

ESH 2

Test Receiver ESH 2

◆ 9 kHz to 30 MHz/ -30* to +137 dBμV

- Synthesizer-based test receiver offering crystal-referenced frequency display, 100 Hz resolution
- Level range > 165 dB
- Automatic voltage calibration at the push of a button
- Interference measurements in line with CISPR, VDE (with model 52) as well as MIL and VG
- AC supply and battery operation

*) The sensitivity is increased by about: 7 dB when using the Preamplifier ESH 3-Z3.

The manually operated **Test Receiver ESH 2** with high sensitivity and overload protection offers a very wide dynamic range and maximum ease of operation. Compact construction, the wide range of power supplies that can be used, and low power consumption make the receiver suitable for use in fixed stations as well as for mobile and portable applications.

Thanks to its excellent characteristics and the availability of a wide range of accessories, the applications of the ESH 2 include **interference measurements** and **field-strength measurements**; for use of ESH 2 as the Field-strength Meter HFH 2 see page 299.

Covering the frequency range from 9 kHz to 30 MHz, the ESH 2 can tune to any signal from LF to the upper shortwave range, where it overlaps with the ESV (page 300).

Characteristics, uses (ESH 2 alone)

The ESH 2 needs no accessories to operate as a *selective voltmeter* (test receiver) with a level range from -30 to +137 dBμV, for example, for measurements, in 50-Ω coaxial systems. The Active Probe ESH 2-Z2 is available for measuring high-impedance test items. Relative and absolute selective voltage measurements are possible even in the presence of a multitude of signals.

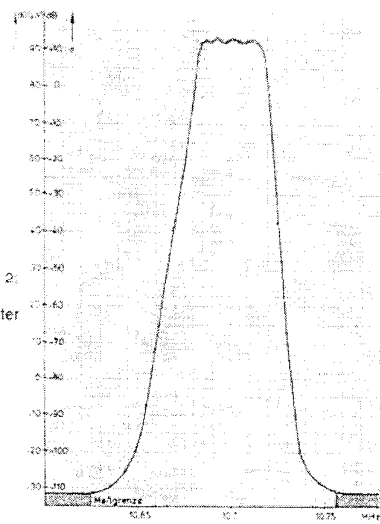
Automatic calibration at the push of a button and excellent receiver selectivity permit accurate measurements of closely spaced signals with very different levels, for example: SSB two-tone measurements, spurious-content and sideband-noise measurements on signal generators, intermodulation and distortion measurements, noise figure measurements.

The calibration-generator output can be used for twoport measurements over an attenuation range of up to 110 dB and a gain range of more than 50 dB; see diagram on the right.

Signal evaluation Four switch-selected IF bandwidths and numerous test outputs make it easy to carry out a wide range of measurements:

- wideband IF output, 75 MHz, for the connection of a panoramic display or a wave analyzer,
- narrowband IF output, 30 kHz, for an oscilloscope,
- AM/FM demodulator outputs,
- recorder output for level and frequency offset,
- output for the connection of a frequency counter.

Overload of the input or of other important circuits is detected by the test receiver and automatically signalled.



Example of twoport measurement using Test Receiver ESH 2; Test item: IF amplifier with crystal filter

Auxiliary instruments for additional applications

Interference measurement Interference voltage and interference current can be measured in accordance with the relevant standards (CISPR, FCC, MIL, VG, VDE). The following accessories are available for this purpose (see specifications on page 289 and page 294):

Current Probe	ESH 2-Z1
Active Probe	ESH 2-Z2
Passive Probe	ESH 2-Z3
Artificial Mains Network	ESH 2-Z5 and
Pulse Limiter	ESH 3-Z2
Preamplifier	ESH-Z3

In addition to the overload indication and automatic calibration which have already been mentioned, the ESH 2 has other features which are particularly important in interference measurements:

- level indication taking into consideration the conversion factor of the sensor, e.g. directly in dB μ A,
- frequency-dependent automatic switchover of weighting and of calibration pulse for CISPR 1 or 3,
- peak indication with selectable hold time,
- IF bandwidths of 200 Hz and 9 kHz in line with CISPR,
- IF bandwidth of 10 kHz in line with MIL.

In interference measurements the Loop Antenna HFH 2-Z2 is used to measure the magnetic component and the Rod Antenna HFH 2-Z1 the electric component.

Radiomonitoring, remote frequency measurement In conjunction with a receiving antenna and a frequency counter the test receiver can be used in radiomonitoring, since it features excellent frequency accuracy and stability and is capable of demodulating A1A, A3E, J3E (formerly A1, A3, A3J) and FM transmissions. With a frequency counter connected to the ESH 2 generator output, high-accuracy remote frequency measurements can be performed. The test receiver then functions as an active filter of high selectivity.

Field-strength measurements Completed by the following antennas the test receiver can be used for field-strength measurements (see also Field-strength Meter HFH 2 on page 299):

Active Rod Antenna	HFH 2-Z1 (9 kHz to 30 MHz)
Active Loop Antenna	HFH 2-Z2 (9 kHz to 30 MHz)
Inductive Probe	HFH 2-Z4 (100 kHz to 30 MHz)

Another Loop Antenna, HFH 2-Z3, is available as an accessory for measurements on very weak signals in the frequency range of 9 kHz to 1 MHz. The Roof-mounting Kit HFH 2-Z5 permits the HFH 2-Z2 to be operated on top of test vehicles.

Propagation measurements and measurements of coverage in the radiomonitoring field can also be carried out; with an YT recorder connected to the corresponding output, field-strength observation is possible over extended periods of time.

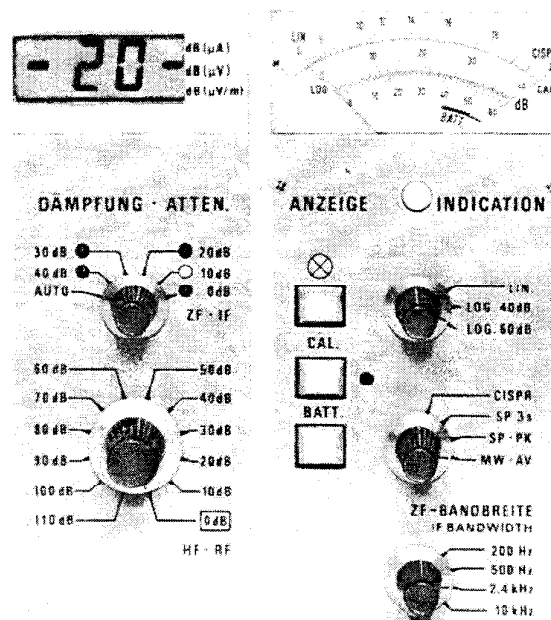
The digital readout of the reference level in dB μ V/m, which takes into consideration the conversion factor of the antenna used, is an important asset in field-strength measurements.

Ease of operation, setting functions

The automatic correction of the level indication taking into account antenna factors and conversion factor of sensors, the automatic level calibration and many more features affording ease of operation make it possible to make do with a minimum of operating controls. Due to the latter and the clear arrangement of the front panel, even unskilled staff can soon learn to operate the instrument.

Frequency setting The whole range from 9 kHz to 30 MHz is covered without band switching, in 100-Hz/1-kHz or 10-kHz steps. The 6-digit LCD frequency display is crystal-controlled. The frequency setting is retained in a memory even while the instrument is switched off.

Sensitivity, measurement range The measurement range for sinewave signals of -30 dB μ V to +137 dB μ V is determined at the lower limit by the inherent noise at 200 Hz IF bandwidth and at the upper limit by the maximum dissipation in the RF attenuator. Sensitivity is set for the RF and IF sections using attenuators with 10-dB steps, see front panel section.



Front panel section with controls for level, bandwidth, weighting and indication

In the AUTO position of the IF attenuator, the IF gain is automatically set as a function of bandwidth and display mode in such a way that the receiver's internal noise on the display is always below 0 dB.

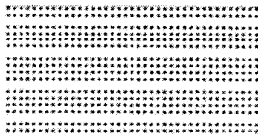
Bandwidths, signal weighting IF bandwidth is switch-selected at 10 kHz, 2.4 kHz, 500 Hz or 200 Hz. The signal weighting mode can be switched to average or peak with different hold times (e.g. 3 s) or noise weighting in line with CISPR.

ESH 2

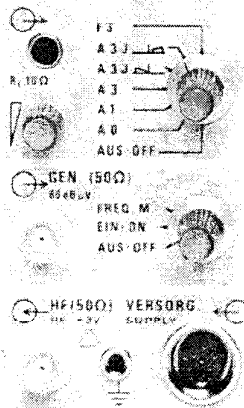
Level indication The meter has a linear range of 20 dB and two logarithmic ranges of 40 and 60 dB. The measured level is obtained from the meter indication and the digital reference value displayed in the same line, e.g. -20 dBµV in the photo on page 287.

Overload indication If one of the stages in the metering path of the receiver is overloaded the reference-value display flashes. This indication operates with sinewave noise as well as with pulses.

Internal calibration, battery check Automatic calibration, initiated at the push of button or when the bandwidth is changed, guarantees reproducibility of the measurements and ease of operation. In the case of battery operation the state of charge of the batteries can also be checked at the push of a button.



NF-AF DEMODULATION



Front-panel section: demodulation and AF settings; output for calibration signal and frequency measurement; RF input and power supply connection

Signal demodulation, outputs The ESH 2 is designed for a multitude of signal waveforms including SSB and frequency modulation: it can be switched to N0N, A1A, A1B, A3E, J3E, formerly A0, A1, A3, A3J (upper or lower sideband) and F3E as well as G3E. Numerous outputs are provided for signal evaluation, recording or plotting:

- wideband output at 1st IF (75 MHz) for the connection of a panoramic display
- narrowband output at 30-kHz IF for the connection of an oscilloscope
- AM and FM demodulator outputs
- outputs for the connection of recorders for level and frequency offset

The power supply is either direct from a 12-V source, from the 12-V battery pack (delivered without batteries), from a 24-V supply (additional adapter required) or from the local AC supply via the power supply unit (safety class II; see photo on

the right), which can at the same time recharge or trickle-charge the 12-V battery.

Description

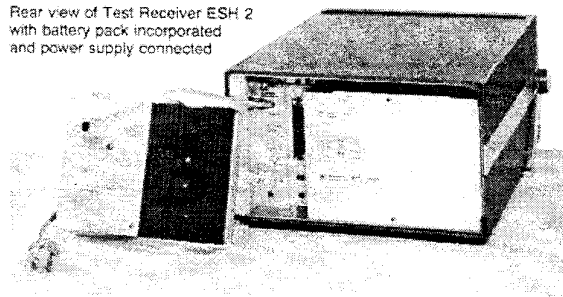
The Test Receiver ESH 2 is a triple heterodyne receiver covering the receiving range from 9 kHz to 30 MHz by means of 16 RF filters, the first 14 of which are fixed-tuned and the upper two tracking with the receive frequency via varicaps. The intermediate frequencies are 75 MHz, 9 MHz and 30 kHz. The signal to be measured passes from the RF attenuator, which is adjustable in steps of 10 dB and through which the calibration signal is fed in during calibration, via the filter group to the first mixer, where it is converted to the first IF of 75 MHz by a synthesizer.

After passing through a crystal filter of 10 kHz bandwidth the signal is converted from 75 MHz to 9 MHz. Two further crystal filters, which can be switch-selected, provide bandwidths of 2.4 kHz and 500 Hz. The following 9-MHz amplifier contains the control element for the nominal gain of the receiver with automatic calibration. After conversion to the last intermediate frequency of 30 kHz the signal is amplified in a 40-dB amplifier, this range being adjustable in 10-dB steps. The IF bandwidth can be decreased to 200 Hz using a mechanical filter. The signal passes through a logarithmic or a linear amplifier with an active demodulator or undergoes interference weighting according to CISPR Publication 1 or 3, depending on the selected indicating mode. A second, independent 30-kHz IF amplifier with AGC operates in parallel with the indicating branch into a demodulator for AM, SSB and FM.

Construction

Even though heavy shielding is provided, this compact receiver weighs only 20 kg. The modern modular design, using primarily plug-in PC boards on a motherboard, makes the ESH 2 very easy to service, whilst at the same time the interior space of the receiver is optimally utilized. The use of high-grade components and the low self-heating as a result of the moderate power drain (approx. 12 W in battery operation) further cut down the failure expectancy of the receiver. A plastic cover may be put on the front or rear panel to protect the receiver during transport or when it is being operated outdoors.

Rear view of Test Receiver ESH 2 with battery pack incorporated and power supply connected



Specifications of ESH 2

Frequency range	9 kHz to 29.9999 MHz
Frequency setting	quasicontinuous with knob
Resolution (step width)	100 Hz, 1 kHz or 10 kHz, switch-selected
Indication	6-digit LCD, switchable back-lighting
Setting error	1.5 × 10 ⁻⁵ + 50 Hz!

RF input $Z_{in} = 50 \Omega$, BNC female
 VSWR with RF attenuation ≥ 10 dB < 1.2
 with RF attenuation 0 dB < 2
 Maximum input level
 with RF attenuation 0 dB 130 dB μ V
 with RF attenuation ≥ 10 dB 137 dB μ V
 Maximum pulse energy ($\tau = 10 \mu$ s)
 with RF attenuation ≥ 20 dB 1 mW s
 Oscillator reradiation < 0 dB μ V
 Internal input filters
 9 to < 150 kHz bandpass filters
 150 kHz to < 10 MHz 13 suboctave filters
 10 to < 20 MHz tracking filter
 20 to < 30 MHz tracking filter

Interference immunity, nonlinearities

Image-frequency rejection (1st IF) > 100 dB, typ. 120 dB
 IF rejection > 100 dB, typ. 110 dB

Nonlinearities: a) frequency range 10 to 150 kHz (signal spacing ≥ 40 kHz)
 b) Frequency range 150 kHz to 30 MHz

Type	Signal level dB μ V	S/N ratio dB	Intercept point (guaranteed) dBm	typical dBm
a) k_2	100	> 55	+47	+60
d_2	100	> 50	+43	+55
d_3	90	> 65	+15	+20
b) k_2	100	> 80	+73	+100
d_2	100	> 80	+53	+75
d_3	100	> 83	+20	+25

Crossmodulation

An interfering signal with $m = 30\%$ and $f = 1$ kHz spaced > 100 kHz away produces 3% modulation of a 20-dB μ V signal at a level of > 100 dB μ V

RF leakage

Variation of indication at a field strength of 10 V/m (with $f = f_0$) < 1 dB

Intermediate frequencies

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

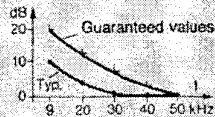
IF bandwidths (for average and peak)

Nominal bandwidth	3-dB bandw.	6-dB bandw. ($\pm 10\%$)	6:80-dB ratio
200 Hz ²⁾	160 Hz ²⁾	200 Hz	≈ 1.5
500 Hz	550 Hz ²⁾	630 Hz	≈ 1.5
2.4 kHz	2.4 kHz	2.6 kHz	$\approx 1:1.8$
10 kHz	8 kHz ²⁾	9.5 kHz	$\approx 1:2.4$

IF bandwidth (-6 dB) for measurements acc. to CISPR (Publ. 1 & 3) and VDE 0875 0.2 kHz/9 kHz (automatic switchover)

Internal noise a ($f_0 > 50$ kHz)	typ. values	guarant. values
Average $B = 200$ Hz	-30 dB μ V	< -27 dB μ V
Peak $B = 200$ Hz	-22 dB μ V	< -19 dB μ V
CISPR 1 $B = 9$ kHz	-6 dB μ V	< -3 dB μ V
CISPR 3 $B = 200$ Hz	-28 dB μ V	< -25 dB μ V

Increase in noise indication (with $f < 50$ kHz, $B = 200$ Hz) see diagram



Voltage range

Lower limit (3 dB above internal noise level) see internal noise
 Upper limit 137 dB
 Inherent spurious responses equivalent to < -6 dB μ V
 Voltage indication moving-coil meter, switchable back-lighting
 Scale ranges, linear 20 dB
 logarithmic 40 dB/60 dB
 battery check tolerance marker
 Types of indication average
 peak
 peak with 3 s hold time
 CISPR (Publ. 1 & 3)

Voltage indication error average in 20 dB $V_{in} \geq 16$ dB above internal noise < 1 dB
 Additional error of log. conversion due to temperature effect < 2 dB

- 1) An input for an external reference frequency of 5 MHz or 10 MHz is provided to improve the setting accuracy.
- 2) Reduced accuracy when measuring sinewaves at 200 Hz bandwidth (additional measuring error 1.5 dB) due to receiver tuning in steps of 100 Hz.
- 3) $\pm 20\%$.

Calibration generator Average/Peak sinewave generator
 CISPR pulse generator
 Types of demodulation N0N, A1A, A1B, A3E, J3E, F3E, G3E;
 Former designations A0, A1, A3, A3J (LSB, USB), F3

Outputs

Sig. generator EMF (ref. voltage, can be switched off) 86 dB μ V ± 0.5 dB; 50 Ω , BNC female connector
 Connector for antenna supply and antenna coding 12-contact Tuchel female
 AF signal, adjustable up to 3.5 V; 10 Ω ; jack JK 34
 IF 75 MHz 50 Ω , BNC female connector
 Gain (input at 0 dB) $< 12 \pm 3$ dB, bandwidth corresponds to RF bandwidth
 IF 30 kHz 1 k Ω ; BNC female connector
 EMF at fs 2 V, bandwidth corresponds to IF bandwidth
 AM demodulator 10 k Ω ; BNC female connector
 EMF, peak to peak 1 V at 100% mod.
 FM demodulator 10 k Ω ; BNC female connector
 EMF ± 0.5 V for 5 kHz deviation
 Recorder output 50-contact Amphenol female connector
 Frequency offset ± 5 V for ± 5 kHz offset; 10 k Ω
 Level 1 in average, peak modes +5 V for fs
 in CISPR +2 V for fs
 10 k Ω output impedance in all modes
 Level 2 lowpass filter simulating meter response acc. to CISPR (1, 3); EMF and output impedance as for level 1

Reference frequency input 5/10 MHz, switch-selected; EMF 1 V across 50 Ω , sinewave (BNC female connector)

General data

Rated temperature range -10 to $+45$ $^{\circ}$ C
 Storage temperature range -25 to $+70$ $^{\circ}$ C (without batteries)
 -10 to $+60$ $^{\circ}$ C (with batteries)
 Power supply either via power supply unit or from battery pack, see photo on the left
 AC power supply unit 110/125/220/235 V $\pm 10\%$ -15%, 47 to 420 Hz (60 VA); VDE 0411 safety class II (DIN 47411) +12 V, 8.5 to 9.5 Ah, operating life ≈ 4 h per charge
 Battery pack 4-contact special socket supply: +10.8 to +14.5 V ≈ 1 A
 Battery input 4-contact special socket
 Charging input 4-contact special socket
 Dimensions, weight 347 mm \times 206 mm \times 484 mm, 19 kg with power supply unit 21 kg with battery pack

Ordering information

Order designation \blacktriangleright Test Receiver ESH 2 303.2020.52
 Accessories supplied Battery pack (without batteries) battery connector: LEMO F. 2304 6.7 50-contact Amphenol male connector

Recommended extras

For interference measurements:
 RF Current Probe ESH 2-Z1 336.8616.52 (9 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 ESH 2-Z5 338.5219.53 (9 kHz to 30 MHz, VDE 0876, CISPR 3)
 Pulse Limiter ESH 3-Z2 357.8810.52
 Preamplifier 9 kHz to 30 MHz ESH 3-Z3 627.8016.52
 Attenuator ESH 2-Z11 349.7518.52
 For field-strength measurements (details under HFH 2, page 299):
 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
 Roof-mounting Kit (for Loop Antenna HFH 2-Z2) HFH 2-Z5 335.5718.02
 General:
 Headphones 110.2959.00
 24-V Adapter ESH 2-Z4 338.4512.02
 6-V Lead-acid Storage Battery 9.5 Ah (2 required) 338.4012.00
 19" Adapter ESH 2-Z6 338.4312.02
 Service Kit ESH 2-Z7 338.4112.00
 Recorders, frequency counters:
 XYT Recorder ZSKT 301.9010.02
 Frequency counter for remote frequency measurement, sensitivity < 10 mV into 50 Ω , e.g. PM 6676/04 from Philips

Accessories for ESH2/ESH3

For field-strength and radio interference measurements

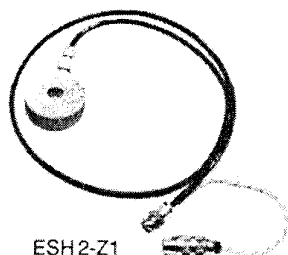
Overview

Designation	Order No.	Page	Used with	Measurements
RF Current Probe	ESH2-Z1 338.3516.52	294	ESH2, ESH3	Current measurement
Active Probe	ESH2-Z2 299.7210.52	295	ESH2, ESH3	High-impedance voltage measurement
Passive Probe	ESH2-Z3 299.7810.52	295	ESH2, ESH3	High-impedance voltage measurement
24-V Adapter	ESH2-Z4 338.4512.02	297	ESH2, ESV	External DC operation
Artificial Mains Network	ESH2-Z5 338.5219.53	297	ESH2, ESH3	Radio interference measurement (VDE/FCC)
19" Adapter	ESH2-Z6 338.4312.02	298	ESH2, ESV	Rack integration
Service Kit	ESH2-Z7 338.4112.00	298	ESH2, ESH3	Service
Attenuator	ESH2Z11 349.7518.52	295	ESH2, ESH3	High-imp. voltage meas., radio interf. meas.
Attenuator for ESH2-Z3	ESH2Z31 827.6513.02	295	ESH2, ESH3	High-impedance voltage measurement
Connecting Cable	ESH3-Z1 349.6011.02	299	ESH2, ESH3	Connect. cable to XY recorder (ZSKT)
Pulse Limiter	ESH3-Z2 357.8810.52	295	ESH2, ESH3	Protection of receiver input
Preamplifier	ESH3-Z3 827.8016.52	294	ESH2, ESH3	Voltage and current measurement
Applications Software	ESVP-K1 397.6018.02	308	ESH3, ESVP	Various user programs
Applications Software	ESVP-K2 399.9014.02	308	ESH3, ESVP	Various user programs
Rod Antenna	HFH2-Z1 335.3215.52	296	ESH2, ESH3	Field strength (E field, H field)
Loop Antenna	HFH2-Z2 335.4711.52	294	ESH2, ESH3	Field strength (E field, H field)
Loop Antenna	HFH2-Z3 335.6214.52	296	ESH2, ESH3	Field strength (E field, H field)
Inductive Probe	HFH2-Z4 338.3016.52	296	ESH2, ESH3	Field strength (E field, H field)
Roof-mounting Kit	HFH2-Z5 335.5718.02	298	ESH2, ESH3	Field strength (HFH2-Z2)
Tripod	HFU-Z 100.1114.02	297	ESH2, ESH3	Field strength (HFH2-Z2/Z3)

Current measurements

Clamp-on RF Current Probe ESH2-Z1

Selective or broadband measurements of both very small and very large RF currents on conductors are easy to perform with the aid of the ESH2-Z1. It is shielded against electrostatic effects and built to VDE 0876.



ESH2-Z1

Specifications

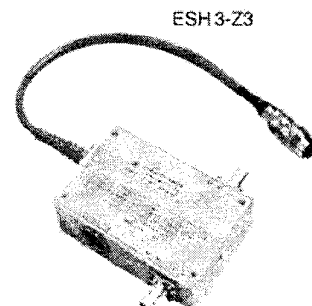
Frequency range	9 kHz to 30 MHz (between 9 and 100 kHz with frequency-dependent conversion factor)
Measurement range using ESH2/ESH3 (IF bandwidth 200 Hz, average-value indication)	
Lower limit (frequency-dependent)	-30 dB μ A, approx.
Upper limit	137 dB μ A
Transfer admittance	1 S
Conversion factor ¹⁾ (I-V)	0 dB referred to 1 S ²⁾
Error of conversion factor	<1 dB
Max. permissible current with f > 10 kHz	10 A
Max. permissible current with f < 500 Hz	50 A
Max. diameter of conductor under test	13.5 mm
General data	
Rated temperature range	-10 to +55 °C
Storage temperature range	-25 to +70 °C
RF connector	BNC male
Termination	50 Ω
Length of connecting cable	1 m
Coding plug (conversion factor)	12-contact Tuchel-type
Dimensions (diameter/height)	55 mm/20 mm
Weight	0.4 kg
Order designation	► Clamp-on RF Current Probe ESH2-Z1 338.3516.52

1) Conversion factor = logarithm of the ratio between the output voltage and the input current; automatically taken into account between 0.1 and 30 MHz in the readout on the ESH2 and ESH3.
2) Below 100 kHz the conversion factor rises up to 11.5 dB at 9 kHz (calibration chart supplied as an accessory).

Voltage and current measurement

Preamplifier ESH3-Z3

With the aid of the Preamplifier ESH3-Z3 the noise figure of the Test Receivers ESH12 and ESH13 is reduced by about 7 dB, so that the average value of noise at 200-Hz IF bandwidth is typically -37 dB μ V. The Preamplifier is fed via the ESH2/3/supply and coding socket which is also used for level display correction. The ESH3-Z3 is also fitted with a gated coding input to ensure that with a current probe or passive probe connected the level and unit display of the test receiver fitted with a preamplifier will be corrected.



ESH3-Z3

Specifications

Frequency range	9 kHz to 30 MHz
Gain	10 dB
Frequency response flatness	max. \pm 0.5 dB, referred to 1 MHz
Input and output impedance	50 Ω
Input VSWR	
with ESH2/ESH3 at RF attenuation of 0 dB	<2, typ. 1.25
Noise figure	<6 dB, typ. 4 dB
1-dB compression point (output level)	+13 dBm (typ.)
3-dB intercept point (IP ₃)	+27 dBm (typ.)
Connectors	
RF input and output	2 x BNC female
Coding for ESH2/3	12-contact Tuchel male
Coding	12-contact Tuchel female
General data	
Rated temperature range	-10 to +50 °C
Storage temperature range	-25 to +70 °C
Dimensions (W x H x D)	160 mm x 29 mm x 110 mm
Weight	0.4 kg
Order designation	► Preamplifier ESH3-Z3 827.8016.52
Accessories supplied	BNC-BNC connecting cable (30 cm)

High-impedance voltage measurements

ESH 2-Z2
ESH 2-Z3

Active Probe ESH 2-Z2/Passive Probe ESH 2-Z3

For high-impedance measurements of, say, narrowband wanted signals on lines or narrowband and broadband interference signals at the receiver input or antenna cabling, use of shielded probes is recommended. They contain internal highpass filter sections to reject supply voltages.

The **Active Probe ESH 2-Z2** is designed for measuring AC voltages over the frequency range 9 kHz to 30 MHz on lines that do not carry AC supply voltage.



ESH 2-Z2

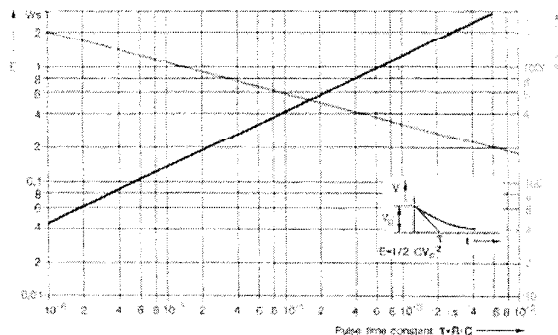
Active Probe ESH 2-Z2 with accessories: the Passive Probe ESH 2-Z3 includes an additional probe tip with hand guard and a 4-mm ground socket



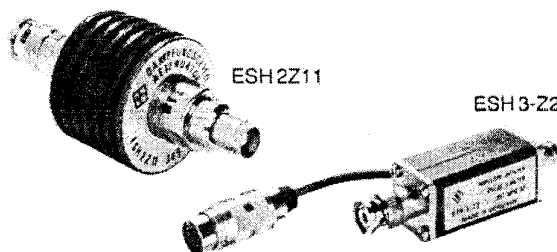
The **Passive Probe ESH 2-Z3** (to VDE 0876 standards) is particularly suitable for measuring radio interference voltages

Pulse Limiter ESH 3-Z2
Attenuator ESH 2Z11

High RF input levels as well as high-energy interfering pulses that may result from switching on or off the test item connected to an artificial mains network may cause damage to the RF input circuits of test receivers. The Pulse Limiter ESH 3-Z2 and the Attenuator ESH 2Z11 limit and reduce the



Pulse power-handling capacity of Pulse Limiter ESH 3-Z2
Black: pulse energy $E = f(t)$
Blue: pulse peak voltage $V_p = f(t)$



ESH 2Z11

ESH 3-Z2

on, for example, AC-supply lines. The Attenuator ESH 2-Z31 to VDE 0877, Part 1, is used for checking the noise source impedance.

Specifications	ESH 2-Z2	ESH 2-Z3
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz
Attenuation ¹⁾	10 dB	30 dB
Attenuation error		
($Z_{source} = 50 \Omega$)	<1 dB	<+1/-3 dB
Measurement range using ESH 2/ESH 3 (IF bandwidth 200 Hz, average value indication)		
Lower limit (frequency-dependent)	-20 dB μ V, approx.	+10 dB μ V, approx.
Upper limit	120 dB μ V	150 dB μ V
Input impedance	118 k Ω \pm 5% shunted by 8 pF	1500 Ω \pm 2% shunted by 6 pF (with 50- Ω termination)
Max. input voltage		
f < 60 Hz	100 V	-
f < 500 Hz	5 V	250 V
f = 9 kHz to 30 MHz	3 V	30 V
Order designation	► Active Probe ESH 2-Z2 299.7210.52	► Passive Probe ESH 2-Z3 299.7610.52
Accessories supplied	Accessories kit, Probe tip	
Recommended extras		
BNC Adapter URV-Z	241.1110.02	
Attenuator ESH 2-Z31	827.6513.02	

¹⁾ Automatically taken into account in the readout on the ESH 2 and ESH 3.

interference level. The pulse limiter is fitted with a coding plug for the Test Receivers ESH 2 and ESH 3 which then automatically take into account the insertion loss.

Specifications

Pulse Limiter ESH 3-Z2

Frequency range	0 to 30 MHz
Insertion loss	10 \pm 0.3 dB
Frequency response (0 to 30 MHz)	\leq 0.2 dB
VSWR with 50- Ω termination	
Input	\leq 1.06
Output	\leq 1.25
Power-handling capacity in continuous operation	1 W
Pulse power-handling capacity	see diagram

General data

Rated temperature range	-10 to +45 °C
Storage temperature range	-25 to +70 °C
Connectors	
RF	BNC (female/male)
Coding (insertion loss)	12-contact Tuchel male
Dimensions (LxWxH)	94 mmx25 mmx25 mm
Weight	0.12 kg

Order designation ► Pulse Limiter ESH 3-Z2 357.6810.52

Attenuator ESH 2Z11

Frequency range	0 to 1500 MHz
Insertion loss for f \leq 500 MHz	20 \pm 0.25 dB
f \leq 1000 MHz	20 \pm 0.5 dB
f \leq 1500 MHz	20 \pm 1.5 dB
Characteristic impedance	50 Ω
Power-handling capacity in continuous operation	10 W
Pulse power-handling capacity	750 W (3 μ s)

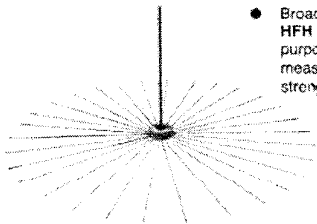
General Data

Rated temperature range	-55 to +125 °C
Connectors	BNC (female/male)
Dimensions (length/diameter)	97 mm/42 mm
Weight	0.15 kg

Order designation ► Attenuator ESH 2-Z11 349.7518.52

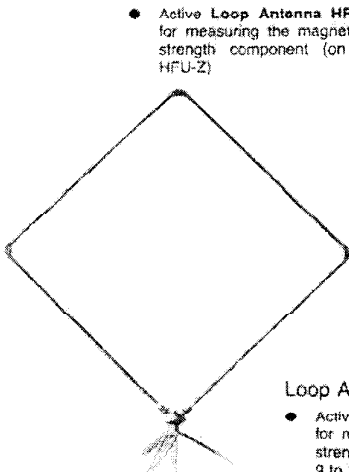
Field-strength measurements The recommended extras available for the ESH 2 and ESH 3 include four antennas:

Rod Antenna HFH 2-Z1

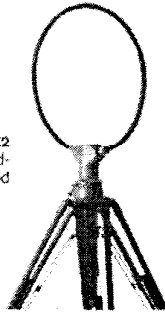


- Broadband active Rod Antenna HFH 2-Z1 for use as a general-purpose receiving antenna and for measuring the electrical field-strength component

Loop Antenna HFH 2-Z2



- Active Loop Antenna HFH 2-Z2 for measuring the magnetic field-strength component (on Tripod HFU-Z)

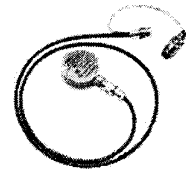


Loop Antenna HFH 2-Z3

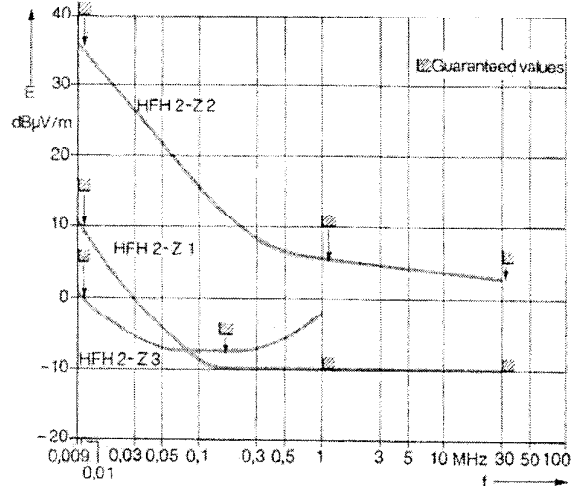
- Active Loop Antenna HFH 2-Z3 for measuring extremely low field strength over the frequency range 9 to 150 kHz (1 MHz)

Inductive Probe HFH 2-Z4

- Inductive Probe HFH 2-Z4 for simple approximate measurements of the magnetic field-strength component.



Minimum measurable field-strength level (for S/N = 1) of the antennas HFH 2-Z1, Z2 and Z3 as a function of the frequency (average-value indication and 200 Hz IF bandwidth). In the CISPR indicating mode the minimum measurable field-strength goes up by about 6 dB over the range 9 kHz to 149.9 kHz (CISPR 3) and about 23 dB over the range 150 kHz to 30 MHz (CISPR 1).



Specifications	Rod Antenna HFH 2-Z1	Loop Antenna HFH 2-Z2	Loop Antenna HFH 2-Z3	Inductive Probe HFH 2-Z4
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz	9 kHz to 1 MHz	100 kHz to 30 MHz
Conversion factor k^1 (E → V) Error	20 dB ² , referred to 1/m < 1 dB	20 dB, referred to 1/m < 1 dB	10 dB, referred to 1/m < 1 dB	80 dB, referred to 1/m < 6 dB
Measurement range (IF bandwidth 200 Hz, average-value indication)				
Lower limit (frequency-dependent, see diagram above)	+15 to -10 dBµV/m	9 kHz to 1 MHz: +40 to +10 dBµV/m; 1 MHz to 30 MHz: +10 to +5 dBµV/m 140 dBµV/m	+5 to -5 dBµV/m	50 dBµV/m (≈ 0 dBµA/m)
Upper limit (1-dB compression)	140 dBµV/m	140 dBµV/m	140 dBµV/m	> 190 dBµV/m
Source impedance	50 Ω	50 Ω	50 Ω	50 Ω (≈ 140 dBµA/m)
Max. output voltage into 50 Ω	1 V	1 V	1 V	—
General data				
Rated temperature range	-10 to +55 °C	-10 to +55 °C	-10 to +55 °C	-10 to +55 °C
Storage temperature range	-25 to +70 °C	-25 to +70 °C	-25 to +70 °C	-25 to +70 °C
Inputs				
RF	BNC female	BNC female	BNC female	BNC male
Supply and coding (antenna factor)	12-contact Tuchel male female connector	12-contact Tuchel male female connector	12-contact Tuchel male female connector	12-contact Tuchel male male connector
Length of connecting cable	10 m	10 m	10 m	1 m
Current drain (±10 V, varies with output level)	< 40 mA	< 40 mA	< 50 mA	—
Weight	in transport case, without cables: 8 kg	in transport case, without cables: 12 kg	without cables, with (without) transport case: 43 (17) kg	with cables: 0.3 kg
Dimensions in mm	ground net, dia. 2510 rod height: 1092	loop dia.: 590	loop diagonal: 3360	—
Order designation	▶ Rod Antenna HFH 2-Z1 335.3215.52	▶ Loop Antenna HFH 2-Z2 335.4711.52	▶ Loop Antenna HFH 2-Z3 335.6214.52	▶ Inductive Probe HFH 2-Z4 338.3016.52
Accessories supplied	coaxial cable (10 m), Supply/coding cable (10 m), 12-pole Tuchel female connector	same as HFH 2-Z1	same as HFH 2-Z1	—
Recommended extras	—	Tripod HFU-Z (in transport bag): 100.1114.02	same as HFH 2-Z2	—

¹) Conversion factor = logarithm of the ratio between the output voltage and the input field strength; automatically taken into account in the readout on the ESH 2 and ESH 3. ²) Adaptable to $k = 10$ dB.

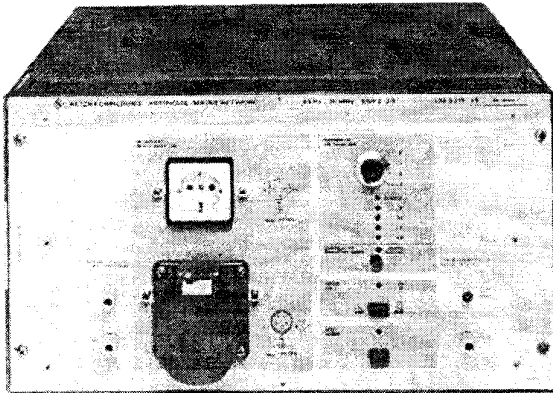
interference measurements

Artificial Mains Network ESH 2-Z5

For interference measurements on AC-supply-dependent loads a circuit must be provided to ensure that the AC supply voltage is supplied to the test item, on the one hand, and, on the other hand, that the AC supply represents a defined load impedance for the test item. Furthermore, provisions are made so that interference from the AC supply does not reach the test circuit, and that the defined interference voltage produced by the test item can be connected to a test receiver suitable for radio interference measurements, such as the ESH 2 or ESH 3.

The **Artificial Mains Network ESH 2-Z5** is a V-network ($50 \mu\text{H} + 5 \Omega$) || 50Ω in line with VDE 0876 and CISPR 3. It uses air-cored coils and contains an artificial hand and a choke to suppress interference on the ground line. A built-in blower with a separate AC supply provides automatically controlled cooling or continuous cooling, as required.

ESH 2-Z4



For phase switching in an automatic test system the Artificial Mains Network can also be remote-controlled via TTL control inputs using the R&S Controllers PUC, PCA 5 and EZM.

Other accessories

24-V Adapter ESH 2-Z4

The ESH 2 as well as the ESV can be powered from a 24-V DC mains supply via the **24-V Adapter ESH 2-Z4** which may be mounted at the rear of the receiver in the place of the power supply or battery pack.

Specifications

Input voltage range (protected against reversal of polarity)	..... +18 to +32 V
Input connector (mating connector is supplied with the ESH 2-Z4)	..... 6-way male standard
Output voltage	..... +12.5 V \pm 0.5 V
Output connector	..... 4-contact female special
Maximum output current (short-circuit-proof)	..... 2 A
Rated temperature range	..... -10 to +45 °C
Storage temperature range	..... -25 to +70 °C
Dimensions (W×H×D)	..... 205 mm×172×50 mm
Weight	..... 1 kg
Order designation	..... ► 24-V Adapter ESH 2-Z4 338.4512.02
Accessories supplied	
Mating connector, female	..... 018.6946.00

Other accessories for use in radio-interference measurements are to be found on page 295, for example

Attenuator ESH 2-Z11 and Pulse Limiter ESH 3-Z2.

They are recommended to protect the receiver's internal attenuator from excessive AC supply interference when working with the Artificial Mains Network.

Specifications

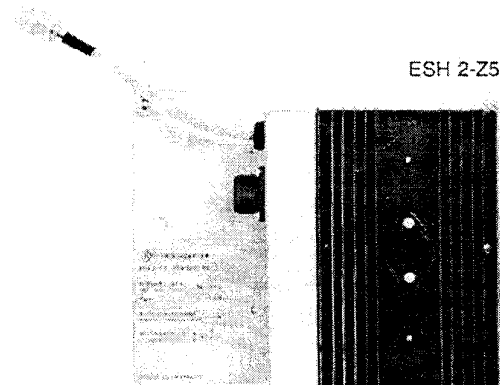
Frequency range	..... 9 kHz to 30 MHz
Equivalent circuit (to VDE 0876)	..... (50 $\mu\text{H} + 5 \Omega$) shunted by 50 Ω
Error limits (to VDE 0876)	..... \pm20%
Continuous-rated output current	..... 4×25 A
Max. instantaneous output current	..... 4×50 A
Max. AC supply frequency	..... 63 Hz
Cooling	..... built-in blower
Connectors	
AC supply inputs	..... Cekon male
Blower connector	..... male European standard
AC supply outputs for test item	
2×16 A	..... female with earthing contact
4×32 A	..... Cekon female
RF output	..... BNC female
Remote control input	..... 50-way Amphenol female
Artificial hand	..... telephone jacks
General data	
Rated temperature range	..... -10 to +45 °C
Storage temperature range	..... -25 to +70 °C
AC supply (blower)	..... 100/120/220/240 V, 20 VA
Overall dimensions (W×H×D)	..... 492 mm×294 mm×603 mm
Weight	..... 26 kg
Order designation	..... ► Artificial Mains Network ESH 2-Z5 338.5219.53
Accessories supplied	
Power cord, RF connecting cable, Amphenol male connector (50-contact), Cekon AC female adapter, Cekon male connector, earthing-contact male connector	
Recommended extras	
Attenuator ESH 2-Z11	
20 dB, 10 W	..... 349.7518.52
Pulse Limiter ESH 3-Z2	..... 357.8810.52

ESH 2-Z4
HFU-Z

Tripod HFU-Z

is used for supporting the Loop Antennas HFH 2-Z2 and -Z3 (page 296).

Order designation ► Tripod HFU-Z
110.1114.02



ESH 2-Z5

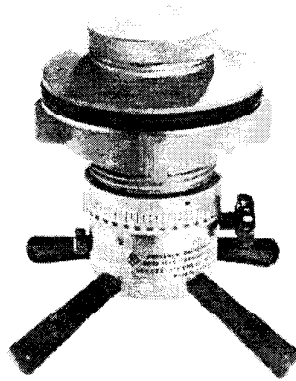
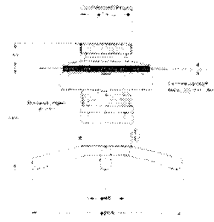
Other accessories (continued)

Roof-mounting Kit HFH 2-Z5

The Roof-mounting Kit is used for fixing the Loop Antenna HFH 2-Z2 on the roof of a vehicle, where it is permanently mounted. The antenna can be rotated from inside the

vehicle. A scale in degree divisions permits reproducible settings. The opening in the vehicle roof must have a diameter of 72 mm, the maximum roof thickness is 20 mm. Rubber rings are used for sealing. The loop antenna is inserted from above. The RF and coding sockets are accessible from inside the vehicle. When the loop antenna is dismantled, the roof opening can be covered up by a cap.

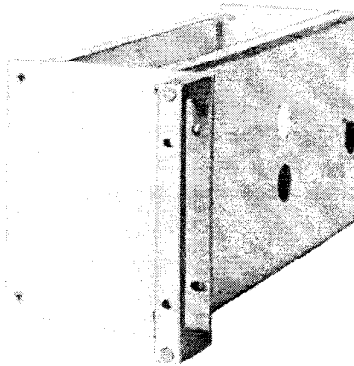
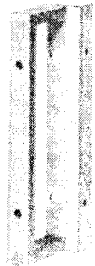
HFH 2-Z5



Specifications

Dimensions	see illustration
Weight	2.2 kg
Order designation	► Roof-mounting Kit HFH 2-Z5 335.5718.02

ESH 2-Z6

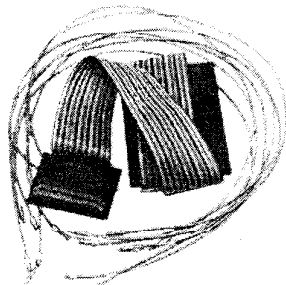


19" Adapter ESH 2-Z6

permits the bench model of the ESH 2 to be converted to a 19" rackmount, four dimensional units in height.

Order designation	► 19" Adapter ESH 2-Z6 338.4312.02
-------------------------	---------------------------------------

ESH 2-Z7

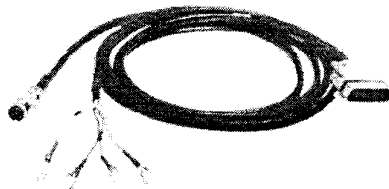


Service Kit ESH 2-Z7

permits plug-in circuit boards to be operated outside the instrument when doing repair work. It comprises a 48-core flexible adapter cable and 14 coaxial connecting cables.

Order designation	► Service Kit ESH 2-Z7 338.4112.02
-------------------------	---------------------------------------

ESH 3-Z1



Connecting Cable ESH 3-Z1

This cable is used for connecting the ESH 3 recorder output to the XYT Recorder ZSKT.

Order designation	► Connecting Cable ESH 3-Z1 349.6011.02
-------------------------	--