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
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
EMI Test Receivers ESHS

- 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
- 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.

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

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 MF2 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 ESHS 10 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. tuning knob in 10 kHz, 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 x 10^-6 + 30 Hz |
| RF input | Zin=50 Ω, N connector, female |
| VSWR | <1.2 with ≥10 dB RF attenuation, <2 with 0 dB RF attenuation |
| Oscillator reradiation at RF input | <20 dBµV |
| without preamplifier | <10 dBµV |
| with preamplifier | switchable between input filter and 1st mixer |
| Gain | 10 dB |
| Preselector | five bandpass filters |
| 1st IF | 74.7 MHz |
| 2nd IF | 80 kHz |
| Intermediate frequencies | <1 dB |
| Level [f1, f2] at receiver input | Preamplifier on |
| f1 <2 MHz | -10 dBm |
| f1 >2 MHz | typ. +15 dBm |
| f2 >15 dBm | typ. +20 dBm |
| Intercept point k2 | typ. +5 dBm |
| Maximum input level | typ. -20 dBm |
| (with and without preamplifier) | typ. -20 dBm |
| RF attenuation 0 dB | typ. -20 dBm |
| DC voltage | 7 V |
| Sine wave AC voltage | 130 dBµV |
| Pulse spectral density | 96 dBµV/µHz |
| RF attenuation ≥10 dB (DC-coupled) | 7 V (± 1 W) |
| DC voltage | 137 dBµV |
| Sine wave AC voltage | 700 V |
| Max. pulse voltage (10 µs) | 100 mWs |

Interference rejection, non-linearities

Image frequency rejection
1st IF >90, typ. 100 dB
2nd IF >75 dB
Intercept point d3, with | off | on |
| Level [f1, f2] at receiver input | Preamplifier |
| f1 <2 MHz | -10 dBm | typ. 15 dBm |
| f1 >2 MHz | >15 dBm | typ. >20 dBm |
| Intercept point k2 | typ. >20 dBm |

RF shielding
Voltage indication at a field strength of 10 V/m with 0 dB RF attenuation [f -fin] <10 dBµV
Additional error in quasi-peak indication range | <1 dB |

1st IF | 74.7 MHz |
| 2nd IF | 80 kHz |

IF bandwidths
Nominal bandwidth | <6 dB |
| Nominal bandwidth | ±20% |
| Nominal bandwidth | ±6 dB |

Shape factor
200 Hz
200 Hz
200 Hz
10 kHz
10 kHz

| BW_{60 dB}/BW_{30 dB} | 1:8 (typ.) |
| BW_{60 dB}/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

<table>
<thead>
<tr>
<th>Average value, BW=200 Hz</th>
<th>Preamplifier on</th>
</tr>
</thead>
<tbody>
<tr>
<td>f&lt;sub&gt;s&lt;/sub&gt; =9 to 50 kHz</td>
<td>&lt;24 to &lt;30 dBµV</td>
</tr>
<tr>
<td>f&lt;sub&gt;s&lt;/sub&gt; =50 kHz</td>
<td>&lt;30 dBµV</td>
</tr>
<tr>
<td>Average value, BW=10 kHz</td>
<td>&lt;14 dBµV</td>
</tr>
<tr>
<td>Peak value, (typ. increase as against average value)</td>
<td>+11 dB</td>
</tr>
<tr>
<td>Quasi-peak Band A (9 to 50 kHz)</td>
<td>&lt;24 to &lt;30 dBµV</td>
</tr>
<tr>
<td>Band B (&gt;150 kHz)</td>
<td>&lt;13 dBµV</td>
</tr>
<tr>
<td>PK/MHz (BW=10 kHz)</td>
<td>&lt;34 dBµV/MHz</td>
</tr>
<tr>
<td>Voltage measurement range f&lt;sub&gt;s&lt;/sub&gt; &gt;50 kHz</td>
<td></td>
</tr>
<tr>
<td>Lower limit (additional error caused by inherent noise &lt;1 dB)</td>
<td></td>
</tr>
<tr>
<td>Average indication (AV)</td>
<td></td>
</tr>
<tr>
<td>BW=200 Hz</td>
<td>&lt;26 dBµV, Typ. =31 dBµV</td>
</tr>
<tr>
<td>f&lt;sub&gt;s&lt;/sub&gt; =50 kHz</td>
<td>&lt;32 dBµV, Typ. =37 dBµV</td>
</tr>
<tr>
<td>Peak indication (PK)</td>
<td></td>
</tr>
<tr>
<td>BW=200 Hz</td>
<td>&lt;8 dBµV, Typ. =13 dBµV</td>
</tr>
<tr>
<td>f&lt;sub&gt;s&lt;/sub&gt; =50 kHz</td>
<td>&lt;16 dBµV, Typ. =20 dBµV</td>
</tr>
<tr>
<td>Quasi-peak indication (QP)</td>
<td></td>
</tr>
<tr>
<td>CISPR band A</td>
<td>&lt;30 dBµV</td>
</tr>
<tr>
<td>CISPR band B</td>
<td>&lt;30 dBµV</td>
</tr>
<tr>
<td>Upper limit</td>
<td>137 dBµV (RF attenuation &gt;10 dB)</td>
</tr>
</tbody>
</table>

Inherent spurious response <10 dBµV (equiv. input voltage)

Level display
digital in dBµV, dBµA, dBm, dBµV/m, dBµV/W analog
3½ digits, resolution 0.1 dB on moving-coil meter in operating range of RF detector with additional digital display of lower range limit 30, 60, 120, 240, 480, 960 dB
Operating ranges
5” CRT with digital display memory 1024 x 1024 pixels
Screen (RF analysis) [ESHS30 only]
Display range X axis (frequency) freely selectable between 9 kHz and 30 MHz
Y axis (level) 10 to 200 µV, 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)
Measurement 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]
Resolution Display range 10 kHz to 2 MHz in 1, 2, 5 steps
<3 dB Shape factor (50%) BW<sub>10kHz</sub> 60 kHz
Nominal bandwidth 10 kHz 3 kHz 1 kHz
<1 kHz 1.4 1.6 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 MS-DOS-compatible HP GL or binary

Connectors and interfaces
Remote control 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 12-contact Tuchel connector
EMF adjustable up to 2 V
Generator output (ESHS30 only) N connector, female, 50 Ω EMF 96 dBµV ±1 dB
Rear-panel outputs
Output to IEC 625-2 (IEEE 488.2)
Gain ref. to RF input (RF attenuation 0 dB) 100 V without preamplifier, 20 V with preamplifier
Bandwidth -3 dB 20 MHz or bandwidth of preselector Z<sub>in</sub> = 50 Ω, BNC connector, female
EMF in range of analog level display for unmod. sine wave signal
Operating range 30 dB 4 mV to 4 V
EMF display voltage (analog) with and without external triggering, RS-232-C interface for firmware updating parallel interface, 15-contact Cannon connector
Printer connection 25-contact Cannon connector
Keyboard connection DIN connector (5-contact) for MF2 keyboard
User interface parallel interface for firmware updating parallel interface, 15-contact Cannon connector
Rear-panel inputs
Ext. reference frequency EMF ≥1 V from 50 Ω
Required level 5/10 MHz
Frequency 3-contact connector
External 11 to 33 V
Required battery
General data
Rated temperature range −10 to +55 °C
[no condensation allowed]
Operating spectrum 40 g, vibration-tested to MIL-T-28800D, class 5; complies with IEC Publ. 68-2-6
EMC to IEC directive of EU (89/336/ECC) and German EMC law
Power supply
AC supply 100/120/240 V ±10%, 230 V ±10%, 47 to 420 Hz (80 VA)
safety class I to VDE 0411 (IEC 348)

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
ESHS30 2.3 A at 12 V
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, active probe 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 ENY41: 1107.9508.02
- Two-Wire ISN to CISPR22 for unshielded telecommunication ports ENY41: 1110.0175.02
- 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
- Rad Antenna ESH2-Z1: 0335.3215.52
- Rad Antenna (ML) ESH2-Z6: 0837.1866.54
- Loop Antenna (9 kHz to 30 MHz) ESH2-Z2: 0335.4711.52
- Loop Antenna (9 kHz to 1 MHz) ESH2-Z3: 0335.6214.52
- Inductive Probe ESH2-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: 0357.9810.52
- Highpass filter 150 kHz EZ-25: 1026.7796.02

Option

- 3 additional RJ45 adapter sets for ENY41 ENY481: 1109.9950.02

Other accessories

- 6-V Lead Acid Storage Battery, maintenance-free, 10 Ah (2 required) 0338.4012.00
- Keyboard (English) PSA-Z1: 1009.5001.32
- Keyboard (German) PSA-Z1: 1009.5001.31
- Headphones 0110.2599.00
- 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
- RF Connecting Cable (BNC) ESHS30: 0816.1767.02
- IECbus Connecting CableEZ-11: 0299.2013.10
- Printer Cable PCK: 0299.2013.20
- Control Cables for artificial mains networks from ESHS to ESHS3-Z5: 2 m EZ-14: 1026.5341.02
- from ESHS to ESHS2-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 ESHS3-Z5: 2 m EZ-14: 1026.5341.02
- from ESHS to ESHS2-Z5: 2 m EZ-13: 1026.5293.02
- from ESHS to ENV4200: 3 m EZ-21: 1107.2087.03

For interference measurements in shielded cabins (both cables required)
- Control Cables for artificial mains networks from ESHS to ESHS3-Z5: 2 m EZ-14: 1026.5341.02
- from ESHS to ESHS2-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 (two required)
- 3 m EZ-21: 1087.2087.10
- 10 m EZ-21: 1087.2087.10

For active antennas in shielded cabins (two required)
- 3 m EZ-21: 1087.2087.10
- 10 m EZ-21: 1087.2087.10

Certified Quality System

ISO 9001
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: __________________________________________
       __________________________________________
       __________________________________________

Name: __________________________________________
Company/Department: ______________________________
Position: _________________________________________
Address: _________________________________________
          __________________________________________
          __________________________________________

Country: _________________________________________
Telephone: _______________________________________
Fax: _____________________________________________
E-mail: __________________________________________