

Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

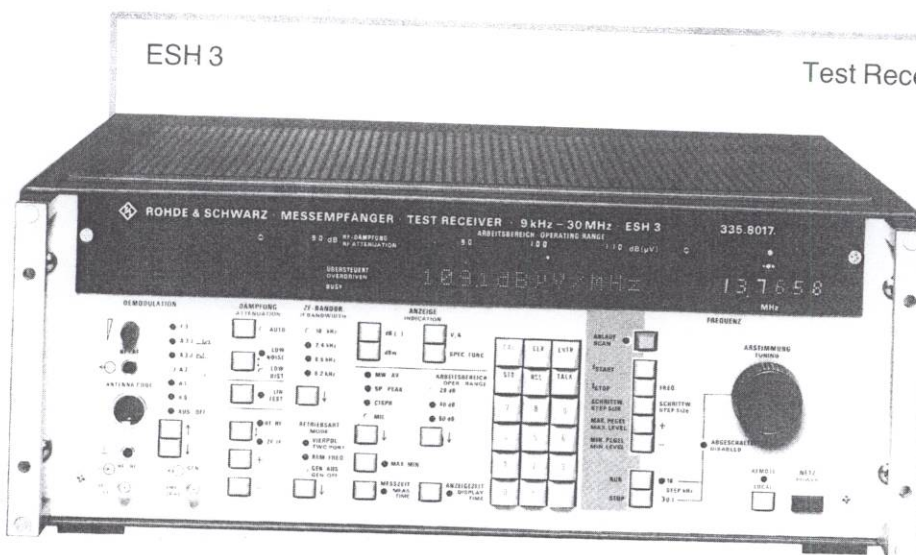
- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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Test Receiver ♦ 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 measurements to MIL and VG standards (model 56)
- Frequency-range extension down to 20 Hz when using model 56 with Spectrum Monitor EZM (model 56)

*) With Preamplifier ESH3-Z3: –37 dBV

IEC 625 Bus

The automatic **Test Receiver ESH 3** which measures and demodulates AM double-sideband, single-sideband, pulse-modulated and FM signals as well as interference in the range of 9 kHz to 30 MHz is suitable for manual and programmed use as a

- ▶ field-strength meter in conjunction with the test antennas of the HFH 2
- ▶ selective RF voltmeter (in conjunction with a current probe, it can also measure RF currents)
- ▶ system unit in automatic test systems.

The ESH 3 has the same RF, IF and demodulator circuits as the ESH 2 (see preceding pages); it thus features the same excellent characteristics and covers the same fields of application. In addition, the ESH 3 is equipped with microcomputer circuitry and an evaluation unit, which make it a versatile, intelligent test receiver with a maximum of **operating convenience**.

Extended signal evaluation capabilities and **extra features and functions** characterize the ESH 3:

- Four selectable IF bandwidths: 0.2/0.5/2.4/10 kHz for model 52 and 0.2/1/2.4/10 kHz for model 56
- Average, peak and quasi-peak indication to CISPR 16 and VDE 0876 with programmable measuring times
- 75-MHz broadband IF output for panoramic display (Spectrum Monitor EZM) or spectrum Analyzer
- Digital level indication in selectable units
- Measurement of frequency offset, frequency deviation and modulation depth
- Automatic ranging (for low noise or low distortion) or pre-setting of RF and IF attenuation
- Frequency setting in programmed steps, eg 9-kHz channel pattern or for harmonic measurements

Automatic scanning with data output to printers or recorders (XY, YT or radiomonitoring recorder)

Storage of last and nine additional device settings even when the unit is switched off or the supply interrupted

Automatic correction after calibration, ensuring full measurement accuracy at all frequencies, IF bandwidths, display modes and types of demodulation

Further characteristics, uses

The ESH 2 is ideal when only manual operation is required and portability and battery-power capability are wanted; the ESH 3 comes into its own when automation is needed to improve efficiency, when **computer** control is required and maximum versatility in terms of measurement functions is important.

In conjunction with the Test Receiver ESVP (page 300), signals and interference can be measured automatically in the range 9 kHz to 1 or 1.3 GHz in accordance with the relevant international regulations.

The antennas, the RF current probe, the probes and the artificial mains network available for the ESH 2 can also be used with the ESH 3.

Selective voltage measurement For use in the laboratory and test department for measurements on signal generators (level of fundamental, harmonics and non-harmonic signals, sideband noise, frequency deviation and modulation depth); twoport measurements (filter attenuation up to >100 dB, gain up to 57 dB) with automatic recording of frequency response with an XY recorder; amplifier measurements (frequency response, noise figure, overdrive capacity, intermodulation and crossmodulation characteristics).

Field strength measurement Propagation and coverage measurements are possible in conjunction with the rod, loop and probe antennas of the HFH 2 (page 300).

In **radiomonitoring** the ESH 3 can be used to measure: field strength and range of fluctuation of field strength with max./min. indication, frequency (remote measurement with add-on frequency counter), frequency offset, frequency deviation and modulation depth.

Data-logging capabilities in radiomonitoring

1. Output of all measured data to a printer via the IEC-bus interface with the ESH 3 in the talk-only mode.
2. Recording of amplitude spectrum on a XY recorder. The values entered for start and stop frequencies and minimum and maximum levels determine the end values of the scales.
3. Long-term recording of frequency-band occupancy using the R&S Radiomonitoring Recorder ZSG 3. One ESH 3 permits up to five different frequency bands with different recording thresholds to be constantly observed and their occupancy to be recorded on five ZSG 3 recorders; see recording below.



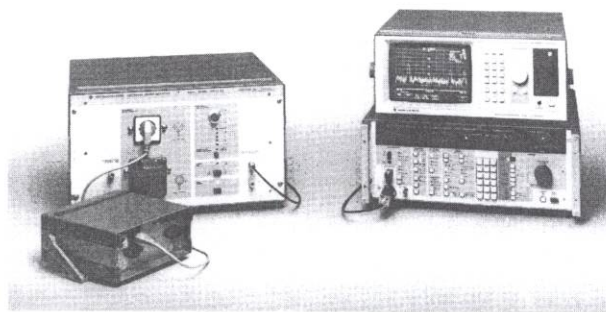
Recording of frequency-band occupancy using Test Receiver ESH 3 and Radiomonitoring Recorder ZSG 3

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 according to the relevant standards (CISPR, VDE, MIL, VG):

- RF Current Probe	ESH 2-Z1
- Active Probe	ESH 2-Z2
- Passive Probe	ESH 2-Z3
- Artificial Mains Network (four-wire system)	ESH 2-Z5
- Pulse Limiter	ESH 3-Z2
- Preamplifier	ESH 3-Z3
- T-network	ESH 3-Z4
- Two-line V-network	ESH 3-Z5
- V-network $5 \mu\text{H} \parallel 50 \Omega$	ESH 3-Z6
- Loop Antenna	HFH 2-Z2
- Inductive Probe	HFH 2-Z4
- Rod Antenna (for MIL-STDs)	HFH 2-Z6
- EMI Test Software	EZM-K1

The ESH 3 offers the following advantages for measuring interference:

- Bandwidth correction factor automatically taken into consideration when measuring pulse spectral density to MIL and VG standards; readout of measured data in $\text{dB}\mu\text{V}/\text{MHz}$, $\text{dB}\mu\text{A}/\text{MHz}$ and $\text{dB}\mu\text{V}/\text{m} \cdot \text{MHz}$
- Indication modes and bandwidths for interference measurements according to MIL-STDs (also to draft for MIL-STD-462 B), DEF STAN 59-41 and VG standards



Automatic interference-voltage measurement with programmed phase-switching: Test Receiver ESH 3, Artificial Mains Network ESH 2-Z5, Spectrum Monitor EZM

- Frequency-range extension down to 20 Hz by combining model 56 with Spectrum Monitor EZM (model 56)
- Average-value indication with programmable integration time for measuring narrowband interference
- CISPR indication mode with determination of maximum value within programmed measuring time
- Programmable measuring times ensuring optimum adaptation of automatic measurements to time-dependent variations of the interference
- Automatic, frequency-dependent switching of quasi-peak-value indication for CISPR band A (9 to 149.9 kHz) and band B (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, autoranging in consideration of CISPR settling times ensuring error free 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).

Operation, functions

The front-panel **controls** of the ESH 3 are arranged for optimum clarity in spite of the multitude of functions, and logically organized according to frequency, display mode, IF bandwidth, attenuation (sensitivity) and demodulation.

A 13-digit alphanumeric display facilitates data entry (frequencies, measuring times, limit levels) and reads out the measured results. In addition, the analog value of the input voltage is indicated within the limits of the demodulator operating range by a row of LEDs. Another LED row indicates the frequency offset.

All active functions are indicated by LEDs. If major operating errors are made, or when a fault occurs in the main modules, an error message is issued with an error code. The end of long-term tests is indicated by a buzzer.

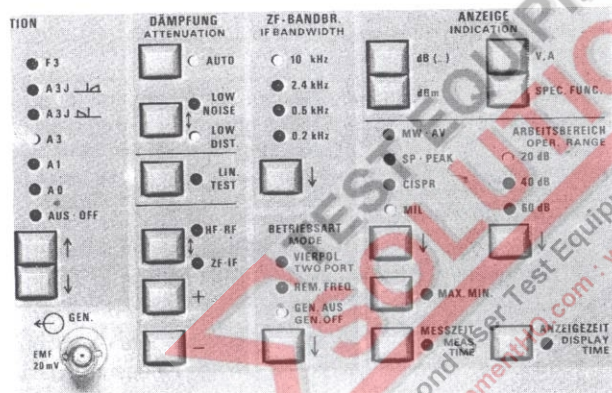
ESH 3

Frequency setting or frequency entry can be carried out in different ways:

1. with tuning knob in steps of 100 Hz or 10 kHz (quasi-continuous)
2. at a keystroke in steps of any preset size, eg in 9-kHz steps, or in steps of the fundamental-frequency width to measure harmonics
3. by keyboard entry
4. by automatic frequency scanning over up to five sub-ranges, with any desired preset start and stop frequencies and step sizes.

Tuning is facilitated by a calibrated offset indication. The last, and nine further complete device settings can be stored.

Sensitivity, measurement ranges The voltage range in the average mode extends from -30 to $+137$ dB μ V. Frequency offset is indicated – depending on IF bandwidth – from -5 to $+5$ kHz, frequency deviation from 0 to 5 kHz; modulation depth can be measured from 0 to 100% and gain from -110 to $+57$ dB.



Front-panel section with operating controls for indication, IF bandwidth, mode, attenuation and demodulation

Calibration Two different calibration processes are initiated depending on whether the calibration button is pressed for a shorter or longer period:

1. Check and, if necessary, correction of level and frequency-offset calibration
2. Measurement of all the calibration correction values that do not vary with time, for frequency response, IF bandwidth, logarithmic amplifier and detector – and storage in a non-volatile memory.

Output of results The measured value is converted into a level with or without logarithmic conversion; RF and IF attenuation, all correction values and transducer conversion factors – if applicable – are added and conveyed together with their physical unit to the alphanumeric display and the IEC-bus interface.

A 24-contact output permits the connection of three types of recorders XY, YT and radiomonitoring recorders. The ESH 3 automatically adjusts to the recorder type connected by selecting the required drive to the A/D converter.

The IEC-bus interface is provided with all the listener and talker capabilities covered in the standard: the limited capabilities of the widely commercial available controllers have, however, also been taken into consideration. For example, it is also possible to use computers without serial- and parallel-poll capability.

Computer control of the ESH 3 via the IEC bus provides the following capabilities:

- Execution of complex test programs
- Automatic evaluation of large quantities of data from various points of view
- Use of the ESH 3 together with other programmable measuring instruments.

Specifications

Frequency range	9 kHz to 29.9999 MHz
Frequency setting	1. quasicontinuous with knob in steps of 100 Hz or 10 kHz
	2. keyboard entry
	3. in steps of any preset size
	4. automatic scanning
Indication	6 digit LED display
Resolution	100 Hz
Setting error	$1.5 \times 10^{-5} + 50$ Hz
RF input	$Z_{in} = 50 \Omega$, BNC female connector
VSWR	<1.2 with RF attenuation ≥ 10 dB
	<2 with RF attenuation 0 dB
Oscillator radiation	<0 dB μ V
Input filter	
Range 1	model 52: 9 to <150 kHz, bandpass filter
	model 56: 20 Hz to <150 kHz, bandpass filter
2	100 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*
9	1.45 to <2.0 MHz
	(8: sub-octave filter, 16: tracking filter)
Maximum input level with	
RF attenuation 0 dB	130 dB μ V
RF attenuation ≥ 10 dB	137 dB μ V

Interference immunity, non-linearities

Image frequency rejection	>100 dB, typ. 120 dB
IF rejection	>100 dB, typ. 110 dB
Non-linearities: signal spacing (d2, d3)	≥ 40 kHz
a) frequency range 9 kHz to <150 kHz	
b) frequency range 150 kHz to 30 MHz	

Type	Signal-level dB μ V	Intermod. ratio dB	Intercept point guaranteed dBm	typical dBm
a) k_2	100	>52	+45	+50
d_2	100	>50	+43	+55
d_3	90	>64	+15	+20
b) k_2	100	>77	+70	+90
d_2	100	>60	+55	+75
d_3	90	>64	+15	+20

Crossmodulation

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

>100 dB μ V

Shielding effectiveness

Difference in reading with field strength 10 V/m ($f \neq f_{in}$)

below the tolerance limits of FTZ regulation 527/1979

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	6-dB bandwidth	6:60 dB ratio
	(±10%)		
200 Hz ³	160 Hz ⁴	200 Hz	approx. 1:5
500 Hz (model 52)	550 Hz ⁴	630 Hz	approx. 1:5
1 kHz (model 56)	800 Hz ⁴	1 kHz	approx. 1:2
2.4 kHz	2.4 kHz	2.6 kHz	approx. 1:1.8
10 kHz	8 kHz ⁴	9.5 kHz	approx. 1:2.4

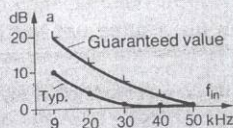
IF bandwidth (−6 dB) for measurements to CISPR (Band A

and Band B) and VDE 0875 0.2 kHz / 9 kHz (automatically switched over)

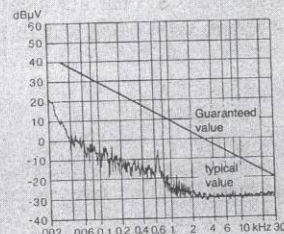
Noise indication a ($f_{in} > 50$ kHz)

Average value	B = 200 Hz	< −27 dB μ V, typ. −31 dB μ V
Peak value	B = 200 Hz	< −19 dB μ V, typ. −22 dB μ V
CISPR band A	B = 200 Hz	< −26 dB μ V, typ. −30 dB μ V
CISPR band B	B = 9 kHz	< −6 dB μ V, typ. −9 dB μ V
Spectral pulse density (MIL)	B = 10 kHz	typ. 38 dB(μ V/MHz)

Increase of noise indication (f < 50 kHz, B = 200 Hz)



Noise indication for combination of ESH3 (model 56) and Spectrum Monitor EZM (function RF/IF analysis of EZM with 10-Hz bandwidth)



Measurement ranges

Voltage	
Lower limit (3 dB above noise level)	see internal noise
upper limit	+137 dB μ V; for pulse spectra: 146 dB μ V/10 kHz
Measurement error	
average, 20 dB	<1 dB with $V_{in} \geq 16$ dB above internal noise
Frequency offset	
	−5 to +5 kHz, depending on IF bandwidth
Frequency deviation	
	0.05 to 5 kHz, depending on IF bandwidth
AM modulation depth	
	approx. 2 to 100%
Gain	
	−110 to +57 dB
Indication of measured value	
	13-digit alphanumeric display of numerical value and unit of measurement for level, frequency offset, deviation, modulation depth or gain

Level	
digital in dB μ V etc.	4 digits, resolution 0.1 dB
in μ V, mV etc.	3 digits, resolution 1 LSD
analog	row of 31 LEDs within operating range of IF detector, with digital indication of range limits

Operating range of IF detector	20, 40, 60 dB
Indicating modes	
	average, peak
	CISPR (QP for bands A and B)
	spectral density to MIL stand.
	max./min. levels over preset period of observation

Frequency offset	
digital in kHz	3 digits, resolution 10 Hz
analog	row of 16 LEDs
Frequency deviation in kHz	
	3 digits, resolution 10 Hz
Modulation depth in %	
	2 digits, resolution 1%
Gain in dB	
	4 digits, resolution 0.1 dB

Types of demodulation	
	N0N (A0, zero beat)
	A1A (A1, 1-kHz beat note)
	A3E (A3, double-sideband AM)
	J3E (A3J, LSB, USB)
	F3E (F3, frequency modulation)

Outputs

Generator (ref. voltage, can be switched off)	86 dB μ V \pm 0.5 dB; 50 Ω , BNC female connector
Connector for antenna supply and antenna coding	
AF signal, adjustable	up to 3.5 V, 10 Ω ; jack JK 34
IF 75 MHz	50 Ω , BNC female
EMF	10 \pm 3 dB above input level with 0 dB attenuation

Bandwidth	corresponding to RF bandwidth
IF 30 kHz	1 k Ω , BNC female connector
EMF at max. analog indication	2 V, bandwidth corresponds to IF bandwidth
AM demodulator	
EMF	10 k Ω , BNC female connector
FM demodulator	1 V at 100% modulation
EMF	10 k Ω , BNC female connector
Frequency offset	\pm 0.5 V for 5 kHz deviation
	\pm 5 V for 5 kHz offset
Analog level output 1 (average, peak, MIL)	
CISPR	0 to +5 V between limits of analog indication
Analog level output 2 (CISPR)	
	0 to +2 V, $Z_{out} = 10$ k Ω , BNC female connector, includes lowpass network to CISPR for simulation of meter response
Recorder output	
	24-contact Amphenol female connector for coding lines to identify recorder type, analog X and Y outputs, penlift control, paper advance for ZSKT, connection of five ZSG 3
Reference frequency input	
	5/10 MHz, switch-selected; required EMF: 1 V into 50 Ω
Remote control	
	interface according to IEC 625-1, 24-contact Amphenol connector; functions: AH1, L4, SH1, T5, RL1, SR1, PP1, DC1, DT1, C0

General data

Rated temperature range	+5 to +45 °C
Storage temperature range	−25 to +70 °C
Power supply, AC	100/120/220/240 V \pm 10%, 47 to 440 Hz (70 VA)
Battery	22 to 32 V, 2.5 A at 24 V
Dimensions, weight	492 mm \times 205 mm \times 514 mm, 25 kg

Ordering information

Order designation	
Model: standard	Test Receiver ESH 3
for MIL-STDs	335.8017.52
Accessories supplied	335.8017.56 power cable
Option	
Oven-controlled Crystal Oscillator	ESVP-B1 . . . 358.1119.02
Recommended extras	
For interference measurements	
RF Current Probe (9 kHz to 30 MHz)	ESH 2-Z1 . . . 338.3516.52
Active Probe (9 kHz to 30 MHz, high impedance)	ESH 2-Z2 . . . 299.7210.52
Passive Probe (9 kHz to 30 MHz, VDE 0876)	ESH 2-Z3 . . . 299.7810.52
Artificial Mains Network (9 kHz to 30 MHz, VDE 0876, CISPR 3)	ESH 2-Z5 . . . 338.5219.53
Connecting Cable (ESH 3-ZSKT)	ESH 3-Z1 . . . 349.6011.02
Pulse Limiter	ESH 3-Z2 . . . 357.8810.52
Preamplifier	ESH 3-Z3 . . . 827.8016.52
T-network	ESH 3-Z4 . . . 800.1510.52
Two-line V-network	ESH 3-Z5 . . . 831.5518.52
V-network 5 μ H 50 Ω	ESH 3-Z6 . . . 836.5016.52
Attenuator	ESH 2-Z11 . . . 349.7518.52

For field-strength measurements (details on following pages):

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

General:	
Headphones	110.2959.00

Recorders:	
XYT Recorder ZSKT	301.9010.02
Radiomonitoring Recorder ZSG 3	242.6015.92
Pinwriter (220 V)	PDN . . . 351.4512.02
Pinwriter (120 V)	PDN . . . 351.4512.03
IEC-bus interface option	PDN-B4 . . . 1006.9706.02
HF Preselector	FK 101 . . . 617.8011.02

Frequency counter for remote frequency measurements, sensitivity better than 10 mV into 50 Ω , such as PM 6676/04 from Philips

Sinewave inverter for operating the ESH3 from a 12-V battery, such as SWR from Audiotechnik, Bad Salzungen

- For greater setting accuracies, the ESH3 has an input for an external reference frequency of 5 or 10 MHz.
- For extreme requirements, the HF Preselector FK 101 can be used (data sheet N 2-322).
- 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.
- \pm 20%.