EMI Test Receivers ESHS

9 kHz to 30 MHz

- Comply with CISPR 16-1, VDE 0876 and ANSI C63.2
- For measurements to European Standards 55011 to 55022, ETS, FCC, VCCI and VDE 0871 to 0879
- Level measurement range –36 to +137 dBµV
- Frequency resolution 10 Hz
- Wide dynamic range
- High measuring accuracy
- Five preselection filters
- Battery or AC supply
- Parallel detectors for average, peak and quasi-peak indication
- Macros for automatic test runs

ROHDE&SCHWARZ

Functions

The EMI Test Receivers ESHS 10 and 30 are double-conversion heterodyne receivers covering the frequency range from 9 kHz to 30 MHz. They can be manually operated, featuring high frequency resolution and accurate level indication, both average and quasi-peak.

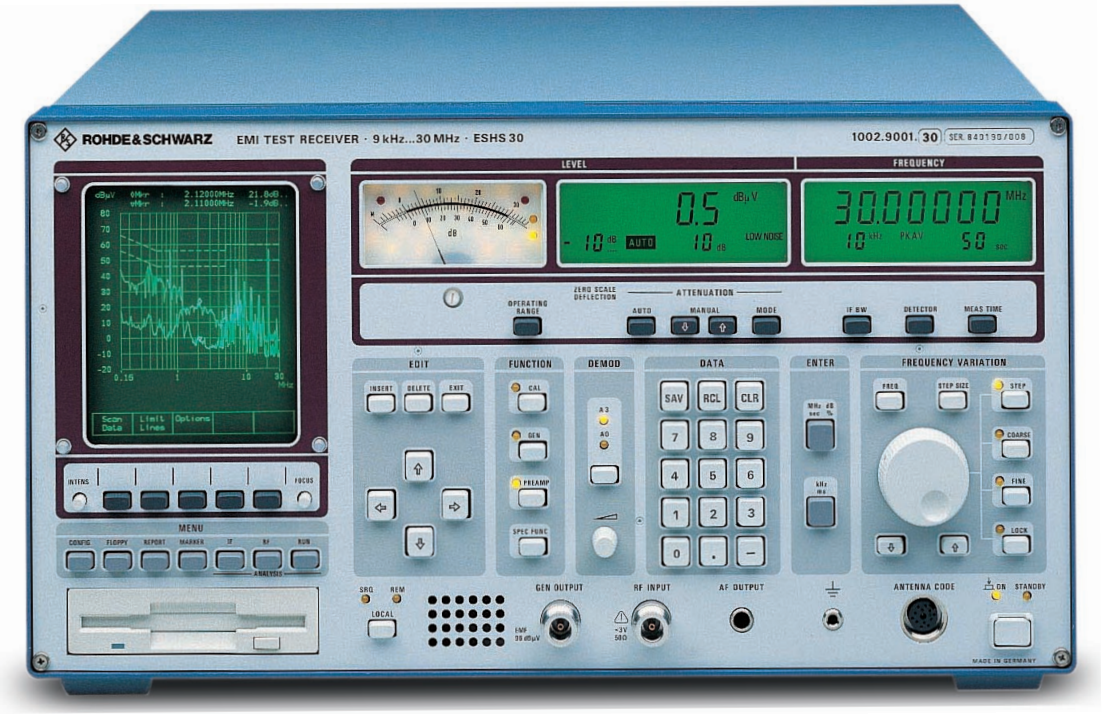
Thanks to the built-in intelligence of the test receivers, the time required for measurements is reduced considerably. Being specialists for EMI measurements to CISPR, CENELEC, ETSI, FCC, VCCI and VDE standards, these test receivers furnish results at a speed and accuracy not possible previously.

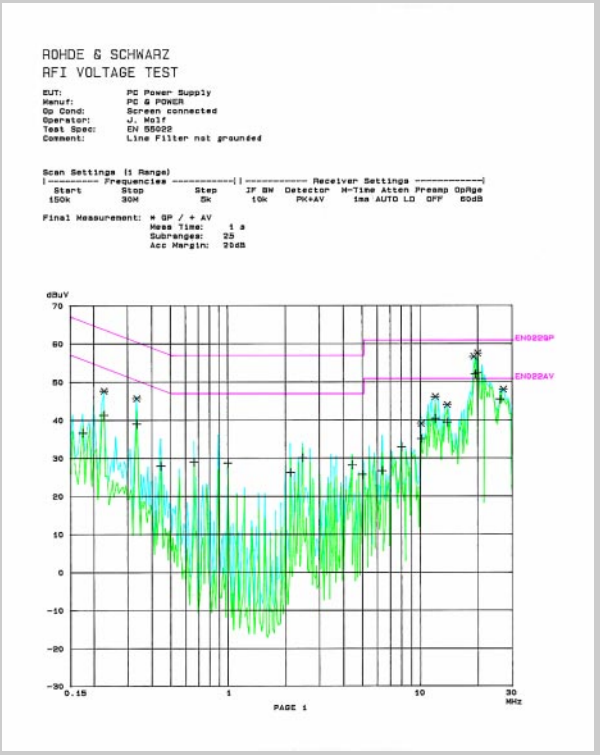
Their real strength, however, is the automatic measurement of RFI voltages. For this measurement, the test receivers control the artificial mains network, detect the line with the highest RFI level, compare the results with the permissible limits and furnish a comprehensive test report with all the necessary information.

Both receiver models combine three classes of instruments in one:
– a compact, manually tunable and battery-operated test receiver
– an automatic test receiver which automatically performs measurements and reports the results
– a system-compatible test receiver

Features

- Frequency range 9 kHz to 30 MHz
- RF attenuator switchable in 10-dB steps in range 0 to 120 dB; high pulse loading capacity of input attenuator (100 mWs)
- Preamplifier with wide dynamic range, can be switched between preselection filter and 1st mixer
- Crystal-controlled synthesizer as 1st LO, variable in 10-Hz steps, sweep mode for fast frequency scans
- High-level input mixer ensuring high isolation of 1st LO
- Field-strength measurements using test antennas
- Highly linear envelope detector with more than 70 dB dynamic range
- Peak, average and quasi-peak detectors operating in parallel
- Peak indication with automatic consideration of IF bandwidth correction factors for measuring broadband interference (PK/MHz)
- Automatic overload detection in mixer stages and in test channel by permanently activated peak detectors
- Logarithmic amplifier with more than 70 dB dynamic range
- 12-bit A/D converter with short conversion time
- IF filters with low delay distortion
- Flash EPROMs allowing convenient and fast firmware updating
- Digital level indication on LC display and analog level indication on moving-coil meter taking into account transducer factors and their units
- High measuring accuracy: error ≤1 dB; typ. ≤0.5 dB
- Detection of faulty modules by built-in selftest facilities





Result of complete, automatic RFI voltage measurement to CISPR 22, class B.
Curves: fast prescan measurement using peak (blue) and average detector (green) simultaneously.
*/+: result of final measurement with long measuring time (1 s) at frequencies with highest levels of prescan measurement;
*: quasi-peak value,
+: average value. List of final measurement results is plotted separately.
Time required for complete measurement including documentation: approx. 4 min

- Automatic calibration at a keystroke with the aid of a high-precision built-in 100-kHz harmonics generator
- Demodulator circuits for AM and A0; headphones connector and built-in loudspeaker
- Automatic monitoring of all synthesizer loops and supply voltages during operation
- Wide dynamic range: noise figure typ. 5 dB with preamplifier, 10 dB without preamplifier, third-order intercept point typ. 20 dBm (without preamplifier)
- Measurement of voltage, field strength, current and pulse spectral density with full indication of units
- Automatic consideration of frequency-dependent transducer factors
- Indication of level on analog meter and digital display with 0.1-dB resolution
- 60-dB operating range also for quasi-peak and average indication
- Output of results as lists and diagrams on printer or plotter including limit lines and user-definable labelling
- Nonvolatile storage of 9 complete instrument settings and 22 different transducer factors and limit lines
- Manual operation or automatic test with report on printer or plotter

Additional features of ESHS30

- IF analysis for visual check of interference spectrum in manual measurement mode; IF analysis module with resolution bandwidth of 1, 3 and 10 kHz; IF analysis executed automatically during level measurement
- Optimal result display for every application
- Display of interference spectra (RF ANALYSIS) including limit lines on low-emission screen
- Full storage and listing of results
- Manual operation or automatic test with spectrum display on screen
- Built-in 3½" disk drive for storing test results and instrument settings
- Built-in tracking generator for attenuation and gain measurements

Manual operation

For solving complex EMC problems, manual measurement often is the most efficient way, since the operator can make full use of his experience in identifying interference sources. ESHS10 and 30 feature conventional test receiver operation with tuning knob, indication of results on a meter and built-in loudspeaker. ESHS30 provides IF analysis in addition.

The clear arrangement of the controls – all keys being assigned one function only – and the LC display of the selected parameters such as attenuation, bandwidth and detector ensure great ease of operation. The display is easy to read in any ambient light.

Automatic operation

The input keys for automatic measurements are arranged on the left of the front panel. A row of menu keys are provided below the screen to enter frequency scans, limits, transducer factors, configuration data and macros for test routines.

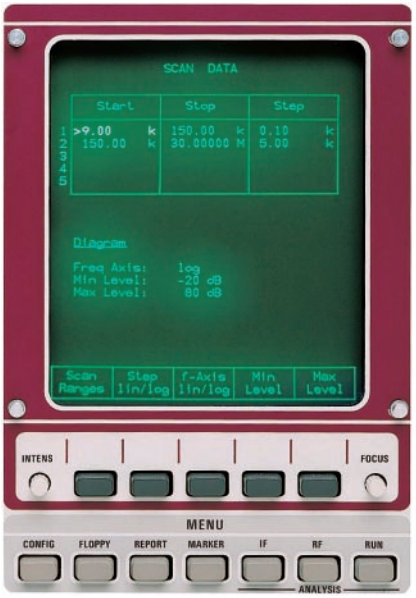
In a frequency scan (lin or log), up to five subscans are covered; each subscan can be assigned a specific test receiver setting. Nonvolatile storage of 22 limit lines and transducer factors with up to 50 values is possible. By combining the transducer factors, all configurations occurring in practice can be covered.

The results of a frequency scan are usually first displayed in graphical form on the screen and then output on a printer as a list and/or on a plotter as a graph. Time can be saved by simultaneous printing of the lists and plotting of the graphs. Plotting is also possible during the frequency scan so that the desired document is already obtained during the measurement. Any relevant information can be added to the test report, either by entering it via a line editor or, more conveniently, via an MF 2 keyboard that can be connected. Information is automatically added to the parameters known to the ESHS such as date, time and receiver settings.

Macros for automatic test runs (ANALYSIS OPTIONS) match the ESHS 10 and 30 to the specific configuration, device under test and measurement specification. Being thus prepared, the test receivers perform the following sequences automatically:

- Fast prescan measurement using the peak and/or average detector
- Final measurement at critical frequencies – for RFI voltage measurements on all phases of the artificial mains network (LISN) – using the average and/or quasi peak detector
- Report of results on printer or plotter
- ESHS 30: storage of results on floppy disk
- Determination of critical frequencies by means of limit lines with data reduction to shorten the measuring time

The minimum configuration consisting of ESHS 10 or 30, artificial mains network (LISN) and plotter is already a powerful and cost-effective test set.



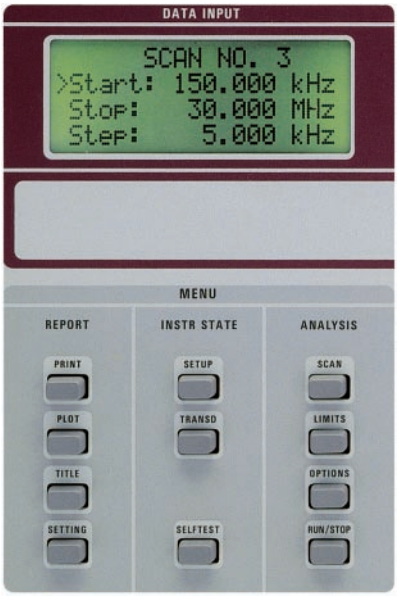
Remote control

The IEC/IEEE-bus interface complies with the latest standard IEEE 488 Part 2. The measured values are output with a resolution of 0.01 dB.

Interfaces

For further signal evaluation and for driving or feeding add-on units, ESHS 10 and 30 have the following interfaces:

- IEC/IEEE-bus interface
- Coding and supply socket (ANTENNA CODE) for active antennas and other accessories
- IF output 80 kHz (80 kHz OUTPUT) for evaluating the IF signal eg with an oscilloscope
- Envelope detector output (VIDEO OUTPUT) for evaluating the detected IF signal eg with an oscilloscope
- Connector for an MF2-compatible keyboard for text entry
- Input for an external reference frequency (5 or 10 MHz, automatic detection)



- USER INTERFACE with
  - 6 TTL ports for driving external devices, eg for phase selection of the Artificial Mains Networks ESH2-Z5 and ESH3-Z5
  - input for external triggering of measurements
  - outputs for the analog display voltage with and without simulation of the meter response for connecting a discontinuous interference analyzer
  - RS-232 interface for reprogramming the built-in flash EPROMs when updating the firmware via an AT-compatible computer
- Parallel interface (PRINTER INTERFACE) for connecting a printer
- IF output 74.7 MHz for connecting a panoramic display (ESHS10 only)
- Connector (11 to 33 V) for battery-powered operation, eg in a vehicle

Design

The service-friendly modular design of the ESHS10 and 30 in conjunction with a consequent design to EMC rules including the low-emission screen ensures excellent results regarding RFI emission and immunity.

A faulty module can easily be found by the built-in selftest and replaced with a minimum of effort and without affecting the other modules.

Specifications

Frequency range 9 kHz to 30 MHz
Frequency setting
1. with tuning knob in 10-Hz, 10-kHz steps or any step size (switch-selected)
2. numerical keyboard entry
3. in steps of any selectable size
4. automatic scanning (RF analysis)

Display 7-digit LCD
Resolution 10 Hz
Setting error $<3 \times 10^{-6}$ +30 Hz

RF input Z_{in} = 50 Ω, N connector, female
VSWR <1.2 with ≥10 dB RF attenuation,
<2 with 0 dB RF attenuation

Oscillator reradiation at RF input
(0 dB RF attenuation)
without preamplifier <20 dBµV
with preamplifier <10 dBµV
Preamplifier switchable between input filter and 1st mixer
Gain 10 dB
Preselector five bandpass filters
9 kHz to <150 kHz
150 kHz to <4.05 MHz
4.05 MHz to <12.8 MHz
12.8 MHz to <21.55 MHz
21.55 MHz to 30 MHz

Maximum input level
(with and without preamplifier)
RF attenuation 0 dB
DC voltage 7 V
Sinewave AC voltage 130 dBµV
Pulse spectral density 96 dBµV/MHz
RF attenuation ≥10 dB (DC-coupled)
DC voltage 7 V (≙ 1 W)
Sinewave AC voltage 137 dBµV
Max. pulse voltage (10 µs) 700 V
Max. pulse energy (10 µs) 100 mWs

Interference rejection, non-linearities
Image-frequency rejection
1st IF >90, typ. 100 dB
2nd IF >75 dB
IF rejection >90, typ. 100 dB
Intercept point d3, with $|f_1-f_2| \geq 100$ kHz and 0 dB RF attenuation

	Preamplifier off	Preamplifier on
Level (f_1, f_2) at receiver input	–10 dBm	–20 dBm
f_{in} <2 MHz	typ. 15 dBm	typ. 0 dBm
f_{in} ≥2 MHz	>15 dBm	>0 dBm
	typ. +20 dBm	typ. +5 dBm
Intercept point k2	>40 dBm	>20 dBm

RF shielding
Voltage indication at a field strength of
10 V/m with 0 dB RF attenuation ($f \neq f_{in}$) <–10 dBµV
Additional error in quasi-peak indication range <1 dB
Intermediate frequencies
1st IF 74.7 MHz
2nd IF 80 kHz

IF bandwidths

Nominal bandwidth	–3 dB (±20%)	–6 dB	Shape factor
200 Hz [1])	150 Hz	200 Hz +20/–30 Hz	$BW_{6\,dB}/BW_{50\,dB}$ = 1:8 (typ.)
10 kHz [2])	7 kHz	9.5 kHz ±0.5 kHz	$BW_{6dB}/BW_{60\,dB}$ = 1:3.5 (typ.)

1) Meets tolerances to CISPR 16.
2) Meets tolerances to CISPR 16 (min. 8 kHz, max. 10 kHz) and complies with MIL tolerance (10 kHz ±10%).

Noise indication

	Preamplifier off	Preamplifier on
Average value, BW=200 Hz		
f_{in}=9 to 50 kHz	<–24 to <–30 dBµV	<–30 to <–36 dBµV
f_{in}>50 kHz	<–30 dBµV typ. –35 dBµV	<–36 dBµV typ. –41 dBµV
Average value, BW=10 kHz		
f_{in}>50 kHz	<–14 dBµV typ. –17 dBµV	<–20 dBµV typ. –25 dBµV
Peak value, (typ. increase as against average value)	+11 dB	
Quasi-peak		
Band A (9 to 50 kHz)	typ. –24 to –30 dBµV	typ. –30 to –36 dBµV
(50 to 150 kHz)	typ. –32 dBµV	typ. –38 dBµV
Band B (≥150 kHz)	typ. –13 dBµV	typ. –19 dBµV
PK/MHz (BW=10 kHz)	typ. 34 dBµV/MHz	typ. 28 dBµV/MHz

Voltage measurement range (f_{in} >50 kHz)
Lower limit (additional error caused by inherent noise <1 dB

	Preamplifier off	Preamplifier on
Average indication (AV)		
BW=200 Hz	<–26 dBµV, typ. –31 dBµV	<–32 dBµV, typ. –37 dBµV
BW=10 kHz	<–10 dBµV, typ. –13 dBµV	<–16 dBµV, typ. –20 dBµV
Peak indication (PK)		
BW=200 Hz	typ. –8 dBµV	typ. –14 dBµV
BW=10 kHz	typ. +10 dBµV	typ. +4 dBµV
Quasi-peak indication (QP)		
CISPR band A (pulse freq. 25 Hz)	typ. –30 dBµV	typ. –36 dBµV
CISPR band B (pulse freq. 100 Hz)	typ. –11 dBµV	typ. –17 dBµV

Upper limit
AV, PK, QP: 137 dBµV (RF attenuation ≥10 dB)
Inherent spurious response: <–10 dBµV (equiv. input voltage)

Level display
digital in dBµV, dBµA, dBm, dBµV/m, dBµA/m, dBpW: 3½ digits, resolution 0.1 dB
analog: on moving-coil meter in operating range of IF detector with additional digital display of lower range limit
Operating ranges: 30, 60 dB
Screen (RF analysis) (ESHS30 only): 5" CRT with digital display memory
Resolution: 1024 x 1024 pixels
Display range
X axis (frequency): freely selectable between 9 kHz and 30 MHz
Y axis (level): 10 to 200 dB, adjustable
Display modes: average (AV), peak (PK), spectral density measurement (PK/MHz), quasi-peak (QP)
Averaging, hold and measuring times: 1 ms to 100 s (1/2/5 steps)

Measuring error
AV for S/N >16 dB: <1 dB (digital display), typ. <2 dB (analog display)
Level calibration: harmonics generator

Demodulation modes: A0 (zero beat), A3 (for A3E emissions)

IF analysis (ESHS30 only)
Display range: 10 kHz to 2 MHz in 1, 2, 5 steps
Resolution

	–3 dB (±20%)	Shape factor $BW_{3dB}:BW_{60dB}$
Nominal bandwidth 10 kHz	10 kHz	1:4
3 kHz	3 kHz	1:6
1 kHz	1 kHz	1:9

Sweep time: 50 ms to 10 s (adjustable in 1/2/5 steps)
Level display range: 80 dB
Input attenuation: 0/20 dB, selectable

Date, time of day: internal clock, permanently operated from internal battery

Floppy disk drive (ESHS30 only): 3½", 1.44 Mbyte formatted
Formatting: MS-DOS-compatible
Data format: HP-GL or binary

Connectors and interfaces

Remote control: to IEC 625-2 (IEEE 488.2)
Remote-control connector: 24-contact Amphenol connector
Plotter: via IEC/IEEE-bus interface

Front-panel outputs
Supply and coding connector for antennas etc: 12-contact Tuchel connector
AF output: Z_{out}=10 Ω, jack JK34
EMF: adjustable up to 2 V

Generator output (ESHS30 only): N connector, female, 50 Ω
EMF: 96 dBµV±1 dB

Rear-panel outputs
IF 74.7 MHz (ESHS10 only): Z_{out}=50 Ω, BNC connector, female
Gain ref. to RF input (RF attenuation 0 dB): 10 dB without preamplifier, 20 dB with preamplifier
Bandwidth (–3 dB): >2 MHz or bandwidth of preselector
IF 80 kHz: Z_{out}=50 Ω, BNC connector, female
EMF in range of analog level display for unmod. sinewave signal:
Operating range 30 dB: 1 to 30 mV
60 dB: 1mV to 1 V
Bandwidth=IF bandwidth
Video output (envelope detector): BNC connector, female
EMF in range of analog level display:
Operating range 30 dB: 4 to 126 mV
60 dB: 4 mV to 4 V
User interface: 25-contact Cannon connector; includes 6 control lines for an external device (eg artificial mains network), display voltage (analog) with and without simulation of meter response, input for external triggering, RS-232-C interface for firmware updating
Printer connection: parallel interface, 15-contact Cannon connector
Keyboard connection: DIN connector (5-contact) for MF2 keyboard

Rear-panel inputs
Ext. reference frequency: BNC connector, female
Required level: EMF ≥1 V from 50 Ω
Frequency: 5/10 MHz
Ext. battery: 3-contact connector
Required voltage: 11 to 33 V

General data

Rated temperature range: –10 to +55°C (no condensation allowed)
Storage temperature range: –25 to +70°C
ESHS30: temperature range for floppy disk drive: +5 to 50°C
Mechanical stress: shock-tested to MIL-STD-810D (shock spectrum 40 g), vibration-tested to MIL-T-28800D, class 5; complies with IEC Publ. 68-2-6
EMC: to EMC directive of EU (89/336/EEC) and German EMC law

Power supply
AC supply: 100/120/240 V ±10%, 230 V +6/–10%, 47 to 420 Hz (80 VA)
safety class I to VDE 0411 (IEC348)
Battery
Internal (ESHS10 only): 12 V, 10 Ah, operating time approx. 4 h
External
ESHS10: 11 to 33 V, 1.2 A at 24 V, 2.3 A at 12 V
ESHS30: 2.1 A at 24 V, 3.9 A at 12 V

Dimensions incl. controls (W × H × D)	
ESHS10	435 mm × 236 mm × 363 mm
ESHS30	435 mm × 236 mm × 463 mm
Weight	
ESHS10	21 kg/18 kg with/without batteries
ESHS30	28.6 kg

Ordering information

Order designation		
EMI Test Receiver ESHS10	1004.0401.10	
EMI Test Receiver ESHS30	1002.9001.30	
Accessories supplied	power cable, connector for external battery, operating manual, N- to-BNC adapter	
ESHS30 in addition	hood for screen	

Recommended extras

For interference measurements:		
RF Current Probe (9 kHz to 30 MHz)	ESH2-Z1	0338.3516.52
ESHS30:		
Current Probe 20 Hz to 100 MHz	EZ-17	0816.2063.02
Active Probe (9 kHz to 30 MHz, high-impedance)	ESH2-Z2	0299.7210.52
Passive Probe (9 kHz to 30 MHz, VDE 0876)	ESH2-Z3	0299.7810.52
Four-line Artificial Mains Network (9 kHz to 150 kHz/30 MHz, VDE 0876)	ESH2-Z5	0338.5219.52
Four-line Artificial Mains Network (150 kHz to 30 MHz, 200 A)	ENV 4200	1107.2387.02
Double Two-Wire ISN to CISPR22 for unshielded telecommunication ports	ENY22	1109.9508.02
Four-Wire ISN to CISPR22 for unshielded telecommunication ports	ENY41	1110.0175.02
Antenna Impedance Converter	EZ-12	1026.4800.02
Two-line V-Network	ESH3-Z5	0831.5518.52
V-Network 5 µH || 50 Ω	ESH3-Z6	0836.5016.52
Attenuator (20 dB, 10 W)	ESH2-Z11	0349.7518.52
Rod Antenna	HFH2-Z1	0335.3215.52
Rod Antenna (MIL)	HFH2-Z6	0837.1866.54
Loop Antenna (9 kHz to 30 MHz)	HFH2-Z2	0335.4711.52
Loop Antennna (9 kHz to 1 MHz)	HFH2-Z3	0335.6214.52
Inductive Probe	HFH2-Z4	0338.3016.52
Tripod	HFU-Z	0100.1114.02
Wooden Tripod (for HFH2-Z6)	HZ-1	0837.2310.02
Pulse Limiter 9 kHz to 30 MHz	ESH3-Z2	0357.8810.52
Highpass filter 150 kHz	EZ-25	1026.7796.02
Option		
3 additional RJ45 adapter sets for ENY41	ENY4-B1	1109.9950.02

Other accessories

6-V Lead Acid Storage Battery, maintenance-free, 10 Ah (2 required) (for ESHS10)		0338.4012.00
Keyboard (English)	PSA-Z1	1009.5001.32
Keyboard (German)	PSA-Z1	1009.5001.31
Headphones		0110.2959.00
Service Manual ESHS10		1004.0553.24
Service Manual ESHS30		1003.0272.24
Service Kit	EZ-8	0816.1067.02
19" Rack Adapter		
with front handles	ZZA-95	0396.4911.00
without front handles	ZZA-951	0396.9488.00
Set of Front Handles	ZZG-95	0396.5176.00
Cables		
RF Connecting Cable (BNC) (ESHS30)		
IEC-bus Connecting Cable		
1 m	PCK	0292.2013.10
2 m	PCK	0292.2013.20
Printer Cable	EZ-11	0816.1767.02
Control Cables for artificial mains networks		
from ESHS to ESH3-Z5, 2 m	EZ-14	1026.5341.02
from ESHS to ESH2-Z5, 2 m	EZ-13	1026.5293.02
from ESHS to ENV4200, 3 m	EZ-21	1107.2087.03
Control Cables for artificial mains networks in shielded cabins (both cables required)		
from ESHS to ESH3-Z5, 2 m	EZ-14	1026.5341.02
10 m	EZ-6	0816.0683.02
from ESHS to ESH2-Z5, 2 m	EZ-14	1026.5341.02
10 m	EZ-5	0816.0625.02
from ESHS to ENV4200, 3m	EZ-21	1107.2087.03
10 m	EZ-21	1107.2087.10
Feeder Cables for active antennas in shielded cabins (two required)		
3 m	HZ-3	0837.3469.02
10 m	HZ-4	0816.0519.02

Certified Quality System
ISO 9001
DQS REG. NO 1954-02

Fax Reply (EMI Test Receivers ESHS)

❑ **Please send me an offer**

❑ **I would like a demo**

❑ **Please call me**

❑ **I would like to receive your free-of-charge CD-ROM catalog**

Others: _____

_____

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Name: _____

Company/Department: _____

Position: _____

Address: _____

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Country: _____

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