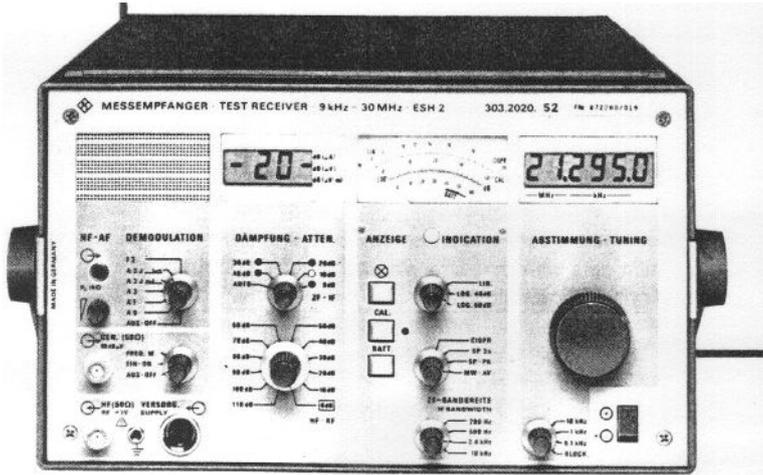


Test Receiver ESH 2 ♦ 9 kHz to 30 MHz/ -30 to +137 dBμV



- Synthesizer-based test receiver offering crystal-referenced frequency display
- Resolution of frequency display 100 Hz
- High overload capacity
- High overall selectivity
- Level range >165 dB
- Automatic voltage calibration at the push of a button
- XY recording of interference and field-strength spectra
- General-purpose unit for:
 - Wanted-signal measurements
 - Interference measurements to CISPR, VDE, MIL and VG
- AC supply and battery operation

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 276.

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 262).

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.

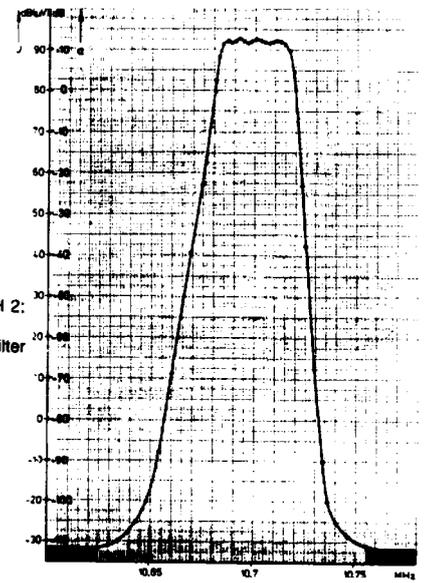
Automatic calibration at the push of a button and excellent receiver selectivity permit accurate measurements of closely spaced signals with very different levels, for example: SSB two-tone measurements, spurious-content and sideband-noise measurements on signal generators, intermodulation and distortion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

The calibration-generator output can be used for twoport measurements over an attenuation range of more than 100 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,
- XY recorder outputs for interference and field-strength spectra,
- 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

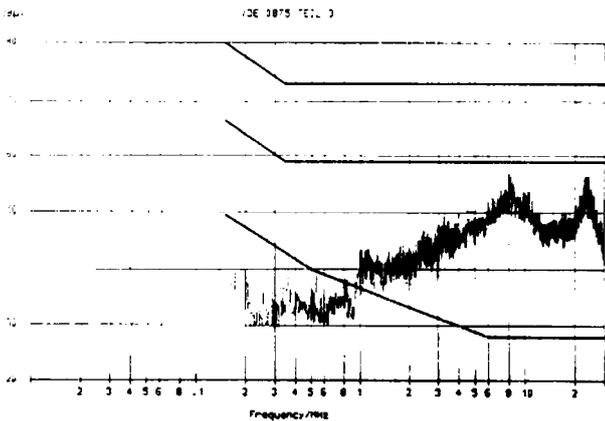
Auxiliary instruments for additional applications

Interference measurement Interference voltage and interference current can be measured in accordance with the relevant standards (CISPR, MIL, VG, VDE). The following accessories are available for this purpose (see specifications on pages 257 and 242):

RF Current Probe	ESH 2-Z1
Active Probe	ESH 2-Z2
Passive Probe	ESH 2-Z3
Artificial Mains Network	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 μ H 50 Ω	ESH 3-Z6
Loop Antenna	HFH 2-Z2
Inductive Probe	HFH 2-Z4

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, eg directly in dB μ A,
- frequency-dependent automatic switchover of weighting and of calibration pulse for CISPR band A and B,
- peak indication with selectable hold time,
- IF bandwidths of 200 Hz and 9 kHz in line with CISPR,
- linear scale range of 20 dB for CISPR measurements; 4F bandwidth of 10 kHz in line with MIL,
- recording on XY recorder (diagram below).



Spectrum of interference voltage on the AC supply line of a hairdrier, measured with Artificial Mains Network ESH 2-Z5 and plotted with XYT Recorder ZSKT using Recorder Adapter ESV-Z4

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 and F3M 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 a tunable 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 276):

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.

For **radiomonitoring applications**, the ESH2 can be used to measure propagation and coverage. Long-term field-strength observation is possible in conjunction with a YT recorder, e.g. the XYT Recorder ZSKT. For plotting field-strength spectra, an XY recorder can be used.

For interference measurements, the Loop Antenna HFH 2-Z2 is used to measure the magnetic component of the interfering signal, and the Rod Antenna HFH2-Z1 for the electrical component.

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

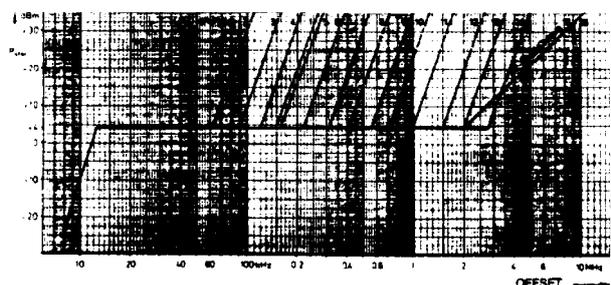
Ease of operation, setting functions

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 setting 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.

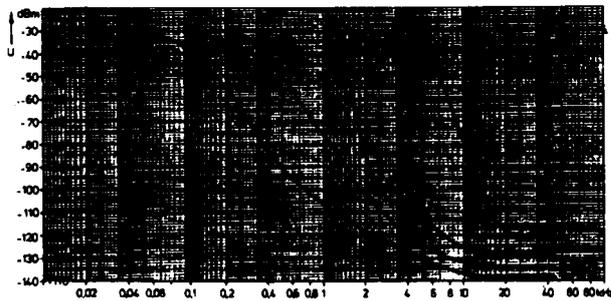
Unfavourable cases of 3% crossmodulation by interfering signal with 30% modulation depth as a function of internally switched RF filters of Test Receiver ESH2 (without RF attenuation) at an IF bandwidth of 10 kHz



ESH 2

Sensitivity setting (cont.) Sensitivity is set for the RF and IF sections by means of separate attenuators in 10-dB steps.

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.



Dynamic IF selectivity of ESH 2 at an input level of -30 dBm (corresp. to 77 dBµV) into 50 Ω
Meßgrenze 10 kHz = Test limit 10 kHz

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 (eg 50 ms, 1 s) or noise weighting in line with CISPR.

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.

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.

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 (A0, zero beat), A1A/A1B (A1, 1-kHz beat note), A3E (A3, double-sideband AM), J3E (A3J, upper or lower sideband) and F3E (F3, frequency modulation). 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,
- frequency-proportional X output for XY recorder (optional linear or logarithmic frequency axis).

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 (24-V Adapter ESH2-Z4 required) or from the local AC supply via the power supply unit (safety class II), which can at the same time recharge or trickle-charge the 12-V battery.

Special features

Triple heterodyne receiver.

RF level switchable in 10-dB steps from 0 to 110 dB.

16 RF filters, linear mixer stage.

Intermediate frequencies: 75 MHz, 9 MHz and 30 kHz.

IF bandwidth adjustable to 0.2 kHz, 0.5 kHz, 2.4 kHz and 10 kHz.

Converter oscillators using synthesizer technique.

IF level switch adjustable in 10-dB steps from 0 to 40 dB.

Average and peak indication as well as quasi-peak weighting in line with CISPR publication 16 band A and B.

Level indication ranges: 20 dB, linear; 40 dB, 60 dB, logarithmic.

Demodulator circuits for FM and AM; BFO for N0N, A1A and J3E (upper and lower sideband); automatic IF gain control for all AM demodulators.

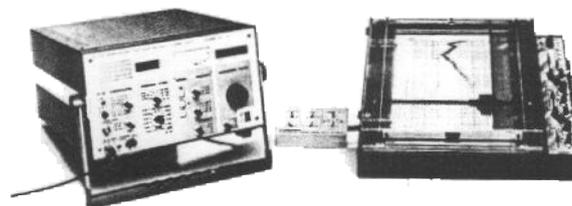
Built-in loudspeaker.

Calibration generator with stable sinewave signal source (tracking generator) and pulse generator for quasi-peak calibration.

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. Rubber covers can be put on front and rear panel to protect the receiver during transport.

Test Receiver ESH 2 with Recorder Adapter ESV-Z4 for operation and calibration of XYT Recorder ZSKT



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	$\pm 1.5 \times 10^{-4} + 50 \text{ Hz}^1$

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	> 53	+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 $f \neq f_0$) < 1 dB

Intermediate frequencies

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

IF bandwidths (for average and peak)

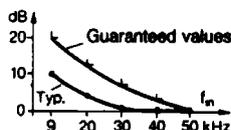
Nominal bandwidth	3-dB bandw.	6-dB bandw.	6:60-dB ratio
200 Hz ²	160 Hz ²	200 Hz	$\approx 1:5$
500 Hz	550 Hz ²	630 Hz	$\approx 1:5$
2.4 kHz	2.4 kHz	2.6 kHz	$\approx 1:1.8$
10 kHz	8 kHz ²	9.5 kHz	$\approx 1:2.4$

IF bandwidths (-6 dB) for measurements acc. to CISPR (Publ. 18) and VDE 0876 0.2 kHz/9 kHz (aut. switchover)

Internal noise a ($f_m > 50$ 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 band A $B = 9$ kHz	-6 dB μ V	< -3 dB μ V
CISPR band B $B = 200$ Hz	-28 dB μ V	< -25 dB μ V

Increase in noise indication (with $f_m < 50$ 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 lin. 20 dB
 $V_m \geq 16$ dB above internal noise < 1 dB
 Additional error of log. conversion due to temperature effect < 2 dB
 Calibration generator Average/Peak sine wave generator
 CISPR pulse generator

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 sine waves at 200 Hz bandwidth (additional measuring error 1.5 dB) due to receiver tuning in steps of 100 Hz.
 3) $\pm 20\%$.

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

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) 10 ± 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 outputs 50-contact Amphenol female conn.
 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
 Level 2 10 k Ω output impedance in all modes
 lowpass filter simulating meter response acc. to CISPR (1, 3); EMF and output impedance as for level 1
 X output, log recorder output, output voltage proportional to log frequency, 0 to +5 V, $R_s = 10$ k Ω
 lin recorder output, output voltage proportional to frequency, 0 to +5 V, $R_s = 10$ k Ω

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

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
 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)
 Battery pack +12 V, 8.5 to 9.5 Ah, operating life ≈ 4 h per charge
 Battery input 4-contact special socket supply: +10.8 to +14.5 V/ ≈ 1 A
 Dimensions, weight 347 mm \times 206 mm \times 484 mm, 19 kg with power supply unit 21 kg with battery pack

Ordering information

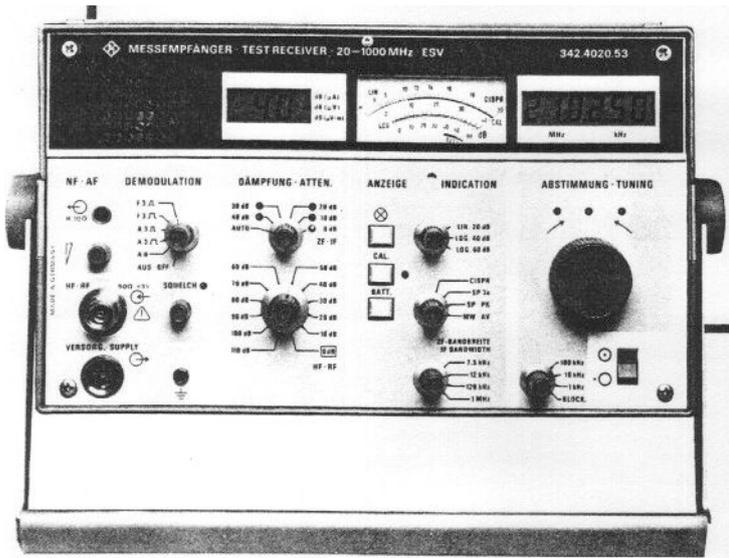
Order designation \blacktriangleright Test Receiver ESH 2 303.2020.52
 Accessories supplied Battery pack (without batteries) batt. connector LEMO F.c 2304 6.7 50-contact Amphenol male connector

Recommended extras

For interference measurements:
 RF Current Probe ESH 2-Z1 338.3516.52 (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
 Preampifier 9 kHz to 30 MHz ESH 3-Z3 827.8016.52
 Attenuator ESH2Z11 349.7518.52
 For field-strength measurements (details under HFH 2, page 276):
 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
 8-V Lead-acid Storage Battery 9.5 Ah (2 required) 338.4012.00
 19" Adapter ESH 2-Z8 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 , eg PM 6678/04 from Philips

TEST RECEIVER ESV

Test Receiver ESV



- ◆ 20 MHz to 1 GHz / -10 to +137 dB μ V
- Synthesizer-based test receiver offering crystal-referenced frequency display
- High overload capacity
- High dynamic selectivity
- Automatic level calibration at the push of a button
- Automatic overload detection
- General-purpose unit for:
 - Wanted-signal measurements
 - Field-strength measurement with test antennas
 - Interference measurements to CISPR, VDE, FCC, MIL and VG
- AC supply and battery operation

The **ESV** is a manually operated, sensitive and overload-protected test receiver offering a very wide dynamic range and maximum ease of operation. Compact construction, wide range of power supplies and low power consumption make the receiver suitable for use in fixed stations as well as for mobile and portable applications. The Test Receiver is available as model 52 (20 to 520 MHz) or as model 53 (20 to 1000 MHz).

Thanks to its excellent characteristics and the availability of a wide range of accessories, the applications of the ESV include **interference measurements** and **field-strength measurements**.

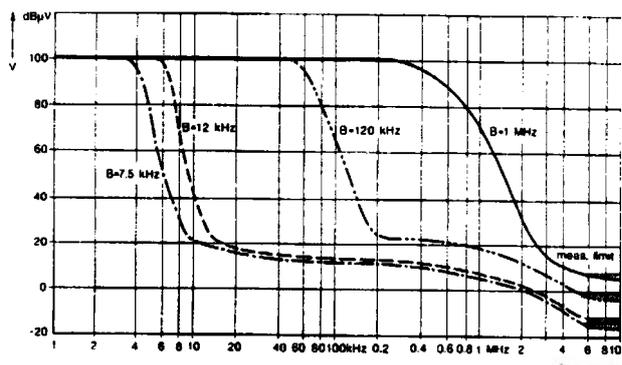
Characteristics, uses (ESV alone)

The ESV needs no accessories to operate as a **selective voltmeter** (test receiver) with a level range from -10 to +137 dB μ V, for example, for measurements in 50- Ω coaxial systems. 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: adjacent-channel measurements, spurious-content and sideband-noise measurements on signal generators, intermodulation and distortion measurements, noise figure measurements.

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 of 10.7 MHz for the connection of a panoramic display or a wave analyzer
- narrowband IF output of 10.7 MHz for connecting an oscilloscope
- AM/FM demodulator outputs
- recorder output for level and frequency offset



Typical IF selectivity of the ESV

TEST RECEIVER ESV

Auxiliary instruments for additional applications

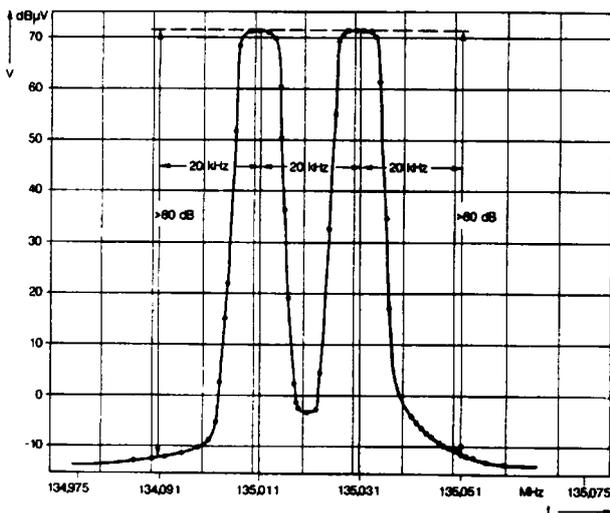
Interference measurement. Interference voltage, interference current and interference power can be measured in accordance with the relevant standards (CISPR, VDE, FCC, MIL, VG). The following accessories are available for this purpose:

- VHF Current Probe ESV-Z1 (20 to 300 MHz)
- Absorbing Clamp MDS-21 (30 to 1000 MHz)
- (Data sheet 203442)

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

- level indication taking into consideration frequency-independent conversion factors of the sensor, e.g. directly in $\text{dB}\mu\text{A}$
- peak indication with selectable hold time
- IF bandwidth of 120 kHz in line with CISPR
- scale range for measurements for CISPR: 10 dB, linear
- IF bandwidths of 12 kHz, 120 kHz and 1 MHz in line with MIL

Radiomonitoring. In conjunction with a receiving antenna the test receiver can be used in radiomonitoring, since it features excellent frequency accuracy and stability. It is capable of measuring and demodulating A0 (NON), A3 (A3E) and F3 (F3E) transmissions and comprises a squelch and a switchable AF filter.



Two-tone measurement on Test Receiver ESV

Field-strength measurements. Completed by the following antennas the Test Receiver ESV becomes the Field-strength Meter HUF:

- Broadband Dipole HUF-Z1** (20 to 80 MHz)
- Log-periodic Antenna HL 023 A1** (80 to 1300 MHz), with mast, tripod and cable set

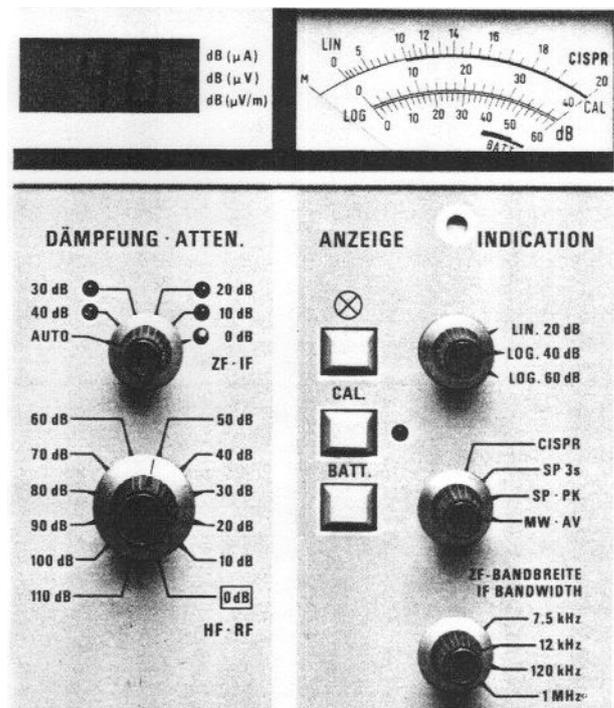
For radiomonitoring applications the HUF can be used to measure antennas, propagation and coverage. It features a field-strength measurement error of $< 3 \text{ dB}$ complying thus with the CCIR recommendation 378-1. Long-term field-strength variations can be recorded if a YT recorder is connected to the recorder output.

Ease of operation, setting functions

The correction of the level indication taking into account conversion factors of sensors, the automatic level calibration and many more logic functions make it possible to make do with a minimum of operating controls. Thanks to the clear arrangement of the front panel, even unskilled staff can learn to operate the instrument.

Frequency setting. The whole range from 20 to 1000 MHz is covered without band switching, in 1-kHz, 10-kHz or 100-kHz steps. The 6-digit LCD display is crystal-referenced. The frequency setting is retained in a memory even while the instrument is switched off.

Sensitivity setting. The measurement range for sinewave signals of -10 to $+137 \text{ dB}\mu\text{V}$ is determined at the lower limit by the inherent noise at 7.5-kHz IF bandwidth and at the upper limit by the maximum dissipation in the RF attenuator. Sensitivity is set for the RF and IF section using attenuators with 10-dB steps, see front-panel section.



Front-panel section with controls for sensitivity, bandwidth, weighting and display

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

Bandwidths, signal weighting. IF bandwidth is switch-selected at 7.5 kHz to 12 kHz, 120 kHz and 1 MHz. The signal weighting mode can be switched to average or peak with different hold times (1 s, 3 s) or noise weighting in line with CISPR.

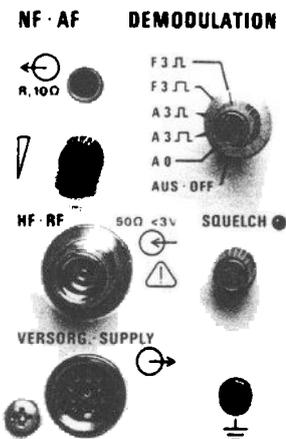
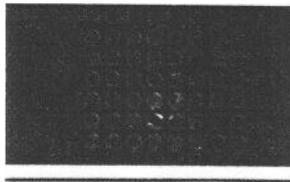
TEST RECEIVER ESV

ESV — Test Receiver

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. 40 dB μ V in the photo on page 3.

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 voltages as well as with pulses.

Internal calibration, battery check. Automatic calibration, initiated at the push of a 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.



Front-panel section:
demodulation and AF setting;
RF input,
squench and power supply
for Current Probe

Signal demodulation, outputs. The ESV is designed for a multitude of modulation types: it can be switched to A0, A3 (AF wide or narrow) and F3 (AF wide or narrow). Numerous outputs are provided for signal evaluation, recording and plotting:

- wideband IF output of 10.7 MHz for the connection of a panoramic display or a wave analyzer
- narrowband output of 10.7 MHz for the connection of an oscilloscope
- AM and FM demodulator outputs
- output 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 (24-V Adapter ESH 2-Z4 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 ESV is a double heterodyne receiver with a phase-synchronized tuning oscillator. The input signal passes via an RF attenuator to one of nine bandpass filters (depending on input frequency) and then to a high-power ring mixer where it is converted to the 1st IF of 810.7 MHz (20 to < 520 MHz) or of 310.7 MHz (up to < 1000 MHz). The signal is then amplified and filtered in multi-section filter circuits. Another mixer stage produces the second IF of 10.7 MHz.

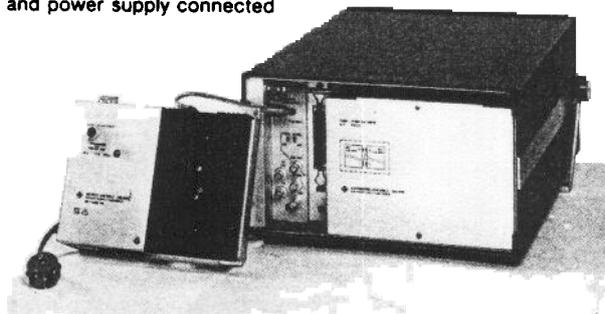
Further signal path: After filtering (crystal filters of 7.5, 12.5 and 120 kHz and LC filter of 1-MHz bandwidth), IF amplification (switchable in 10-dB steps) and rectification, the signal passes through circuits producing peak and average values and undergoes weighting to CISPR before it reaches the display.

An amplifier for monitoring AM signals and a limiter amplifier for FM signals are operative in parallel to this measurement and display section. Four demodulators permit reception of AM and FM signals with four different IF bandwidths.

Construction

Even though heavy shielding is provided, this compact receiver weighs only 20 kg. The modern cassette design, using primarily plug-in PC boards on a motherboard, makes the ESV 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 low power drain (approx. 20 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 ESV
with battery pack incorporated
and power supply connected



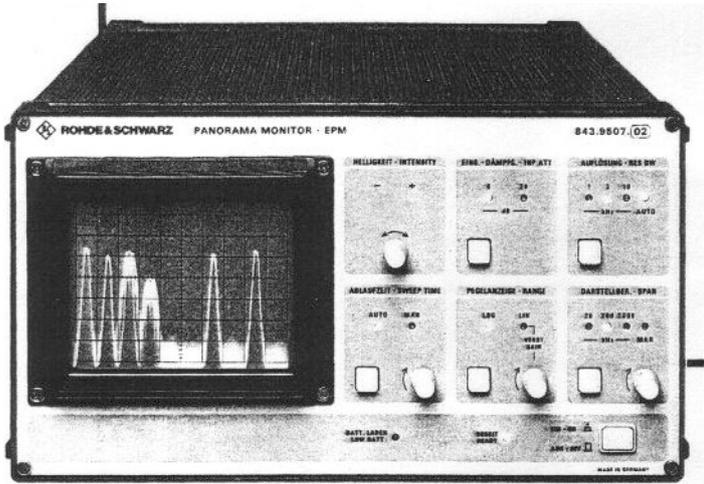
TEST RECEIVER ESV

Specifications

	Models 52 and 53	Model 53
Frequency range	20 to 1000 MHz 519.999 MHz	50 to 1000 MHz 999.999 MHz
Frequency setting	quasi-continuous with knob (tuning speed increases with speed of rotation)	quasi-continuous with knob (tuning speed increases with speed of rotation)
Resolution (step width)	1, 10 or 100 kHz, switch-selected	1, 10 or 100 kHz, switch-selected
Indication	6-digit LCD, switchable back-lighting	6-digit LCD, switchable back-lighting
Setting error	$\pm 1 \times 10^{-3}$	$\pm 1 \times 10^{-3}$
Max. setting error (at 520 or 1000 MHz)	< 5 kHz	< 10 kHz
RF input	$Z_{in} = 50 \Omega$, N female connector	$Z_{in} = 50 \Omega$, N female connector
VSWR	< 1.2	< 1.2
with RF attenuation ≥ 10 dB	< 2	< 2
with RF attenuation 0 dB	< 10 dB μ V	< 20 dB μ V
Oscillator reradiation	5 tracking filters	4 tracking filters
Internal input filters	5 tracking filters	4 tracking filters
Interference immunity, non-linearities		
Image-frequency rejection (1st IF)	> 80 dB typ. 100 dB	> 80 dB typ. 90 dB
IF rejection	> 80 dB typ. 100 dB	> 80 dB typ. 90 dB
d_3 intercept point	> +13 dBm typ. +20 dBm	> +13 dBm typ. +20 dBm
k_2 intercept point	> +40 dBm typ. +50 dBm	> +40 dBm typ. +50 dBm
Blocking (typical, frequency-dependent)	An interfering signal spaced > 2 MHz from the receive frequency influences the display of a signal to be measured by < 1 dB (RF attenuation 0 dB) at a level of > 110 dB μ V	
Shielding effectiveness	Indication at a field strength of 10 V/m (with $f \rightarrow 1$ st IF) (adjust $f = f_{interf.}$ for calibration)	
Intermediates frequencies		
1st IF	810.7 MHz	310.7 MHz
2nd IF	10.7 MHz	10.7 MHz
IF bandwidths (for average and peak)		
Nominal bandwidth ($\pm 20\%$)	-3 dB: 6 dB $\pm 10\%$: 7.5 kHz	6: 60-dB ratio 7.5 kHz
7.5 kHz	8.3 kHz	$\approx 1:2$
12 kHz	13.4 kHz	$\approx 1:2$
120 kHz	120 kHz	$\approx 1:3$
1 MHz	1 MHz	$\approx 1:4$
IF bandwidth (-6 dB) for measurements to CISPR (Publ. 2 and 4) and VDE 0875	120 kHz (automatically switched on with measurements to CISPR)	
AF bandwidth (-3 dB)		
narrow	300 Hz to 3.5 kHz	
wide	< 50 Hz to > 15 kHz	
Internal noise (automatic switched on)		
Average B = 7.5 kHz	< -10 dB μ V typ. -14 dB μ V	< -8 dB μ V typ. -12 dB μ V
Peak B = 7.5 kHz	typ. -4 dB μ V	typ. -2 dB μ V
CISPR	typ. +5 dB μ V	typ. +7 dB μ V
Voltage range		
Lower limit (3 dB above internal noise level)	-10 dB μ V	-8 dB μ V
Upper limit	137 dB μ V	137 dB μ V
RF attenuation ≥ 10 dB	equivalent to < 5 dB μ V	equivalent to < 5 dB μ V
Inherent spurious responses	moving-coil meter	switchable back-lighting
Voltage indication		
Scale ranges		
CISPR	10 dB	
linear	20 dB	
logarithmic	40/60 dB	
battery check	tolerance range	
Types of indication	average	peak with 3 s hold time
Maximum permissible input level		
RF attenuation 0 dB		
DC voltage	7 V	
Sinusoidal AC voltage	120 dB μ V	
Pulses (spectral density)	96 dB μ V/MHz (100 V x 0.5 ns)	
RF attenuation ≥ 10 dB (no DC separation)		
DC voltage	7 V	
Sinusoidal AC voltage (at ≥ 10 dB)	137 dB μ V	
Max. permissible input voltage	100 V	
Max. permissible pulse energy (10 μ s)	1 mJ	
Voltage indication error		
average, linear, 20 dB, for an unmodulated sine wave signal	$\pm 1.5\%$	$\pm 1.5\%$
10 dB above noise indication	$\pm 1.5\%$	$\pm 1.5\%$
B = 120 kHz/12 kHz	$\pm 1.5\%$	$\pm 1.5\%$
B = 7.5 kHz/12 kHz	$\pm 1.5\%$	$\pm 1.5\%$
peak, linear, 20 dB	$\pm 1.5\%$	$\pm 1.5\%$

	Models 52 and 53	Model 53
CISPR (Publ. 2 and 4)		
(for Impulse Interference)		
Additional error		
at 100 dB/100 kHz		
at 100 dB/100 kHz		
Types of demodulation	AM (Narrow)	AM (Wide or narrow)
AM (Wide or narrow)	AM (Wide or narrow)	AM (Wide or narrow)
AM (Wide or narrow)	AM (Wide or narrow)	AM (Wide or narrow)
AM (Wide or narrow)	AM (Wide or narrow)	AM (Wide or narrow)
Outputs		
Connector for supply and accessories	25-pin D-sub female connector	25-pin D-sub female connector
AF signal, EMF, 40 dB	50 Ω , BNC female connector	50 Ω , BNC female connector
IF, 10.7 MHz	50 Ω , BNC female connector	50 Ω , BNC female connector
wide (approx. 2 MHz)	50 Ω , BNC female connector	50 Ω , BNC female connector
narrow	50 Ω , BNC female connector	50 Ω , BNC female connector
EMF at 100 kHz	50 Ω , BNC female connector	50 Ω , BNC female connector
AM demodulator	50 Ω , BNC female connector	50 Ω , BNC female connector
EMF at 100 kHz	50 Ω , BNC female connector	50 Ω , BNC female connector
FM demodulator	50 Ω , BNC female connector	50 Ω , BNC female connector
EMF at IF bandwidth	50 Ω , BNC female connector	50 Ω , BNC female connector
7.5 kHz and 12 kHz	50 Ω , BNC female connector	50 Ω , BNC female connector
120 kHz and 1 MHz	50 Ω , BNC female connector	50 Ω , BNC female connector
120 kHz and 1 MHz	50 Ω , BNC female connector	50 Ω , BNC female connector
Level 1 (CISPR)	50 Ω , BNC female connector	50 Ω , BNC female connector
Level 2 (CISPR)	50 Ω , BNC female connector	50 Ω , BNC female connector
Input for ext. reference	50 Ω , BNC female connector	50 Ω , BNC female connector
General data		
Nominal temperature range	0 to 40 °C	0 to 40 °C
Storage temperature range	-25 to 50 °C (without batteries)	-25 to 50 °C (without batteries)
Power supply	230 V AC, 50 Hz	230 V AC, 50 Hz
Air power supply unit		
Battery pack		
Battery type	6 x AA (LR6)	6 x AA (LR6)
Dimensions (W x H x D)	180 x 100 x 40 mm	180 x 100 x 40 mm
Weight with power supply	18 kg	18 kg
with batteries	20 kg	21 kg
Ordering information		
Order designation	Test Receiver ESV	Test Receiver ESV
Test Receiver ESV 20 to 1000 MHz	342 A021.50	342 A021.50
Test Receiver ESV 20 to 1000 MHz	342 A021.50	342 A021.50
Accessories supplied		
Battery pack (without batteries)		
Battery connector LEMO		
Recommended extras		
Option 05 for 7 GHz (for model 52)	ESV-82	333.0012.02
For interference measurements		
VHF Current Probe (20 to 300 MHz)	ESV-21	353.2019.02
Absorbing Clamp (90 to 1000 MHz)	MDS-01	194.0100.50
Adapter (BNC female to N male)		118.2012.00
For field strength measurements		
Broadband Dipole (20 to 80 MHz)	RF-2-1	358.0512.52
Log-periodic Antenna (80 to 1300 MHz)	HL 023 A	577.8017.02
Tripod	RFU-2	100.1114.02
Mount for probe	RFU-2	100.1120.02
RF cable (7 m)	RFU-2	228.0005.55
General		
Head of probe	ESV-21	107.0009.00
24 V AC	ESV-21	538.0012.02
6-V Lead-acid Battery	ESV-21	538.0012.02
10 V AC	ESV-21	538.0012.02
General		
Price for 100 units		

Panorama Monitor EPM ♦ 10.7 to 75 MHz



- Display of spectrum about receiver tuning frequency
- Automatic centre-frequency calibration
- Model for receivers with other IFs available
- AC-supply and battery operation
- Minimum power consumption, low weight

Characteristics, uses

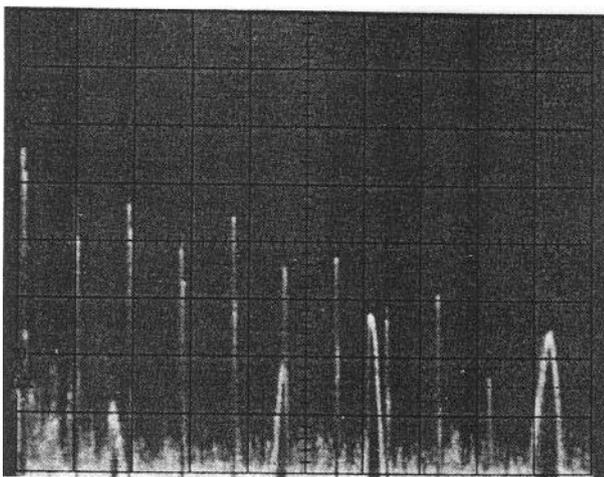
Main applications

- Interference measurement – Display of interference spectrum
- Interference identification on open-area test sites
- Radiomonitoring – Checking band and channel occupancy

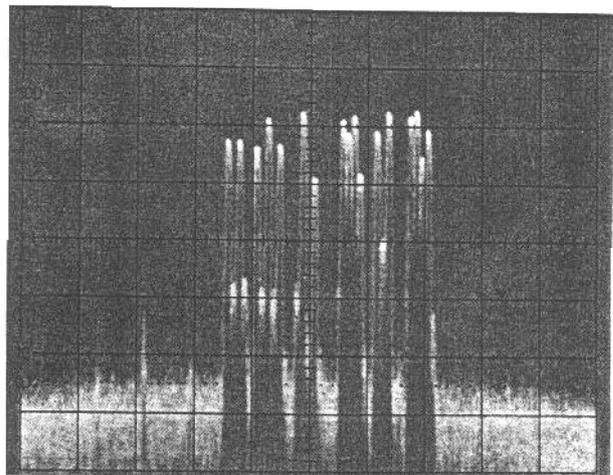
Connected to the wideband IF output of a receiver, the Panorama Monitor EPM shows the **RF input spectrum** ± 1 MHz about the receive frequency. The EPM is mechanically (housing width and depth) and electrically (IF and level) compatible with the R&S Test Receivers ESH2 (9 kHz to 30 MHz, page 288) and ESV (20 kHz to 1000 MHz, page 296).

When receivers are used to measure useful signals and interference or to receive radio messages, it is often essential to have an overview of the frequency-band occupancy above and below the actual receive frequency. In this way, one can determine if the receiver has been correctly tuned and also determine the cause of any interference. When **interference spectra are being examined**, the panorama display makes it easy to determine the character of the interference – narrow or wideband, pulsing or stable (see Figs below). In open-site RFI measurements, Panorama Monitor EPM clearly shows the difference between IUT interference and ambient interference. As far as radiomonitoring is concerned, IF analysis gives a clear overview of band occupancy, the channel operating state, level, modulation and the frequency spacing between signals.

Measuring an interference spectrum with test receiver and EPM: the narrow lines are caused by pulse (broadband) interference, the wide traces by narrow-band interference



Public land-mobile radio network measurements: span 2 MHz, resolution bandwidth 10 kHz



Operation and design

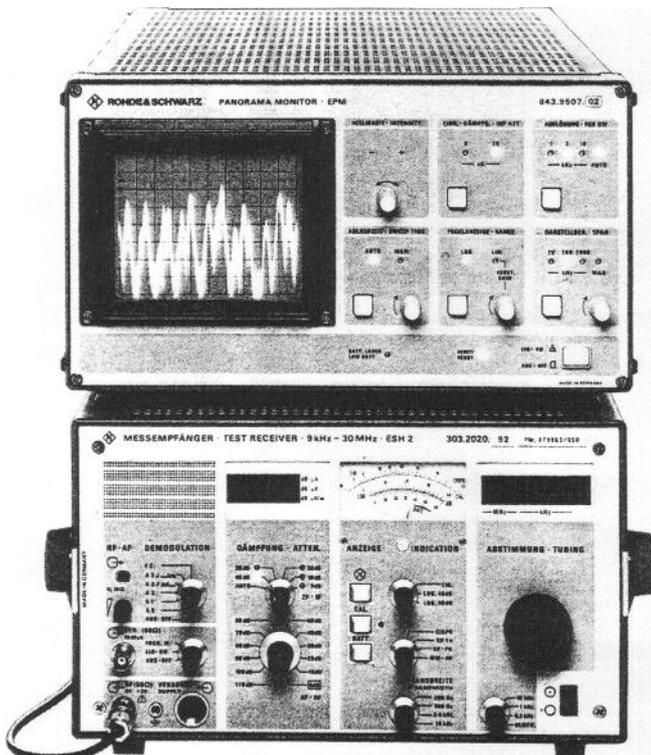
The input can be switched over from 10.7 MHz (IF of the ESV) to 75 MHz (IF of the ESH2). The receive frequency can be set to values between 70 and 85 MHz to handle the IFs of other receivers. The level display range is 80 dB. Using the internal 20-dB attenuator, it is possible to display the IF signal right up to the full-scale deflection of the receiver meter even if the test receiver has a high IF attenuation. With linear display selected, the level is continuously adjustable. The frequency span can be switched from 2000 kHz to 200 or 20 kHz. Using a potentiometer, all spans from 2 to 2000 kHz can be set manually. In the bandwidth setting AUTO, the resolution bandwidth is set automatically for the frequency range selected. This guarantees a clear, flicker-free display at short sweep times (80 ms). The sweep time is automatically increased for narrow resolution bandwidths. The sweep time can be increased or decreased by a factor between 0.5 and 2.

The EPM can be powered from, the AC supply, from an external battery or from a maintenance-free lead storage battery which is incorporated in the unit. The Panorama Monitor is also in this respect fully compatible with the Test Receivers ESH2 and ESV. An LED shows the state of battery charge. Another LED indicates the correct functioning of the main EPM subassemblies.

Specifications

Input frequencies	10.7 MHz, 75 MHz ¹⁾	selectable via rear-panel switch
Input	50 Ω, BNC connector	
Input attenuation	0/20 dB (selectable)	
VSWR	<2 (input attenuation 0 dB) <1.2 (input attenuation 20 dB)	
Level required for full scale in log display mode		
$f_{in} = 10.7 \text{ MHz}$	67 dB μ V	
$f_{in} = 75 \text{ MHz}$	70 dB μ V	
Gain setting range	±4 dB	
Input bandwidth (-1 dB)	2 MHz	
Frequency setting error at centre frequency (span 20 kHz)	<1 kHz	
Frequency linearity error	<5 % (-10 to +40 °C) <10% (-10 to +55 °C)	
Noise indication (peak value, BW = 10 kHz) at nominal gain		
$f_{in} = 10.7 \text{ MHz}$	typ. <-70 dB	
$f_{in} = 75 \text{ MHz}$	typ. <-65 dB	
Intermodulation-free range for input signals 10 dB above full scale, frequency spacing >20× resolution bandwidth		
Level display range, log	80 dB	
f_{in}	continuous	
Linearity error of log amplifier		
	<2.5 dB (-10 to +40 °C) <3 dB (-10 to +55 °C)	
Frequency spans		
	20 kHz 200 kHz 2000 kHz manual: 2 to 2000 kHz	
	typ. shape factor 3/80 dB	
Resolution bandwidths (-3 dB)		
	1 kHz ±20% 1:8 3 kHz ±20% 1:7 10 kHz ±20% 1:3.5	
Sweep times		
	AUTO IF bandwidth and frequency span coupled: 80 ms, 0.4 and 4 s	
	MAN AUTO sweep times can be adjusted by a factor of 0.5 to 2 ²⁾	
CRT		
	rectangular, long-persistence (JEDEC-Typ P7)	
Screen diagonal	14 cm	
Internal graticule	10 cm × 8 cm	
Ext. battery connector	4-contact (Lamosa)	

Test setup comprising Panorama Monitor EPM and Test Receiver ESH2 for interference-spectrum display and radiomonitoring



General specifications

Rated temperature range	-10 to +55 °C
Storage temperature range	-25 to +70 °C (without batteries) -10 to +60 °C (with batteries)
AC supply	100/120/220/240 V ±10%, (47 to 440 Hz) safety class II
Battery, external	10.8 to 15 V, 1 A
internal	2 × 6-V lead storage, 9.5 Ah
Power consumption	approx. 12 W (battery operation) approx. 25 VA (AC supply)
Dimensions (W×H×D)	342 mm × 192 mm × 475 mm
Weight	14.7 kg with lead battery 12.7 kg without lead battery

Ordering information

Order designation	► Panorama Monitor EPM
Standard model	843.9507.02
Model for an input frequency ¹⁾ other than 75 MHz (on request)	843.9507.xx
Accessories supplied	
AC supply cable	025.2365.00
Cover (2 supplied)	839.5548.00
Manual	
Recommended extras	
6-V lead battery, 9.5 Ah (2 required)	338.4012.02
Battery connector (Lamosa)	303.9447.00
Service Kit EPM-Z1	837.2482.02

¹⁾ Model xx for receivers with IFs in the range 70 to 85 MHz is available.