4 MHz >90 dB, typ. 110 dB

Image-frequency rejection

ESBI, ESMI: $f + 10.8428$ GHz >80 dB, typ. 90 dB

ESBI: $f + 442.8$ MHz >100 dB, typ. 115 dB

ESMI: $f + 442.8$ MHz >85 dB, typ. 100 dB

All models at $f + 42.8$ MHz >100 dB, typ. 115 dB

All models at $f + 8.388$ MHz >100 dB, typ. 115 dB

Sweep

	Frequency span >0 Hz	Frequency span = 0 Hz (sampling rate: 1/8.9 μ s)		
Sweep time	Step size	Error	Step size	Error
0.2 to 10 ms	-	-	1/2/4/8/10	$<2\%$
20 ms to 2 s	20 ms	10^{-3}	20 ms	10^{-3}
2 to 20 s	200 ms	10^{-3}	200 ms	10^{-3}
20 to 1980 s	2 s	10^{-3}	2 s	10^{-3}

Trigger modes free run, line, video, external

Scalar network analysis

Tracking generator frequencies and levels

	Output frequency		Output level		Steps
	min.	max.	min.	max.	
ESBI	100 Hz	5 GHz	26 dB μ V	107 dB μ V	0.1 dB
ESMI	100 Hz	5 GHz	32 dB μ V	107 dB μ V	5 dB
ESMI + ESMI-B1	100 Hz	26.5 GHz	32 dB μ V	107 dB μ V	5 dB

Measurement ranges for gain and attenuation

	Measurement range		Frequency offset
	Gain	Attenuation	
ESBI	110 dB	110 dB	0 to \pm 1 GHz
ESMI (up to 5 GHz)	105 dB	110 dB	0 to \pm 1 GHz
ESMI + ESMI-B1	105 dB	5 to 18 GHz: 105 dB 18 to 26.5 GHz: 100 dB	not possible

Demodulation

Modulation analysis	AM and FM measurement of modulation depth and frequency deviation
Monitoring	built-in loudspeaker, headphones output

VDU

Screen	9" in-line colour CRT, 1024 x 512
Display mode	full display height or 2 x $\frac{1}{2}$ display height (split screen)
Number of picture memories	4
Output on plotter/printer	HP-GL, pinwriter (24-pin), laser printer
Functions	curve arithmetic (swap, subtract), comparison with tolerance curves, averaging, peak hold

Inputs and outputs

Front panel, RF section

Input 1 (all models)	BNC connector, 50 Ω
DC coupling	20 Hz to 200 MHz (AC from 9 kHz)
VSWR with RF attenuation \geq 10 dB	<1.2
Protection	fuse, surge arrester

Input 2 (DC coupling only)	N connector, 50 Ω
VSWR with RF attenuation \geq 10 dB	<1.2 (f <1 GHz) <1.5 (f=1 to 1.8 GHz)

ESBI	20 Hz to 5 GHz <1.2 (f <1 GHz) <1.5 (f=1 to 2.7 GHz) <1.8 (f= 2.7 to 4.8 GHz)
ESMI	20 Hz to 26.5 GHz, adaptable to 3.5 mm SMA connector <1.2 (f <1 GHz) <1.5 (f=1 to 2.7 GHz) <1.8 (f= 2.7 to 4.8 GHz) <2 (f= 4.8 to 26.5 GHz, RF attenuation \geq 20 dB)

Selectable preamplifier

ESBI, ESMI	10 dB
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Input attenuator

ESBI	0 to 120 dB in 2 dB steps
ESMI	0 to 75 dB in 5 dB steps

Calibration output

BNC connector, 50 Ω

Coding and supply connector

Tuchel connector, 12-contact

Supply voltages

+10 V, -10 V, max. 100 mA each

Front panel, display section

Headphones connector	jack JK-34
Keyboard connector	jack JK-34

Rear panel, RF section

IF OUTPUT 21.4 MHz	BNC connector, 50 Ω , VSWR \leq 2
10-MHz reference	BNC connector
EXT ALC	BNC connector, 0 to -1 V (V_{input})
SWEEP OUTPUT	BNC connector, 0 to 5 V (V_{output})
START-SWEEP-STOP	BNC connector
Function	positive TTL signal (t=1.4 μ s) occurring at sweep start or stop

Rear panel, display section

IF OUTPUT 21.4 MHz (narrow)	BNC connector, 50 Ω , VSWR \leq 2
EXT. SWEEP TRG	BNC connector
VIDEO-OUTPUT	BNC connector
EXTERNAL MONITOR	BNC connectors for RED, GREEN, BLUE, COMP VIDEO; V SYNC; H SYNC
Line frequency/sync pulses	29.4 kHz/2 μ s
EXT FLOPPY	Cannon D connector, 37-contact for PZ.11
RS-232C	Cannon D connector, 25-contact
PARALLEL INTERFACE (Centronics)	Amphenol connector, 36-contact
USER PORT	Cannon D connector, 25-contact
PHONES	jack JK-34, 30 Ω
IEC 625-Bus (IEEE 488)	24-contact Amphenol connector

General data

Power supply	100/120/220/240 V \pm 10%, 45 to 66 Hz
Dimensions (W x H x D); weight	
ESBI	435 mm x 413 mm x 590 mm; 64 kg
ESMI	435 mm x 457 mm x 590 mm; 68 kg
ESMI with ESMB1	435 mm x 457 mm x 590 mm; 72 kg

Ordering information

EMI Test Receiver	ESBI	1005.4000.52
	ESMI	1032.5510.53
Optional Tracking Generator for ESMI (5 to 26.5 GHz)	ESMI-B1	1033.3240.52
Extras		
Service Kit	FS-Z1	811.0010.02
Connecting Cable Set (for servicing, 1 m)	FS-Z2	811.0304.02
Microwave Cable and Interchangeable Adapter Set (DC to 26.5 GHz)	FS-Z15	1046.2002.02