EMC/Field-Strength Measurements

EMI Test Receivers ESHS 10 and ESVS 10

ESH 10: 9 kHz to 30 MHz
ESHV 10: 20 MHz to 1000 MHz

Test receivers for commercial EMI measurements

Brief description

The receivers ESHS 10 and ESVS 10 are suitable for measuring electromagnetic interference in line with commercial standards:
- CISPR 16, VDE 0876 and ANSI C63.2
- EN 55011 to 5522, ETS, FCC, VCCI and VDE 0871 to 0879 and ANSI C63.4

Applications

The instruments are ideal for routine tasks in industry such as development and approval tests in line with commercial standards. Featuring mains-independent battery powering, they are also suitable for mobile applications at EMC service providers, test houses and safety standard authorities.

Main features

- Calibrated attenuator with high pulse loading capacity, switchable in 10-dB steps from 0 to 120 dB
- Comprehensive preselection filters
- Switchable preamplifier with wide dynamic range
- Crystal-stabilized, fast synthesizer with high resolution and sweep mode for fast frequency scanning
- High-level mixer with high oscillator rejection
- Delay-equalized IF filters
- Automatic overload detection in mixer stages and in test channel by permanently activated peak detectors

Powerful processor system

- Manual operation or internal or external processor control
- Flash EPROMs for convenient and fast firmware update through PC
- Macros for automatic and semi-automatic test runs
- Automatic level calibration
- Automatic consideration of frequency-dependent transducer factors
- All built-in functions fully programmable via IEC/IEEE bus
- Fast measurement in external trigger mode; output of up to 5000 values/s via IEC/IEEE bus, up to 400 values/s including frequency change within certain frequency bands
- 12-bit A/D converter with short conversion time, measurement time selectable between 1 ms and 100 s
- High measurement accuracy thanks to automatic total calibration
- Automatic monitoring of all synthesizer loops and supply voltages during operation

Detailed specifications:

- Superior circuit design
  - High measurement accuracy, typical error 0.5 dB
  - Wide dynamic range, typical noise figure 7 dB with preamplifier, third-order intercept point 20 dBm (without preamplifier)
EMC/Field-Strength Measurements

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Optimum result display and printout
- Measurement of voltage, field strength, current and pulse spectral density with display of relevant units
- Indication of result on analog meter or digital display with 0.1 dB resolution
- Output of results as lists and diagrams on printer including limit lines

Further features
- Digital level indication on LCD and analog level indication on moving-coil meter taking into account transducer factors and their units
- Numerous interfaces for driving or feeding additional devices
- AC supply as well as battery powering for mobile applications

Operation
RFI field-strength and RFI power measurements
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. The receivers feature conventional test receiver operation with tuning knob, indication of results on a meter and built-in loudspeaker.

Nonvolatile storage of 22 limit lines and transducer factors with up to 50 values is possible. By combining the transducer factors, all test configurations occurring in practice can be covered.

Macros for semi-automatic test runs (ANALYSIS OPTIONS) match the test receivers to the specific configuration, device under test and test specification. Being thus prepared, the test receivers perform the following routines:
- Fast prescan measurement using peak or average detector
- Determination of critical frequencies by means of limit lines with data reduction to shorten the measurement time
- Final measurement at critical frequencies using average and/or peak detector
- Output of results on printer

The test receivers offer a choice between automatic, semi-automatic and user-controlled test runs. Scan options are available for prescan measurements, data reduction and final measurements.

Data reduction is the main criterion for optimizing the test run. It is the link between prescan interference measurement and correct weighting with test parameter variation (final measurement) to reduce measurement time. There are also scan options taking account of the test configuration, for instance measuring RFI voltage with LISNs, RFI power with an absorbing clamp and RFI field strength with antennas.

Design
The modular design of the test receivers provides excellent RF shielding and great convenience for servicing. An extremely low-noise, temperature-controlled fan ensures low self-heating. The comprehensive selftest functions allow easy identification of a faulty module which can be replaced with a minimum of effort and without affecting the other modules.

Specifications in brief: ESHS

<table>
<thead>
<tr>
<th>Specification</th>
<th>ESHS10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>9 kHz to 30 MHz</td>
</tr>
<tr>
<td>Frequency setting</td>
<td>in 10 Hz, 10 kHz steps or user-selectable step size for RF analysis</td>
</tr>
<tr>
<td>Automatic scan</td>
<td></td>
</tr>
<tr>
<td>Display</td>
<td>7-digit LCD</td>
</tr>
<tr>
<td>Resolution</td>
<td>10 Hz</td>
</tr>
<tr>
<td>Frequency drift</td>
<td>&lt;3 x 10^{-6} + 30 Hz</td>
</tr>
<tr>
<td>RF input</td>
<td>N connector, 50 Ω</td>
</tr>
<tr>
<td>VSWR</td>
<td>&lt;1.2 with 10 dB RF attenuation,</td>
</tr>
<tr>
<td></td>
<td>&lt;2 without 0 dB RF attenuation</td>
</tr>
<tr>
<td>Preamplifier</td>
<td>10 dB, can be connected between preselector and 1st mixer</td>
</tr>
<tr>
<td>Preselector</td>
<td>5 fixed-tuned filters</td>
</tr>
<tr>
<td>Maximum input level</td>
<td>7 V (corresp. to 1 W)</td>
</tr>
<tr>
<td>Sinewave AC voltage</td>
<td>137 dBuV</td>
</tr>
<tr>
<td>Max. pulse voltage (10 μs)</td>
<td>700 V</td>
</tr>
<tr>
<td>Max. pulse energy (10 μs)</td>
<td>100 mWs</td>
</tr>
<tr>
<td>Interference rejection, nonlinearity</td>
<td></td>
</tr>
<tr>
<td>Image-frequency rejection</td>
<td></td>
</tr>
<tr>
<td>1st IF</td>
<td>&gt;30, typ. 100 dB</td>
</tr>
<tr>
<td>2nd IF</td>
<td>&gt;75 dB</td>
</tr>
<tr>
<td>IF rejection</td>
<td>&gt;30, typ. 100 dB</td>
</tr>
<tr>
<td>Intercept point d3 with</td>
<td></td>
</tr>
<tr>
<td>and 0 dB RF attenuation</td>
<td></td>
</tr>
<tr>
<td>Level (f1, f2) at receiver</td>
<td>preamplifier off</td>
</tr>
<tr>
<td>f1c, &lt;2 MHz</td>
<td>2x –10 dBm</td>
</tr>
<tr>
<td>f1c, ≥2 MHz</td>
<td>typ. 15 dBm</td>
</tr>
<tr>
<td></td>
<td>&gt;15 dBm, typ. &gt;0 dBm, typ. &gt;5 dBm</td>
</tr>
<tr>
<td>Intercept point k2</td>
<td>&gt;40 dBm</td>
</tr>
<tr>
<td></td>
<td>&gt;20 dBm</td>
</tr>
</tbody>
</table>

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RF shielding
Voltage indication at field strength of 10 V/m with 0 dB
RF attenuation (f = f0)
Additional error in CISPR indication range at 10 V/m

IF bandwidth
200 Hz/10 kHz

Displayed noise floor
Average value, BW=200 Hz
preamplifier off preamplifier on
Displayed noise floor (average value)
Average value, BW=10 kHz
preamplifier off preamplifier on
Peak value (typ. increase relative to average value)
Quasi-peak
Band A (9 kHz to 50 kHz)
50 kHz to 150 kHz
Band B (≥150 kHz)
PK/MHz (BWf = 10 kHz)
Voltage measurement range (f0, -50 kHz)
Lower limit:

Level display
Digital
3½ digits, resolution 0.1 dB in dBµV, dBµA, dBm, dBµV/m or dBµA/m on moving-coil meter in operating range of IF detector with additional digital display of lower range limit
Operating ranges
30 dB, 60 dB

Display modes (detectors)
Average (AV), peak (PK), spectral density measurement (PK/MHz), quasi-peak (QP)
Averaging, hold and meas. times
1 ms to 100 s (1/2/5 steps)

Measurement accuracy (AV for S/N >16 dB)
Digital display
<1 dB

Date, time of day
Internal clock

Remote control
to IEC 625-2 (IEEE 488-2) HP-GL

Front-panel outputs
Supply and coding connector for antennas, etc
AF output 12-contact Tuchel connector jack JK34, 10 Ω

Rear-panel outputs
IF 74.7 MHz (ESHS10 only) BNC connector, 50 Ω
Bandwidth (< 3 dB) 2 MHz or bandwidth of preselector
IF 80 kHz BNC connector, 50 Ω
Video output (envelope demod.) BNC connector

Interfaces
25-pin contact Cannon connector, includes 6 control lines for an external device (e.g. LISN), display voltage with and without meter simulation, input for external triggering, RS-232-C interface for firmware update

Printer connection parallel interface
Keyboard connection 5-contact connector for MF2 keyboard

Rear-panel inputs
Ext. reference frequency
Frequency 5/10 MHz
Ext. battery 3-contact connector
Required voltage 11 V to 33 V

General data
AC supply 100/120/220/240 V ±10%, 47 Hz to 440 Hz
Power consumption
Internal battery 12 V, 10 Ah
Operating hours approx. 4 h
External battery 11 V to 33 V
Current drain 47 Hz to 440 Hz
1.2 A/2.3 A
Dimensions (W x H x D) 435 mm x 236 mm x 363 mm
Weight 18 kg (21 kg with battery)

Specifications in brief: ESVS

Data specified below differ from that of ESHS.

Frequency range
20 MHz to 1000 MHz
Frequency setting with tuning knob
in 100 Hz, 100 kHz steps or user-selectable step size
numerical in steps
any size selectable
automatic scan for RF analysis
Display 8-digit LCD
Resolution 100 Hz
Frequency drift <3 x 10^-4

RF input
Connector N, 50 Ω
<1.2 with ≥10 dB RF attenuation,
<2 with 0 dB RF attenuation
Preamplifier can be switched between preselector and 1st mixer
Gain 10 dB

Preselector
1 fixed-tuned and 5 tracking filters

Maximum input level (with and without preamplifier)
RF attenuation ≥10 dB
DC voltage 50 V
Sine wave AC voltage 137 dBµV (corresp. to 1 W)
Max. pulse voltage 150 V
Max. pulse energy (20 µs) 10 mWs
EMC/Field-Strength Measurements

EMI Test Receivers ESHS10 and ESVS10

RF attenuation ≥10 dB (option ESVS-B1)
- DC voltage 7 V
- Sinewave AC voltage 137 dBuV (corresp. to 1 W)
- Max. pulse voltage 1500 V
- Max. pulse energy (10 µs) 100 mWs

Interference rejection, nonlinearities
- Image frequency rejection typ. 100 dB
- IF rejection >90, typ. 100 dB

Intercept point d3
- Preamp. off: P1=2x (−10 dBm) typ. +20 dBm
- Preamp. on: P1=2x (−20 dBm) typ. +10 dBm

Intercept point k2
- >35 dBm
- >25 dBm

RF shielding
- Intermediate frequencies
  - 1st/2nd/3rd IF 1354.7/74.7/10.7 MHz
  - IF bandwidths 10/120 kHz
  - BW=120 kHz
  - IF=10 kHz
  - Peak value, BW=10 kHz
  - Quasi-band C/D
  - PK/MHz (spectral density measurement, BW=120 kHz)

Displayed noise floor
- Average value, BW=10 kHz
- Peak value, BW=10 kHz
- Quasi-band C/D
- PK/MHz (spectral density measurement, BW=120 kHz)

Voltage measurement range
- Lower limit (additional error caused by inherent noise <1 dB):
  - Average indication (AV)
  - Peak indication (PK)
  - Quasi-peak indication (QP)

Quasi-peak band C/D
- (100 Hz pulse frequency)
- Preamp. off typ. −16 dBuV
- Preamp. on typ. −21 dBuV

Peak value, BW=10 kHz
- typ. −4 dBuV
- typ. −8 dBuV

Quasi-band C/D
- typ. +2 dBuV
- typ. +1 dBuV

PK/MHz (spectral density measurement, BW=120 kHz)
- typ. +25 dBuV
- typ. +21 dBuV

Level display
- Digital 3½ digits, resolution 0.1 dB in dBuV, dBµA, dBm, dBµV/m, dBµA/m or dBpW
- Analog

Demodulation modes
- A0, A3, F3

Remote control
- to IEC 625-2 (IEEE 488-2)

Front-panel outputs
- Supply and coding connector for antennas, etc
- AF output
- 12-contact Tuchel connector
- jack JK34, 10 Ω

Rear-panel outputs
- IF 74.7 MHz (ESVS10 only) BNC connector, 50 Ω
- IF 10.7 MHz BNC connector
- BNC connector
- Video output
- BNC connector

Interfaces
- 25-contact Cannon connector, includes 6 control lines for an external device (e.g. LISN), display voltage with and without meter simulation, input for external triggering, RS-232-C interface for firmware update
- Printer connection parallel interface
- Keyboard connection 5-contact connector for MF2 keyboard

Rear-panel inputs
- Ext. reference frequency
  - Frequency
  - Ext. battery
  - Required voltage
- 10 V to 33 V

Date, time of day
- internal clock

General data
- AC supply 100/120/220/240 V ±10%, 47 Hz to 440 Hz
- Power consumption 60 VA
- Internal battery
  - approx. 2.5 h
- External battery
  - Current drain 24 V/12W
- Dimensions (W x H x D)
  - 435 mm x 236 mm x 363 mm

Ordering information
- EMI Test Receiver
  - ESHS 10
  - ESVS 10
  - 1004.0401.10
  - 1011.2006.10

Intercept point d3
- Before preamp. off: |f1−f2| ≥ 5 MHz typ.
  - +20 dBm typ. +10 dBm
- Before preamp. on: |f1−f2| ≥ 5 MHz typ.
  - +10 dBm typ. +0 dBm

Intercept point k2
- Before preamp. off: >35 dBm
- Before preamp. on: >25 dBm

Displayed noise floor
- Before preamp. off: −15 dBuV
- Before preamp. on: −21 dBuV

Peak value, BW=10 kHz
- typ. −8 dBuV
- typ. −10 dBuV

Quasi-band C/D
- typ. +1 dBuV
- typ. +2 dBuV

PK/MHz (spectral density measurement, BW=120 kHz)
- typ. +25 dBuV
- typ. +21 dBuV

PK/MHz (spectral density measurement, BW=10 kHz)
- typ. +25 dBuV
- typ. +21 dBuV

Quasi-peak band C/D typ. +2 dBuV
- typ. +25 dBuV
- typ. +21 dBuV

PK/MHz (spectral density measurement, BW=120 kHz) typ. 25 dB
- typ. +25 dBuV
- typ. +21 dBuV

Ordering information
- EMI Test Receiver
  - ESHS 10
  - ESVS 10
  - 1004.0401.10
  - 1011.2006.10