ROHDE & SCHWARZ

ESH 3

TEST RECEIVER ESH 3

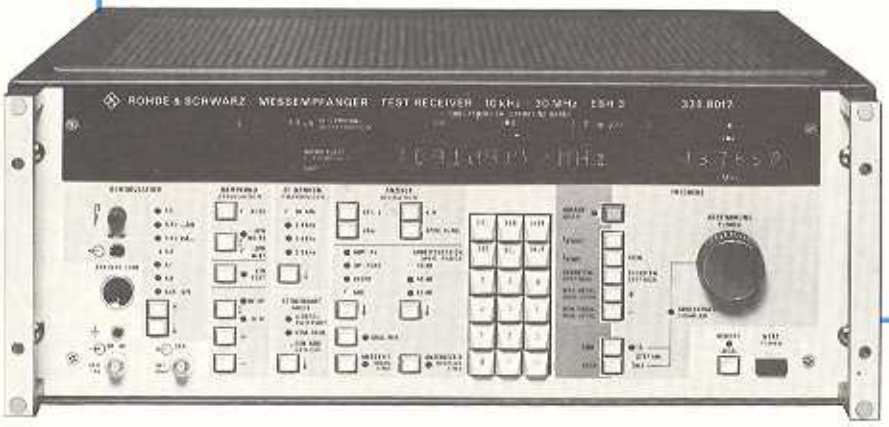
IEC-Bus

9 kHz to 30 MHz
−30 to +137 dBµV

Data sheet
335.801
E - 1

CHARACTERISTICS, USES

ESH 3 — Programmable Test Receiver ESH 3 ♦ 9 kHz to 30 MHz
−30 to +137 dBµV



- Field-strength measurements in conjunction with test antennas
- Radio-interference (EMI) measurements to CISPR, VDE and FCC regulations
- Interference (EMI) measurements to MIL and VG regulations
- Radiomonitoring, remote frequency measurements
- Selective voltage measurements in laboratory and test department

IEC625Bus

The **Test Receiver ESH 3** demodulates and measures AM double-sideband, single-sideband, PM and FM signals, as well as sinusoidal and impulsive interference, over the range 9 kHz to 30 MHz. High overload capacity, wide dynamic range, manifold measuring and evaluation capabilities, and numerous available accessories make the ESH 3 suitable for selective voltage and two-port measurements – also in automatic test systems – and for all applications in the field of **radiomonitoring** (page 5) and **EMC** (**e**lectro**m**agnetic **c**ompatibility – EMI measurements – page 4).

Selective voltmeter. Its wide measurement range of −30 to +137 dBµV permits the use of the Test Receiver ESH 3 as an automatic **high-precision** selective voltmeter in the laboratory, test department and service workshop without any accessory units. For high-impedance test items the Active Probe ESH 2-Z2 can be supplied. The Clamp-on RF Current Probe ESH 2-Z1 is available for measuring RF current in electric conductors. Excellent receiver selectivity makes it possible to measure signals of large level differences to a high degree of accuracy even when there are many signals present. Possible applications: SSB two-tone measurements, measurement of harmonics, non-harmonic spurious signals and sideband noise on generators, intermodulation and crossmodulation measurements on RF modules. In all these applications the ESH 3 can be set either to low-noise or low-distortion measurement. Automatic linearity testing permits an inherent non-linearity to be distinguished from that of the test item.

Other features

- Synthesizer-based design offers frequency setting and readout to crystal accuracy – resolution 100 Hz
- Automatic frequency scanning with selectable start and stop frequencies and step sizes – recording of measured results on printer and/or XY recorder (VDE/FTZ/MIL chart paper can be used)
- Accuracy in compliance with CCIR recommendations
- Automatic calibration of level and frequency offset measurements; frequency response and bandwidth correction values are automatically taken into consideration, making for optimum speed and accuracy of level measurements
- Automatic measurement of voltage, field strength, current, pulse spectral density, and two-port attenuation, with indication of respective physical unit; conversion factors for probes and test antennas and bandwidth correction values are automatically taken into consideration
- Digital data output in µV to V, dBµV, dBm and corresponding units for current field strength, and pulse spectral density
- High overload capacity, outstanding overall selectivity, **automatic indication when overdriven;** automatic linearity test triggered at the push of a key
- Programmable measuring times of 5 ms to 100 s for average-value and peak-value indication; determination of RF input level variation (MAX./MIN. as in cases where fading occurs) with programmable measuring times
- Two-port and remote frequency measurement capability
- Additional signal evaluation capabilities: frequency-offset, modulation-depth and frequency deviation
- Storage of 9 complete device settings and 5 range limits for automatic frequency scanning; stored contents and last device setting are preserved when the receiver is switched off or the current supply is interrupted
- Remote-control interface conforming to IEC 625-1 (IEEE 488) for universal application; Talk-Only Mode for data output to IEC(IEEE)-bus-compatible printer without using a controller

Calibration generator. The calibration generator output providing 80 dBµV ±0.5 dB into 50 Ω at receiver centre frequency is ideally suited for measuring the frequency response of amplifiers and filters. The attenuation measurement range extends to 110 dB and the gain measurement range to 57 dB. The RF Current Probe ESH 2-Z1 permits easy measurement of the **shielding effectiveness** of cables. The **return loss** of two-terminal networks (e.g. antennas) and of four-terminal networks can be measured with the calibration generator in conjunction with a VSWR bridge.

In the remote frequency mode it is possible to connect a frequency counter to the generator output for exact (remote) frequency measurement of the signal received by use of the reconversion principle.

Signal evaluation

- **Four** switchable **IF bandwidths:** 0.2/0.5/2.4/10 kHz
- Average, peak and pulse weighted (CISPR Publ. 1 and 3) indication with programmable measuring times
- Switch-selected demodulation modes **A0, A1, A3, A3J (USB, LSB), F3** - built-in loudspeaker and phones output
- **Analog indication** of level and frequency offset in addition to the **digital data output**
- Indication of RF input overload or overloading of other essential stages and automatic **linearity test** at the push of a key
- **Broadband 75-MHz IF output** for connection of panoramic adapter or spectrum analyzer
- **Narrowband 30-kHz IF output** for connection of oscilloscope
- AM and FM demodulator outputs
- Recorder outputs for level and frequency offset
- **Generator output** for signal frequency measurement
- Digital measurement of modulation depth, frequency offset and deviation

Recording of results. Spectra of harmonics, non-harmonic spurious signals and sideband noise as well as gain and attenuation curves can be readily output on an XY recorder (Figs. 1 and 2). The start and stop frequencies and maximum and minimum levels set on the ESH 3 define the recorder writing area. The frequency axis can be either linear or logarithmic. VDE/FTZ/MIL or the user's own chart paper can be used.

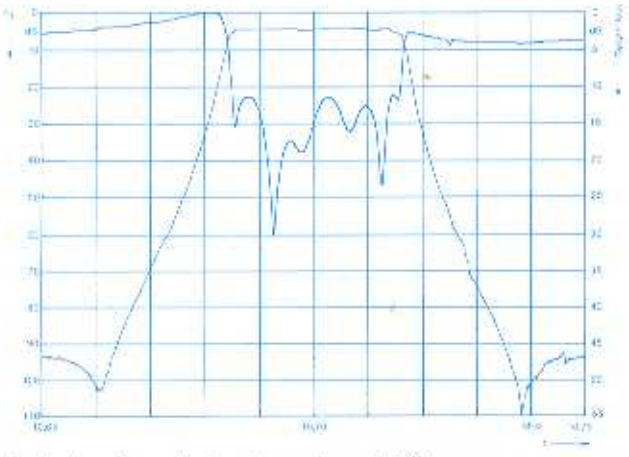


Fig. 1 Insertion and return loss of a crystal filter.

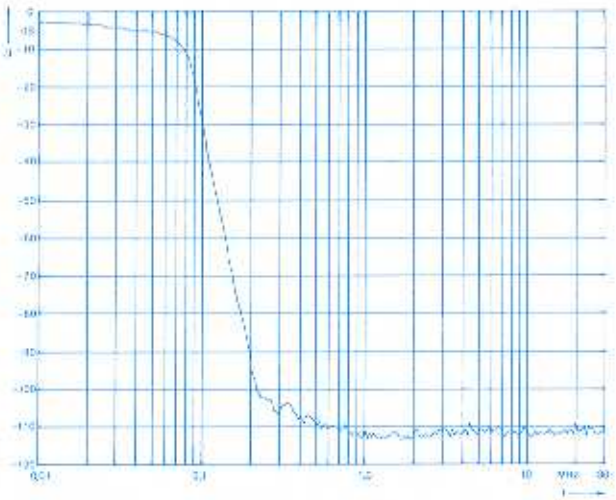


Fig. 2 Attenuation curve of a low-pass filter.

Remote control. The **IEC(IEEE)-bus interface** is provided with all standard listener and talker capabilities. The capabilities of commercially available controllers (Fig. 3) have, however, also been taken into consideration, i.e. it is also possible, for example, to use controllers without serial and parallel poll capabilities.

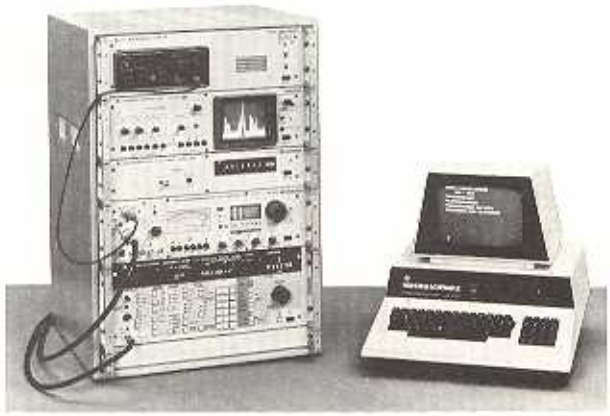


Fig. 3 Automatic test system for 9 kHz to 1000 MHz, measurement range -30 (-10) to +137 dBµV, consisting of Test Receiver ESH 3 (at bottom), Programmable VHF-UHF Test Equipment MSUP, and Process Controller PPC.

CHARACTERISTICS, USES

Interface functions:

Device Clear resets all functions to a predefined state.

Device Trigger starts test run at exactly defined time.

Local Lockout disables the front panel during automatic test run.

Talk-Only Mode outputs measured data without using a controller.

Interference measurements. In the field of interference measurements the ESH 3 offers considerable advantages over earlier test receivers, featuring programmable automatic frequency scanning and data logging with **direct control** of a printer or XY recorder. The following accessories are available for measuring interference voltages, currents and field strengths to the applicable standards (CISPR, VDE, MIL, VG, FCC):

RF Current Probe	ESH 2-Z1
Active Probe	ESH 2-Z2
Passive Probe [1]	ESH 2-Z3
Artificial Mains Network (LISN) (9 kHz to 30 MHz) [2]	ESH 2-Z5
Rod Antenna	HFH 2-Z1
Loop Antenna	HFH 2-Z2
Inductive Probe	HFH 2-Z4

(See also Accessories for Programmable Test Receiver ESH 3, Data sheet 303 203.)

Fig. 4 Automatic measurement of interference voltage with programmed phase switchover (Test Receiver ESH 3, Printer PUD, XYT Recorder ZSKT, Artificial Mains Network (LISN) ESH 2-Z5, Process Controller PPC, and Code Converter PCW). Door to test item open for demonstration purposes.

As interference in the frequency range 9 kHz to 30 MHz is mainly propagated along lines (conducted), interference voltage and current measurements are of major importance (Figs. 4 to 6). In addition to data logging on a printer or XY recorder the ESH 3 offers the following advantages for measuring interference:

- Probe or test antenna conversion factor automatically taken into consideration and indication of appropriate physical unit
- Bandwidth correction factor automatically taken into consideration when measuring pulse spectral density to MIL and VG standards; readout of measured data in dBµV/MHz, dBµA/MHz and dBµV/m · MHz
- Peak-value indication with programmable hold time for broadband interference measurements to MIL and VG standards
- Average-value indication with programmable integration time for measuring narrowband interference
- CISPR indicating mode with determination of peak value within programmed measuring time
- Programmable measuring times ensuring optimum adaptation of automatic measurements to time-dependent variations of the interference
- Automatic selection of weighting to CISPR depending on frequency (CISPR 3 for 9 to 149.9 kHz and CISPR 1 for 0.15 to 30 MHz)
- 60-dB operating range: ideal for measurements to MIL and VG standards
- 20-dB operating range: for measurements to CISPR, automatic selection of measurement range and consideration of CISPR settling times ensuring errorfree measurements
- Selectable logarithmic frequency scale for data output on XY recorder, permitting direct recording of measured data on tolerance charts

Since the characteristic of broadband noise spectra is a continuous curve, frequency scanning in constant linear or logarithmic steps is possible and appropriate. Each single value, especially with CISPR weighting, is measured with due consideration of the overall settling time (charging and discharging time constant, time constant of low-pass filter simulating meter response).

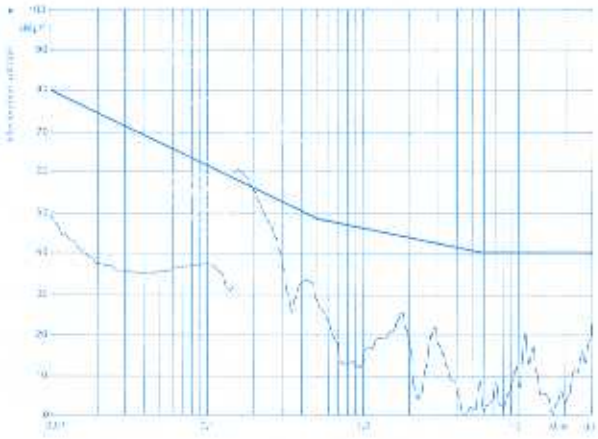


Fig. 5 Interference voltage of commercial desk-top calculator, measured in conjunction with Artificial Mains Network (LISN) ESH 2-Z5 (indicating mode: CISPR). Tolerance curve to FTZ regulation 529/1970 (limit levels for general approval).

Besides these final measurements, the ESH 3 in conjunction with the Active and the Passive Probe, RF Current Probe and Inductive Probe is also suitable for **investigating noise sources** and testing suppression measures. The generator output of the ESH 3 permits **attenuation measurements on two-port networks** up to 110 dB so that the effectiveness of RF cable screens and other shieldings, and the attenuation of interference suppression filters can be measured.

[1] To VDE 0876 regulation.
[2] To VDE 0876 regulation, CISPR Publ. 3 and FCC requirements.

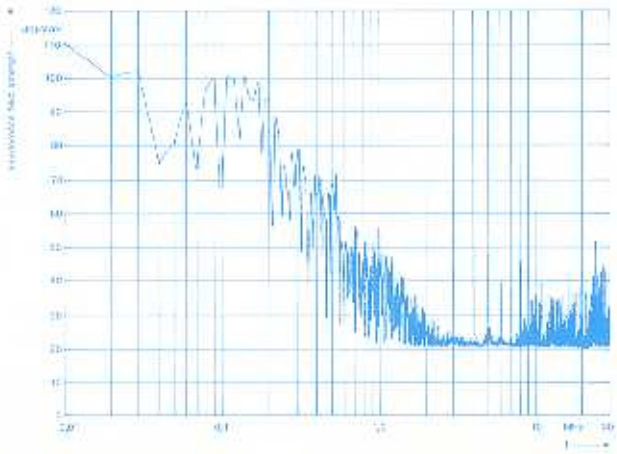


Fig. 6 Interference field strength of a commercial desk-top calculator, measured in conjunction with Loop Antenna HFH 2-Z2 in a screened room at 1 m from test item (indicating mode: average value, IF bandwidth: 10 kHz, step size 10 kHz).

Radiomonitoring. Its outstanding RF characteristics, such as high setting accuracy, high overload capacity and overall selectivity, selectable IF bandwidths and demodulation modes, the wide range of available test antennas and recorders as well as programmability make the ESH 3 suitable for all **radiomonitoring tasks** including **remote frequency measurement, recording of frequency band occupancy** and **propagation and coverage measurements.** It offers the following possibilities:

- Graphic representation of field strength of selected frequency bands either in form of a line spectrum or as a continuous curve on an XY recorder plus output of measured field-strength level and; for example, of modulation depth on a printer (Figs 7 to 11).

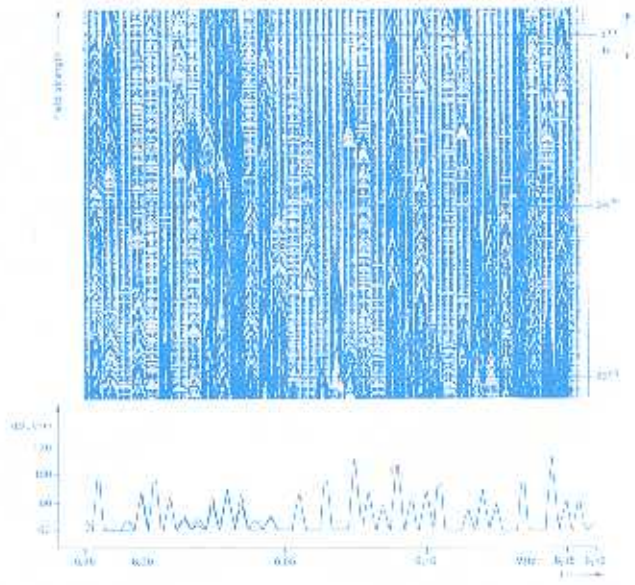


Fig. 7 Recording of 49-m band on Recorder ZSKT; XYT representation (above) and XY representation (below).

```
STRT  0.5400MHz
STOP  1.6020MHz
STEP  0.0090MHz
MAX    120.0dB*
MIN     40.0dB*

SF  11:dB*
SF  21:m
SF  50:SINGLE
SF  52:LINSTEP
SF  60:X-LIN
SF  71:DISCRET

0.5490MHz     55.9dBuV/m   75%
0.5760MHz     59.6dBuV/m   70%
0.5940MHz     46.5dBuV/m   25%
0.6390MHz     53.6dBuV/m    9%
0.6660MHz     57.6dBuV/m   81%
0.7200MHz     72.7dBuV/m   86%
0.7560MHz     50.0dBuV/m   13%
0.8010MHz    108.4dBuV/m   37%
1.0170MHz     44.0dBuV/m   95%
1.0260MHz     50.5dBuV/m   40%
1.0440MHz     46.6dBuV/m   71%
1.1070MHz    101.3dBuV/m   68%
1.1970MHz     94.9dBuV/m    4%
1.4220MHz     53.1dBuV/m   61%
1.5390MHz     52.8dBuV/m   54%
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Fig. 8 Printout of automatic frequency scan over medium-wave range (ESH 3 in Talk-Only Mode, Universal Printer PUD with IEC(IEEE)-bus interface in Listen-Only Mode).

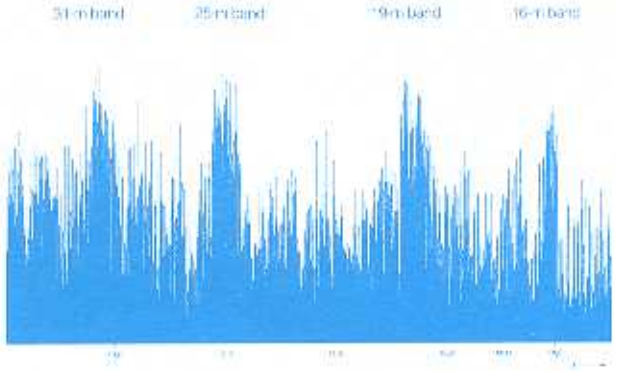


Fig. 9 Line spectrum of short-wave range (sound broadcasting bands clearly recognizable).

- Measurement of range of variation of field-strength level within a preset measuring time (1 to 1000 s).
- **Recording of field strength** as a function of time on YT recorder (Fig. 14), for example, on board a helicopter to determine the horizontal and vertical radiation patterns of transmitting antennas.

Examples of applications continued on page 8.

TEST RECEIVER ESH 3

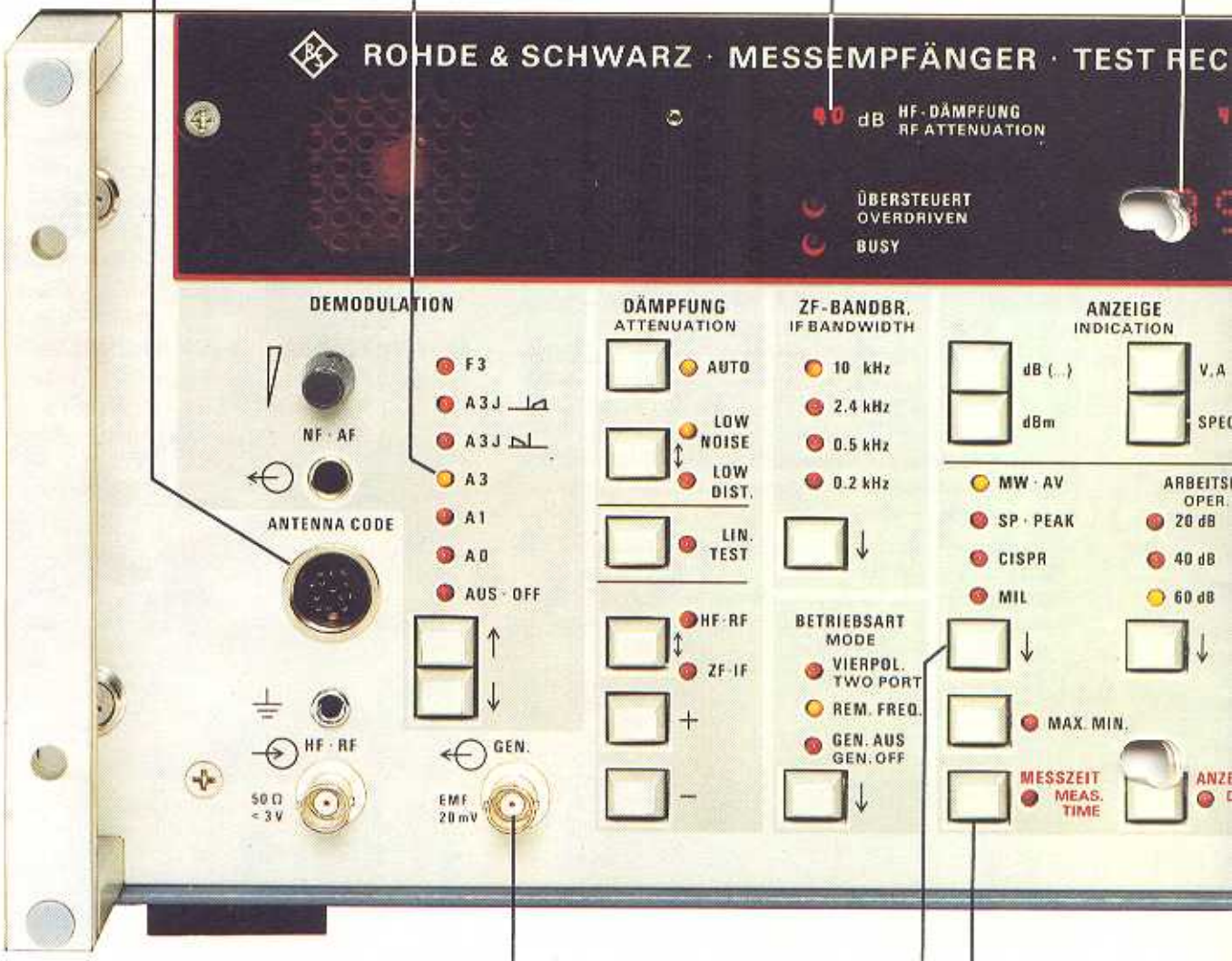
Supply and coding input for test antennas and probes

Demodulation modes

RF attenuation

Auto

Meas
digita
Test
level,
devia
Intera



Generator output for twoport and remote frequency measurement

Measurement-time setting

Indicating modes
- average value
- peak value
- CISPR
- pulse spectral density

FRONT PANEL DETAILS

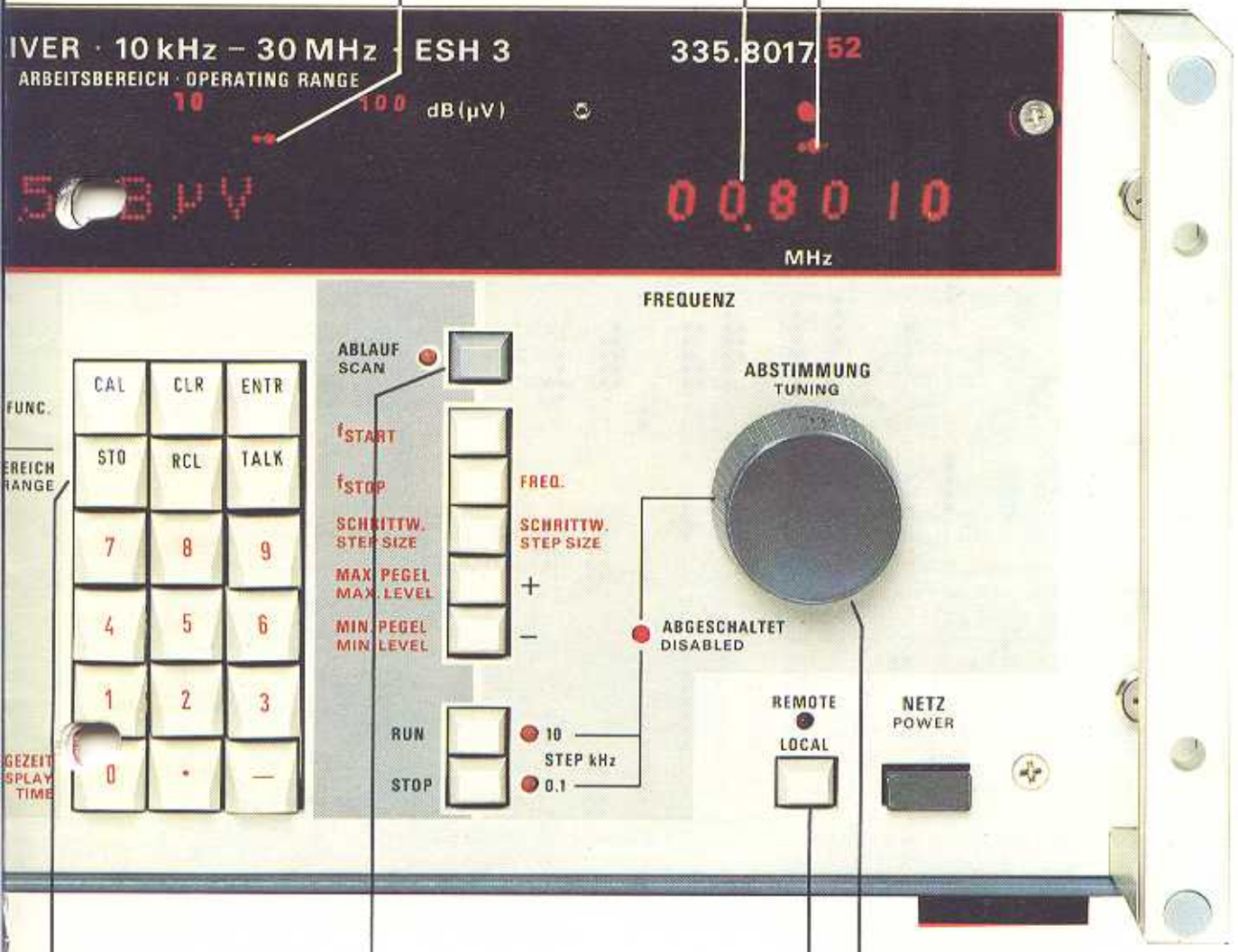
ranging and display

red data:
complete with unit
arameters:
requency offset, frequency
on, modulation depth or gain
tive data entry

Digital frequency display

Analog indication of measured data with range limits

Analog frequency-offset indication



Automatic frequency scanning

Programming via IEC bus

Storage of 9 complete device settings

Frequency setting

- with rotary knob
- in preset steps
- numerical entry via keyboard
- automatic frequency scanning with preset start and stop frequencies

USES

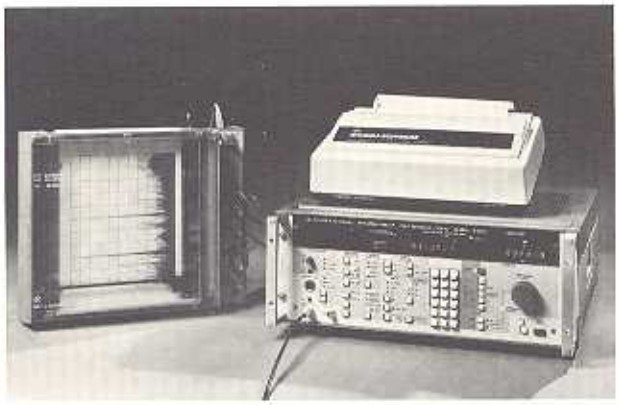


Fig. 10 XYT Recorder ZSKT, Test Receiver ESH 3 and Universal Printer PUD.

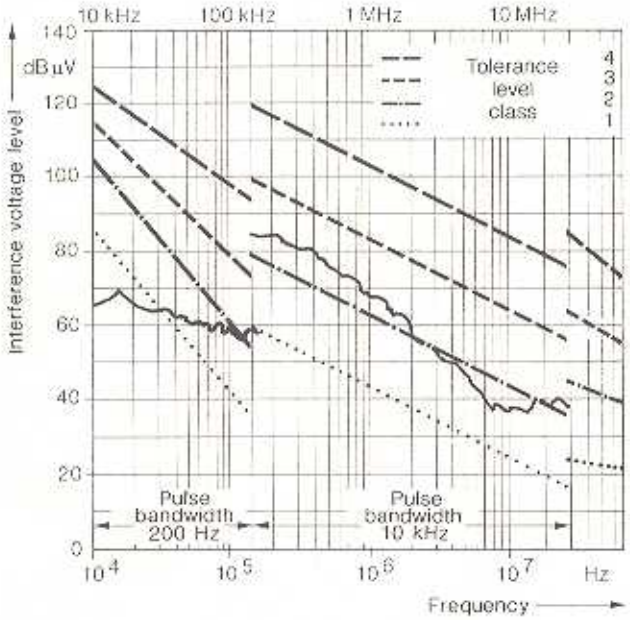


Fig. 11 Broadband interference (peak value) measured with the ESH 3 and plotted on VG chart paper on XY recorder.

- **Recording of frequency-band occupancy** as a function of time on the Radiomonitoring Recorder ZSG 3. When the signal level exceeds the preset threshold level (= MIN. LEVEL) the recorder traces a dash (Fig. 12). The ESH 3 can drive up to five Radiomonitoring Recorders ZSG 3 in a sequential cycle (Fig. 13).

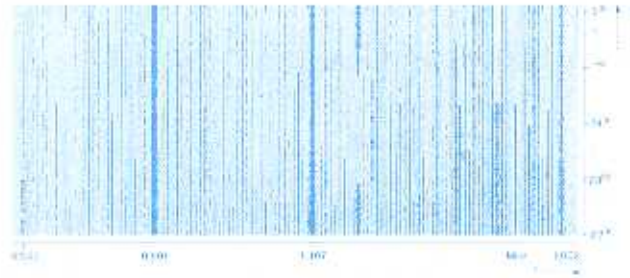


Fig. 12 Frequency-band occupancy over medium-wave band plotted on Radiomonitoring Recorder ZSG 3.

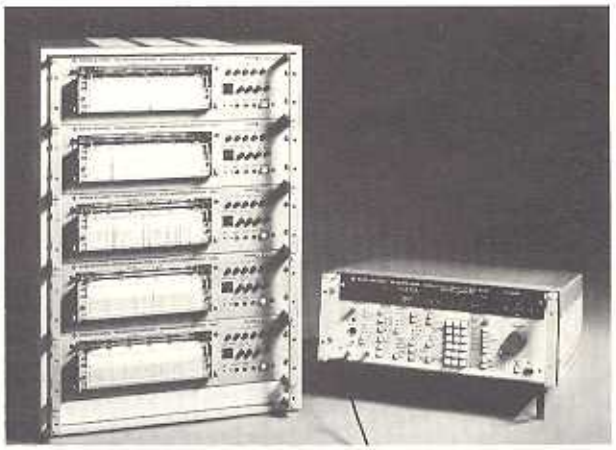


Fig. 13 ESH 3 with five Radiomonitoring Recorders ZSG 3 for scanning five different frequency bands and plotting the band occupancy.

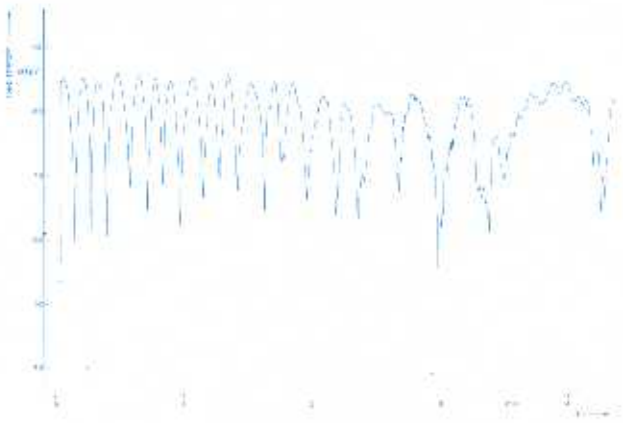


Fig. 14 Automatic plotting of field-strength fluctuations on YT recorder at a constant frequency (6.075 MHz); the scale of the Y axis is determined by entering the MAX. and MIN. levels.

- **Programmed frequency scanning** by the ESH 3 reduces the quantity of measured data: only the signal levels above the threshold level and the corresponding frequencies are transferred to the computer.

  For all cases where speed is at a premium and the work of the IEC(IEEE)-bus controller is to be minimized the IEC-bus interface of the ESH 3 offers the following possibilities:

  The controller instructs each connected ESH 3 to constantly scan a certain frequency range and if the threshold level is exceeded to either

  issue a **Service Request** in reply to which the controller identifies the ESH 3 that is calling by way of a **Serial Poll** and accepts the measured data,

  or to answer a **Parallel Poll** of the controller.

It therefore depends on the controller capabilities whether or not the ESH 3 can be used to full advantage.

The front panel of the ESH 3 has been laid out with an eye to **logical organization and intelligibility of the controls, displays, and engravings.** All settings are indicated by LEDs.

Operator errors cause the following responses: When an inhibited key is pressed the LED of the function causing the inhibit blinks; when the operating range of the demodulator is exceeded or essential stages are overdriven (cw or by pulses) the data readout blinks; when illegal data are input or an essential module fails, a coded error message appears and an aural signal comes on. The end of measurements that have been carried out over an extended period of time is also signalled aurally.

Fig. 15 Front-panel frequency display and alphanumeric display for readout of measured data, input and output of setting data and output of error messages.

The 13-digit alphanumeric display (Fig. 15) on the one hand **outputs the measured data complete with units** and on the other hand permits checking the formatted input of setting data. Since these data cannot all be read out at the same time, they can be called up for indication at the push of a key.

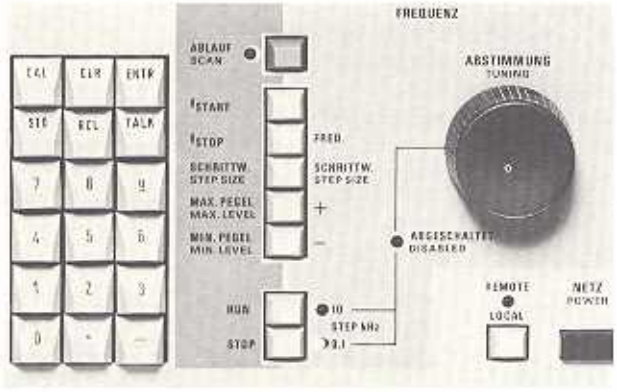


Fig. 16 Front-panel controls for frequency entry and scanning.

The battery-buffered memory of the ESH 3 stores the last and nine more complete device settings. In addition, it stores all correction values for frequency response, IF bandwidths, and demodulator characteristics obtained in an automatic calibration procedure. As a result, full accuracy is ensured at all times and the measuring times in automatic operation are considerably reduced.

Frequency setting is possible in several ways, calibrated offset indication being provided as a tuning aid (Fig. 16):

- quasi-continuous in 100-Hz or 10-kHz (switch-selected) steps by means of a rotary knob;
- in steps of any preset size, e. g. in 9-kHz steps, or in steps of the fundamental frequency for measuring harmonics;
- direct keyboard entry of a numerical value;
- automatic frequency scanning over maximum of five subranges with programmable start and stop frequencies and step sizes.

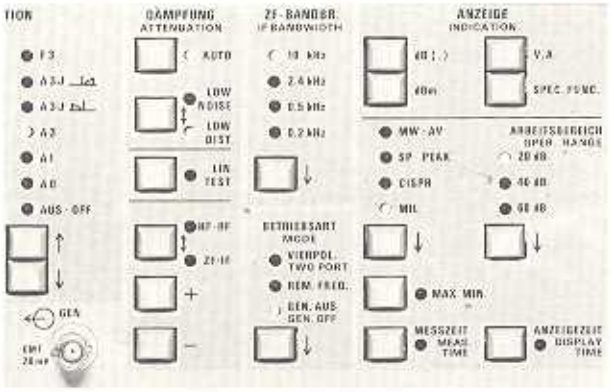


Fig. 17 Front-panel controls for indication, IF bandwidths, modes, attenuation, and demodulation.

Range selection for level measurements can be made either manually by separate setting of the RF and IF attenuation (Fig. 17) or by automatic RF attenuation setting (autoranging) with the low-noise or low-distortion IF attenuation setting determined by the selected IF bandwidth and indicating mode. In addition, a 1-dB RF attenuator is provided for a **linearity test.**

Conversion factors for **probes and test antennas.** The use of probes and test antennas with the ESH 3 does not cause additional work for the user when making measurements, since the correct units are automatically switched in and the conversion factors for probes and test antennas taken into consideration. Reading errors are thus rare.

Three demodulator operating ranges. Three demodulator operating ranges covering 20, 40 or 60 dB are provided to meet the measurement needs. **Automatic attenuation setting** (autoranging) is effected in 10-, 20- or 30-dB steps depending on the operating range.

Level indication. The operating range also determines the dynamic range of the analog level indication, which consists of an array of 31 LEDs. The range limits of this analog indication and the RF attenuation setting are digitally displayed.

Calibration. By either momentarily pressing the CAL key or holding it down, two different calibration processes can be triggered:

1. Adjustment of IF gain and frequency offset to the nominal value a receiver frequency of 1 MHz and subsequent verification of the level measurement at the original frequency.

2. Measurement and storage in non-volatile memory of all calibration correction values that are constant over a long period of time: frequency response, gain differences with different IF bandwidths and demodulator linearity.

DESCRIPTION

Operating principle. The Test Receiver ESH 3 is a triple heterodyne receiver with the following features:

RF attenuator, switchable in 10-dB steps from 0 to 140 dB; a 1-dB attenuator for linearity tests.

Diode mixer of high linearity following 16 switchable bandpass filters without amplifier to achieve an extremely wide dynamic range.

IF bandwidth, switch-selected: 0.2 kHz, 0.5 kHz, 2.4 kHz and 10 kHz.

Signal evaluation with average- and peak-value indication, pulse weighting to CISPR Publ. 1 and 3.

Measuring times, programmable, 5 ms to 100 s, for ready adaptation to measurement needs.

"MIL" indicating mode, peak-value indication, with IF bandwidth correction values automatically taken into consideration, for measuring broadband interference.

MAX-MIN indicating mode, measurement of range of variation of input signal in a sequence of programmable length, consisting of individual measurements of 100 ms duration each.

Display period, separately programmable; ensuring that signals exceeding a programmed threshold are indicated long enough during automatic frequency scanning.

Mixer oscillators based on synthesizer principle.

Up-conversion 1st IF (75 MHz) with 10-kHz crystal filter – minimizing intermodulation risk and easing the pulse linearity requirements on the succeeding stages.

2nd IF at 9 MHz with crystal filters for **0.5 and 2.4 kHz** bandwidth and adjustable gain for calibration purposes.

3rd IF at 30 kHz with **attenuator switchable** in 10-dB steps **from 0 to 40 dB** and a mechanical 200-Hz filter; linear IF gain for 20-dB operating range and logarithmizing IF amplifier for 40- and 60-dB operating ranges.

Active demodulator with switch-selected CISPR weighting and peak-value measurement; circuits for measuring modulation depth.

Demodulator circuits for FM and A3; BFO for A0, A1 and A3J (upper and lower sideband); automatic IF gain control for all AM demodulators; built-in loudspeaker; FM demodulator also used as signal source for frequency offset and deviation measurements.

Calibration generator with high-stability sinewave source (tracking generator) and pulse generator for CISPR calibrations.

The test voltage is applied via a sample-and-hold circuit to a **10-bit A/D converter** with a conversion time of about 25 µs. The combination of microprocessor + A/D converter permits 64 measurements in 5 ms, perfect digital averaging being provided even at the maximum IF bandwidth of 10 kHz. Digital averaging does away with the settling time required with analog low-pass filters. Thus autoranging is possible in a minimum of time.

The measured value is converted into a level value, then RF and IF attenuation, all calibration correction values and any conversion factors for probes or test antennas are added before it is read out with the correct units on the alphanumeric display and output to the IEC (IEEE) bus, if required.

Construction. Modular construction – almost all modules are exchangeable independent of each other, the RF modules are of modern cassette design – and the signature analysis capability and provision of firmware test routines make the ESH 3 very easy to service. Low internal heating of the receiver reduces the failure rate of component parts.

SPECIFICATIONS

Frequency range ..... 9 kHz to 29.9999 MHz
Frequency setting ..... 1. in 100-Hz or 10-kHz steps (switch-selected) by means of tuning knob
2. keyboard entry of numerical value
3. in steps of any preset size
4. automatic scanning
Readout ..... 6-digit LED display
Resolution ..... 100 Hz
Setting accuracy [1]
from 10 to 150 kHz ..... to within 100 Hz
from 150 kHz to 30 MHz ..... to within 500 Hz

RF input ..... Z_{in} = 50 Ω, BNC female
VSWR ..... < 1.2 with RF attenuation ≧ 10 dB
< 2 with RF attenuation 0 dB
Oscillator reradiation ..... < 0 dBµV
Input filter
Range 1 ..... 9 to < 150 kHz band-pass filter
2 ..... 150 to < 200 kHz
3 ..... 200 to < 280 kHz
4 ..... 280 to < 390 kHz
5 ..... 390 to < 540 kHz
6 ..... 540 to < 750 kHz
7 ..... 0.75 to < 1.05 MHz
8 ..... 1.05 to < 1.45 MHz sub-octave filters
9 ..... 1.45 to < 2.0 MHz
10 ..... 2.0 to < 2.7 MHz
11 ..... 2.7 to < 3.7 MHz
12 ..... 3.7 to < 5.2 MHz
13 ..... 5.2 to < 7.2 MHz
14 ..... 7.2 to < 10 MHz
15 ..... 10 to < 20 MHz tracking filters
16 ..... 20 to < 30 MHz
Maximum input level with
RF attenuation 0 dB ..... 130 dBµV
RF attenuation ≧ 10 dB ..... 137 dBµV
Maximum pulse energy with
RF attenuation ≧ 20 dB ..... 1 mWs

Interference immunity, non-linearities
Image frequency rejection ..... > 100 dB, typ. 120 dB
IF rejection ..... > 100 dB, typ. 110 dB
Non-linearities: a) frequency range 10 to 150 kHz (≧ 40 kHz off carrier)
b) frequency range 150 kHz to 30 MHz

Type	Signal level dBµV	Intermod. ratio dB	Intercept point guaranteed dBm	typical dBm
a) k_2	100	> 55	+ 30	+ 45
d_2	100	> 50	+ 25	+ 40
d_3	90	> 65	+ 15	+ 20
b) k_2	100	> 80	+ 75	+ 100
d_2	100	> 60	+ 55	+ 75
d_3	100	> 52	+ 20	+ 25

Crossmodulation
An interference signal of m = 30 % and f = 1 kHz spaced > 100 kHz away produces 3 % spurious modulation of 20-dBµV signal at a level of ..... > 100 dBµV
RF leakage
Difference in reading with field strength 10 V/m ($f = f_{in}$) ..... < 1 dB

Radio interference (EMI) from internal microcomputer, etc. ..... below VDE 0876 tolerance limits

Intermediate frequencies
1st IF ..... 75 MHz
2nd IF ..... 9 MHz
3rd IF ..... 30 kHz

IF bandwidths (average and peak value)

Nominal bandwidth	3-dB bandwidth (± 10 %)	6-dB bandwidth	6 : 60 dB ratio
200 Hz [2]	160 Hz [3]	200 Hz	approx. 1 : 5
500 Hz	550 Hz [3]	630 Hz	approx. 1 : 5
2.4 kHz	2.4 kHz	2.6 kHz	approx. 1 : 1.8
10 kHz	8 kHz [3]	9.5 kHz	approx. 1 : 2.4

IF bandwidth (–6 dB) for measurements to CISPR (Publ. 1 and 3) and VDE 0875 ..... 0.2 kHz/9 kHz (automatically switched over)

[1] For greater setting accuracies, the ESH 3 has an input for an external reference frequency of 5 or 10 MHz.
[2] The accuracy is reduced when measuring sinewave signals at 200 Hz bandwidth (additional measuring error 1.5 dB) because the receiver is tuned in 100-Hz steps.
[3] ± 20 %.

Internal noise a (f_{in} > 50 kHz)

Average value	B = 200 Hz ...	typ. – 30 dBµV
Peak value	B = 200 Hz ...	typ. – 22 dBµV
CISPR 1	B = 9 kHz ...	typ. – 6 dBµV
CISPR 3	B = 200 Hz ...	typ. – 28 dBµV
Pulse spectral density (MIL)	B = 10 kHz ...	typ. 38 dB(µV/MHz)

Increase in internal noise ..... see diagram (f_{in} < 50 kHz, B = 200 Hz)

Measurement ranges
Lower limit
(3 dB above noise level) ..... see noise indication
Upper limit ..... + 137 dBµV
Inherent spurious responses .... equivalent to < – 6 dBµV
Indication
digital in dBµV, dBm ..... 4 digits, max.; resolution 0.1 dB
in µV, mV, V ..... 3 digits
analog ..... LED array (31 LEDs) over operating range of IF rectifier with digital indication of range limits
Operating ranges of IF rectifier ..... 20, 40, 60 dB

Indication of measured data
Indicating modes ..... average value (programmable averaging time)
peak value (programmable hold time)
pulse spectral density to MIL (programmable hold time)
CISPR Publ. 1 and 3 (programmable measuring time)
Programmable measuring times: 5 ms to 100 s
Measurement of maximum and minimum levels: the maximum and minimum levels are determined from individual measurements of 0.1 s duration each; programmable measuring time: 1 to 1000 s

Measuring error
Error of level indication for unmodulated sinewave signals ≧ 16 dB above the indicated noise level (AV) ..... < 1 dB
Additional error over operating ranges 40 and 60 dB ..... typ. < 0.5 dB
Level calibration
Average/peak value ..... tracking generator (sinewave)
CISPR ..... pulse generator
Error of analog level indication
Operating range 20 dB ..... typ. < 2 dB
Operating ranges 40, 60 dB.... typ. < 4 dB

Frequency offset
Indication
digital in kHz ..... 3 digits, resolution 0.01 kHz
analog ..... LED array (16 LEDs)
Measurement range (B = 10 kHz) – 5 to + 5 kHz
Measuring error
Centre frequency (calibrated) . < 0.1 kHz (without frequency setting error)
Offset from centre frequency .. < 10 %

Frequency deviation
(positive and negative peak deviation and average deviation)
Digital indication in kHz ..... 3 digits, resolution 0.01 kHz
Measurement range ..... 0.05 to 5 kHz
(deviation + $f_{mod} \leq B_{IF\,3\,dB}/2$)
Measuring error at S/N ratio > 40 dB ..... < 10 %

Modulation depth
(positive and negative peak value and average AM)
Digital indication in % ..... 2 digits, resolution 1 %
Measurement range ..... about 2 to 99 %
Measuring error (IF attenuation = 40 dB and analog level indication in upper half of 20-dB operating range), $f_{mod} \leq 1$ kHz at B_{IF} = 10 kHz ..... < 5 digits

SPECIFICATIONS

Gain
Digital indication in dB ..... 4 digits, max.; resolution 0.1 dB
Measurement range ..... (–110) –100 to + 57 dB
Absolute error ..... < 1 dB, typ. < 0.5 dB

Demodulation modes ..... A0, A1, A3, A3J, (LSB/USB), F3

Remote control
Interface to IEC 625-1 (IEEE 488) for controlling all device functions and for data output
Interface functions AH1, L4, SH1, T5
SR1, PP1, DC1, DT1, RL1, C0
Typical data rate in
Talker Mode ..... approx. 5 kbyte/s
Listener Mode ..... approx. 2 kbyte/s
Setting times
Internal frequency
in steps of 0.1 to 99 kHz ..... typ. 10 ms to 20 ms
when exceeding
a 100-kHz digit ..... typ. 40 ms
RF level switch, internal ..... 30 ms/step
Max. measuring time with R&S Process Controller PPC, frequency step size ≦ 1 kHz, measuring time set on ESH 3
5 ms ..... 65 ms/measured value
Connector for remote control ... 24-way Amphenol female

Front panel outputs
Generator output
(can be switched off) ..... Z_{out} = 50 Ω, BNC female
EMF ..... 86 dBµV ± 0.5 dB
Connector for antenna supply and coding AF output ..... 12-way Tuchel female
AF output ..... Z_{out} = 10 Ω, telephone jack JK 34
EMF ..... adjustable up to 3.5 V

Rear-panel outputs
IF output 75 MHz ..... Z_{out} = 50 Ω, BNC female
EMF ..... about 12 dB above input level with 0 dB RF attenuation
Bandwidth ..... corresponds to RF bandwidth
IF output 30 kHz ..... Z_{out} = 1 kΩ, BNC female
EMF ..... 0 to 2 V over range of analog level indication
Bandwidth ..... corresponds to IF bandwidth
AM demodulator ..... Z_{out} = 10 kΩ, BNC female
EMF ..... 1 V with m = 100 %
FM demodulator ..... Z_{out} = 10 kΩ, BNC female
EMF ..... ±0.5 V with deviation = 5 kHz
Frequency offset ..... Z_{out} = 10 kΩ, BNC female
EMF ..... ±5 V with offset = 5 kHz
Analog level output 1 ..... Z_{out} = 10 kΩ, BNC female
EMF (with AV, PEAK and MIL indicating mode) ..... 0.5 to 5 V over range of analog level indication
EMF (with CISPR indicating mode) ..... 0.2 to 2 V over range of analog level indication
Analog level output 2 ..... Z_{out} = 10 kΩ, BNC female
EMF (with CISPR indicating mode) ..... 0.2 to 2 V over range of analog level indication (network for simulation of meter response with time constant to CISPR Publ. 1 and 3 provided)
Recorder output ..... 24-way Amphenol female including coding inputs for recorder type D/A converted X and Y analog outputs
X = 0 V: start frequency
= +10 V: stop frequency
Y = 0 V: MIN level
= +10 V: MAX level
pen lift control,
low level corresponding to pen up
formatted paper feed for ZSKT
(high pulse, duration 10 ms)
connection of 5 Radiomonitoring Recorders ZSG 3

Rear-panel input
for external reference frequency . Z_{in} = 50 Ω, BNC female
Required level ..... EMF = 1 V from 50 Ω, sinewave source
Frequency ..... 5/10 MHz (switch-selected)

General Data
Operating temperature range .... +5 to + 45 °C
Storage temperature range ..... –25 to + 70 °C [1]
AC supply ..... 115/125/220/235 V + 10/–15 %, 47 to 440 Hz (70 VA)
Dimensions; weight ..... 492 mm x 205 mm x 514 mm; 25 kg

Ordering information

Order designation ..... ▶ Test Receiver ESH 3 335.8017.52

Accessories supplied
Power cord 025.2365.00
Manual

Recommended extras (see also data sheet 303.203)
For interference measurements:
Clamp-on RF Current Probe ..... ESH 2-Z1 ... 338.3516.52
(100 kHz to 30 MHz)
Active Probe ..... ESH 2-Z2 ... 299.7210.52
(9 kHz to 30 MHz, high impedance)
Passive Probe ..... ESH 2-Z3 ... 299.7810.52
(9 kHz to 30 MHz, VDE 0876)
Artificial Mains Network (LISN) .. ESH 2-Z5 ... 338.5219.52
(9 kHz to 150 kHz/30 MHz, VDE 0876)
Attenuator (20 dB, 10 W) ..... ESH 2-Z11 .. 349.7518.52
For field-strength measurements:
Rod Antenna ..... HFH 2-Z1 ... 335.3215.52
Loop Antenna ..... HFH 2-Z2 ... 335.4711.52
Loop Antenna ..... HFH 2-Z3 ... 335.6214.52
Tripod ..... HFU-Z 100.1114.02
Inductive Probe ..... HFH 2-Z4 ... 338.3016.52
Auxiliary equipment:
Headphones 110.2959.00
Service Kit ..... ESH 2-Z7 ... 338.4112.02
XYT Recorder ..... ZSKT 301.9010.02
Connecting Cable
ESH 3 - ZSKT (XY) ..... ESH 3-Z1 ... 349.6011.02
Radiomonitoring Recorder ..... ZSG 3 ..... 242.6015.92
Universal Printer ..... PUD 349.8914.02
IEC (IEEE) Interface Option .... PUD-B4 .... 349.9404.02

Frequency counter for remote frequency measurements, sensitivity better than 10 mV into 50 Ω, such as PM 6615/04 from Philips

Sinewave inverter for operating the ESH 3 from a 12-V battery, such as SWR 200 from Audiotechnik, Bad Salzuflen

[1] The receiver uses a NiCd storage battery for buffer operation of the CMOS RAMs. It should, therefore, not be stored at ambient temperatures above + 50 °C over an extended period of time.

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