

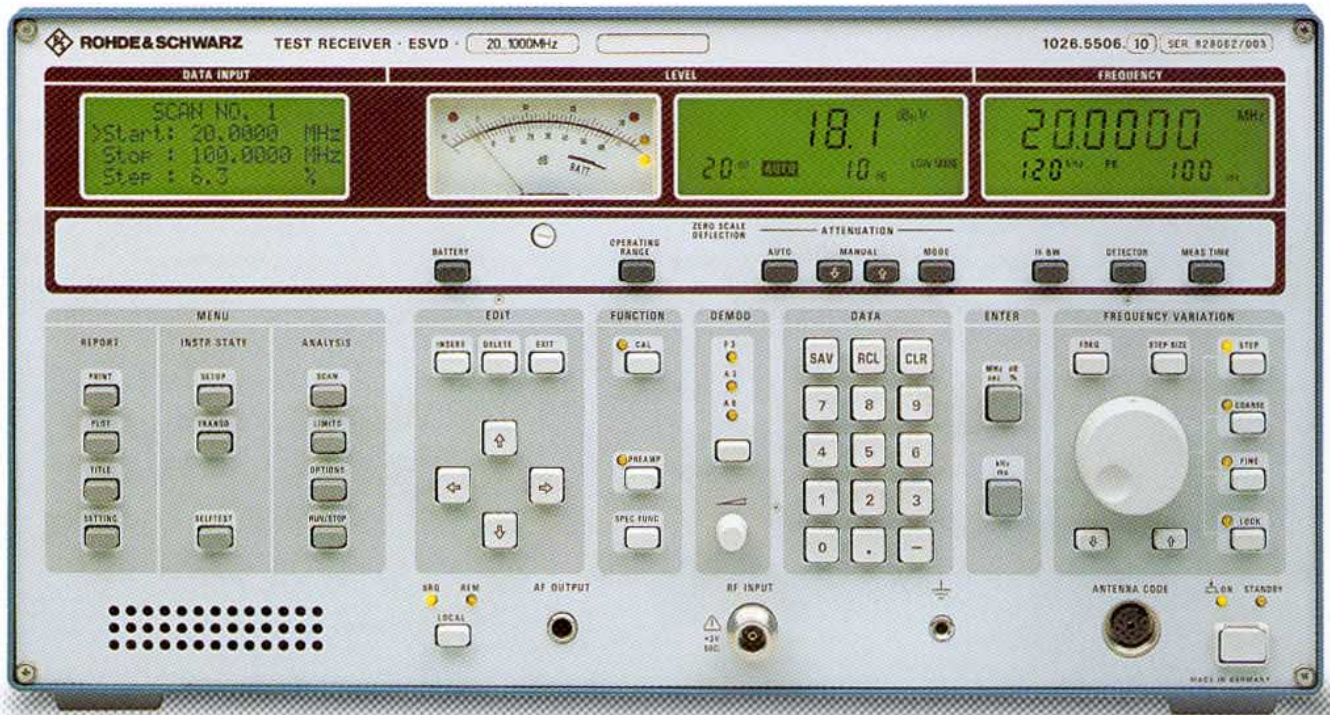
Test Receiver ESVD

for digital mobile radio networks

- For field-strength measurements in the planning stage and operation of mobile radio networks (GSM, PCN)
- For RFI measurements to European standards EN55011 to 55022, ETS, FCC, VCCI and VDE 0871 to 0879
- In line with CISPR 16-1, VDE 0876 and ANSI C63.2
- Frequency range 20 to 1000 (2050) MHz
- Level measurement range -14 to $+137$ dB μ V
- Frequency resolution 100 Hz, setting error $<1 \cdot 10^{-7}$
- Field-strength measurements using test antennas
- Filter bandwidths for coverage measurements in cellular networks
- Programmable test receiver for selective voltage measurements in laboratory and test department
- Manual operation or control via internal or external controller
- Battery supply (int./ext.) or AC supply



ROHDE & SCHWARZ



Test Receiver ESVD is equally suitable for the measurement of signal strength and interference.

For planning and operation of mobile radio networks it is essential to know the propagation conditions in the area to be covered. Test Receiver ESVD features optimal bandwidths for mobile radio services as well as a high measurement rate so that it is ideal for fixed and mobile coverage measurements.

The number of measurements required to ensure electromagnetic compatibility is continuously increasing in the field of RFI measurements. Thanks to the built-in intelligence of Test Receiver ESVD, the time required for such measurements is reduced considerably. Being also a specialist for EMI measurements to CISPR, CENELEC, ETSI, FCC, VCCI and VDE standards, the ESVD can furnish results more rapidly and accurately than has been possible up to now.

Description

Test Receiver ESVD for digital mobile radio networks is a triple-conversion heterodyne receiver covering the frequency range from 20 to 1000 (2050) MHz. Its main features and facilities are:

- RF attenuator switchable in 10-dB steps in the range 0 to 120 dB
- One preselector with fixed tuning and five tracking preselectors, option ESVD-B2 with four additional filters with fixed tuning
- Preamplifier with wide dynamic range, can be switched between preselector and 1st mixer
- Crystal-stabilized synthesizer as 1st LO, variable in 100-Hz steps, sweep mode for fast frequency scans; frequency accuracy complying with GSM recommendations
- High-level mixer ensuring high isolation of 1st LO for converting the input frequency to the first IF (1354.7 MHz or 394.7 MHz)
- High-level mixers for conversion to the second (74.7 MHz) and third (10.7 MHz) IF
- IF filters (10 kHz, 120 kHz, 300 kHz and 1 MHz) in the third IF stage with group-delay optimization
- Precise I/Q demodulator
- Highly linear envelope detector with more than 70 dB dynamic range
- Peak, average and quasi-peak detectors operating in parallel, which enables simultaneous measurements in different weighting modes
- Peak indication with IF bandwidth correction factors for measuring broadband interference (PK/MHz) automatically taken into account
- Measurement monitoring by means of automatic overload detection in the relevant ESVD stages and by the permanently activated peak detector

- Logarithmic amplifier with more than 70 dB dynamic range
- 12-bit A/D converter with short conversion time
- Measurement time selectable between 1 ms and 100 s
- Flash EPROMs allowing convenient and fast firmware updating with the aid of a PC
- Digital level indication on LC display and analog level indication on moving-coil meter taking into account transducer factors and their units
- Automatic calibration at a key-stroke with the aid of a high-precision built-in generator
- Demodulator circuits for FM, AM and A0; built-in loudspeaker and headphones connector
- Automatic monitoring of all synthesizer loops and supply voltages during operation
- Detection of faulty modules by built-in selftest facilities

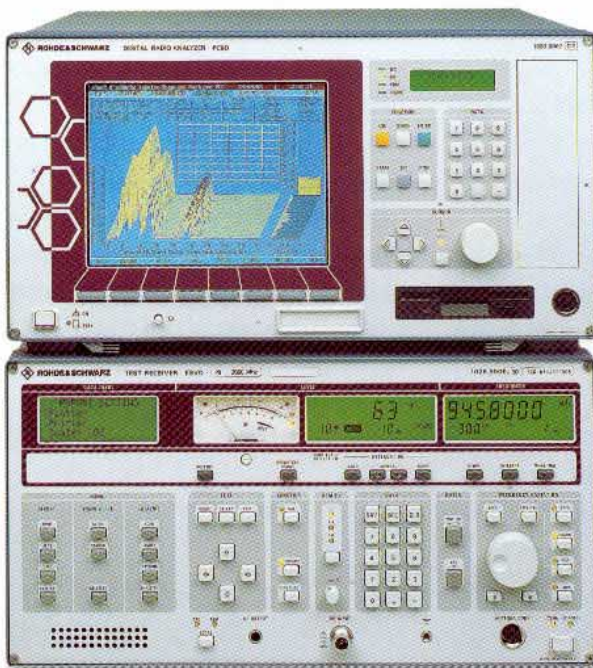
Design

The service-friendly modular design of ESVD ensures excellent results regarding RFI emission and immunity. A quiet, temperature-controlled blower minimizes self-heating of ESVD. Comprehensive built-in test functions allow any module requiring servicing to be easily identified and replaced independently of other modules.

Special features

- High measurement accuracy; error <1 dB
- Wide dynamic range: noise figure typ. 7 dB with preamplifier, 12 dB without preamplifier, third-order intercept point 20 dBm (without preamplifier)
- IF filter with optimum group delay ensuring fast frequency scanning and distortion-free demodulation of digitally modulated signals; correct averaging of pulse and sine signals

- Inphase and quadrature output for evaluating any modulated signal
- Frequency-dependent transducer factors are automatically taken into account
- Automatic level calibration
- Level shown on analog meter and digital display with 0.1-dB resolution
- Fast synthesizer, frequency resolution 100 Hz, any frequency step in <30 ms, sweep mode for fast frequency scanning
- Measurement of voltage, field strength, current and pulse spectral density with full indication of units
- 60-dB range also for quasi-peak and average indication; ESVD furnishes correct results at all times due to continuous level monitoring at all relevant stages of the signal path
- Parallel detectors for average, peak and quasi-peak indication
- Macros for automatic test runs
- Output of results as lists and diagrams on printer or plotter including limit lines and labelling
- Nonvolatile storage of 9 complete instrument setups and 22 transducer factors and limit lines



Interference analysis in GSM networks with ESVD and PCSD

Functions

ESVD combines three classes of instruments in one:

- the system-compatible test receiver for GSM field-strength and EMI measurements
- the compact, manually tunable and battery-operated test receiver
- the automatic test receiver which performs EMI measurements and reports the results

Field-strength measurements in mobile radio networks

ESVD is ideal for propagation measurements in mobile radio networks thanks to its level-display accuracy, excellent frequency resolution and precision, high sensitivity as well as the 300-kHz bandwidth specially optimized for the GSM network.

The user-friendly operating concept and the easy-to-read LCDs for settings and test results make the ESVD a handy and convenient test instrument for manual operation. The internal or external battery – 12 or 24 Volt – makes the ESVD suitable for mobile use.

Within a mobile radio band the field strength can be recorded very fast on different frequencies with measurement rates of up to 2.5 ms per value. Thus, for example, field-strength statistics of several base stations in the GSM band are possible at normal speed of the test vehicle with a single receiver using the Lee method.

For additional evaluation of the signals received, the ESVD can be fitted with an I/Q demodulator (ESVD-B1). This most general type of demodulator is very important in digital communication systems as an interface between analog and digital signal processing. It allows processing of any kind of modulated signals. The characteristics of option ESVD-B1 closely follow the GSM and PCN specifications.

The frequency range of communication networks above 1 GHz is covered by the optional frequency extension to 2.05 GHz (ESVD-B2).

RFI field-strength and RFI power measurements

For solving complex EMC problems, manual measurement often is the most efficient way, as the operator can fully utilize his experience in identifying interference sources. ESVD features conventional test receiver operation with tuning knob, result indication on a meter and a built-in loudspeaker.



The entry keys for automatic measurements are arranged on the left of the front panel. Three groups of menu keys are provided below a four-line LCD window to enter frequency scans, limit lines, transducer factors, configuration data and complex test routines.

During a frequency scan (lin or log) up to five subranges are scanned. Nonvolatile storage of 22 limit lines and of transducer factors with up to 50 values is possible. By combining the stored transducer factors, all test configurations occurring in practice can be covered.

The results of a frequency scan are output on a printer with parallel interface or on a plotter with IEC/IEEE-bus interface. Time can be saved by the simultaneous printing of lists and plotting of graphs. Plotting is also possible during the frequency scan so that an overview of the interference spectrum can already be obtained during the measurements.

Any relevant information can be added to the test report either via a line editor or, more conveniently, via an MF2 keyboard. Information can be automatically added to the parameters known to the ESVD such as date, time and receiver settings.

Macros for semi-automatic test runs (ANALYSIS OPTIONS) match the ESVD to the specific configuration, device under test and measurement specification. Being thus prepared, the ESVD performs the following routines:

- Fast prescan measurement using the peak and/or average detector
- Determination of critical frequencies by means of limit lines with data reduction to shorten the measuring time
- Final measurement at critical frequencies using the average and/or quasi-peak detector
- Result documentation on plotter or printer

The minimum configuration consisting of ESVD, absorbing clamp and plotter is already a powerful and cost-effective test setup for RFI measurements.

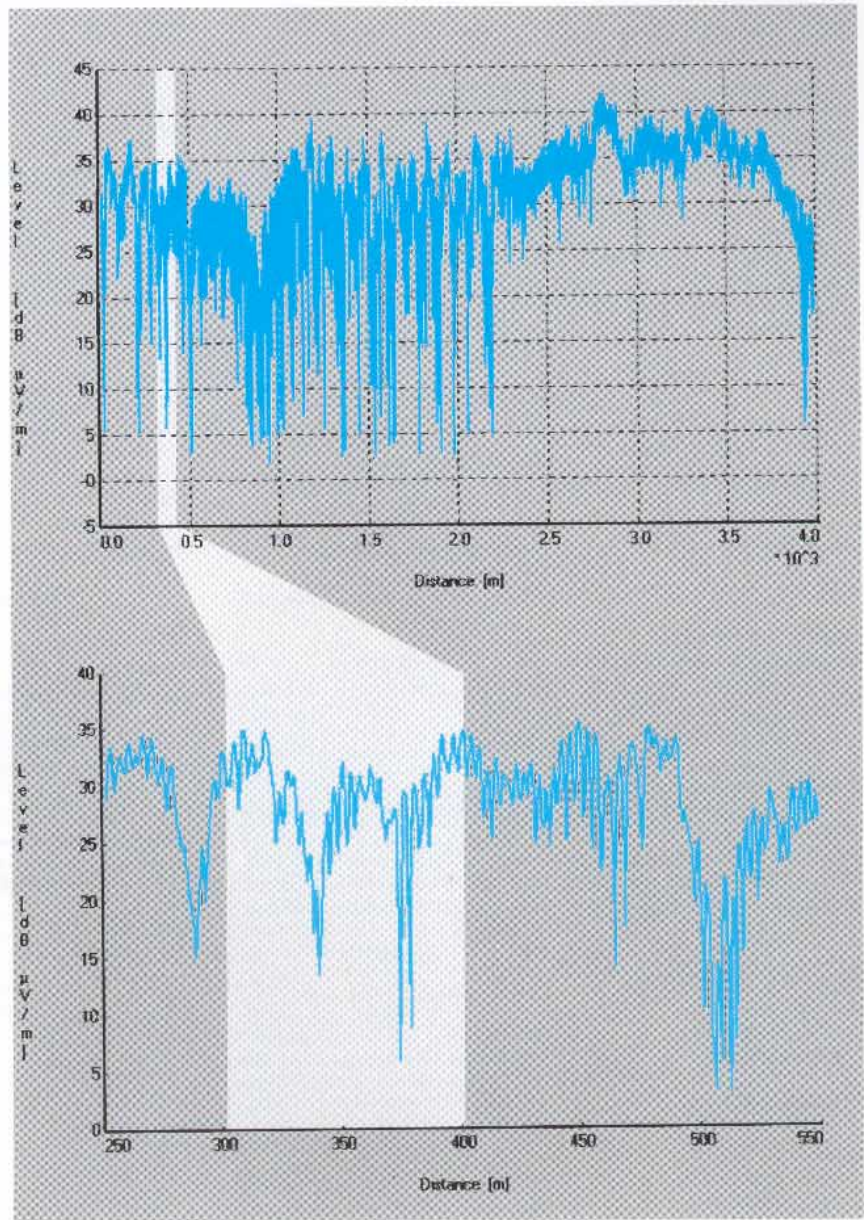
Remote control

The IEC/IEEE-bus interface complies with the latest IEEE Standard 488 Part 2. Measured values are output with a resolution of 0.01 dB. Up to 5000 measured values per second can be output via the IEC/IEEE bus when the ESVD is triggered externally.

Interfaces

For further signal evaluation and for driving or feeding add-on units, the ESVD is provided with the following interfaces:

- Coding and supply socket (ANTENNA CODE) for active antennas and for transducer factor coding
- 74.7-MHz IF output for a panoramic display
- 10.7-MHz IF output for evaluating the IF signal eg with an oscilloscope
- Regulated inphase and quadrature output for evaluating any modulated signal (option ESVD-B1)
- Envelope detector output (VIDEO OUTPUT) for evaluating the detected IF signal eg with an oscilloscope
- User interface with
 - 6 TTL ports for driving external devices
 - inputs for external trigger signals
 - outputs for the analog display voltage with and without meter simulation



Field strength recorded over a distance of 4 km (top), below a zoomed section over 300 m measured with ESVD and Test System TS9955

- RS-232 interface for updating the firmware by reprogramming the built-in flash EPROMs via an IBM-compatible PC
- Parallel interface (PRINTER INTERFACE) for connecting a printer
- IEC/IEEE-bus interface
- Connector for an MF2-compatible keyboard for text entry
- Output for internal crystal reference frequency (10 MHz)
- Input for external battery (11 to 33 V) for battery-powered operation, eg in vehicles



Specifications

Frequency range with option ESVD-B2 Frequency setting with tuning knob	20 to 1000 MHz 20 to 2050 MHz		
numerical in steps automatic scan	in 100-Hz, 100-kHz steps or in any selectable step size by keyboard entry of any selectable size for RF analysis		
Display Resolution	8-digit LCD 100 Hz		
Setting error (after 30 min. warmup)	$<1 \cdot 10^{-7}$		
Temperature effect	$<1 \cdot 10^{-9}/^{\circ}\text{C}$		
Aging	$<1 \cdot 10^{-9}/\text{day}$		
RF input VSWR	N connector, female, 50 Ω		
20 to 1000 MHz	<1.2 with ≥ 10 -dB RF attenuation <2 with 0-dB RF attenuation		
1000 to 2000 MHz	<1.35 with ≥ 10 -dB RF attenuation <2 with 0-dB RF attenuation		
Preamplifier	switchable between input filter and 1st mixer		
Gain	10 dB		
Oscillator reradiation at RF input (0-dB RF attenuation)	Off Preamplifier On		
20 to 1000 MHz	<20 dB μV <10 dB μV		
1000 to 1900 MHz	<50 dB μV <40 dB μV		
1900 to 2050 MHz	<60 dB μV <50 dB μV		
Interference rejection, nonlinearities	20 to 1000 MHz 1000 to 1900 MHz 1900 to 2050 MHz		
Image-frequency rejection 1st IF	>90 , typ. 100 dB	>80 , typ. 100 dB	>70 , typ. 100 dB
2nd IF	>90 , typ. 100 dB	>80 , typ. 100 dB	>80 , typ. 100 dB
IF rejection	>90 , typ. 100 dB	>80 , typ. 100 dB	>80 , typ. 100 dB
$P_{11, f2}$ ($ f_1 - f_2 > 5$ MHz)	Off Preamplifier On		
Intercept point d3	-10 dBm		-20 dBm
20 to 50 MHz	typ. 15 dBm		typ. 5 dBm
50 to 1000 MHz	>15 dBm		>5 dBm
1000 to 2050 MHz	typ. 20 dBm		typ. 10 dBm
Intercept point k2			
20 to 1000 MHz	>13 dBm		>3 dBm
1000 to 2050 MHz	typ. 18 dBm		typ. 8 dBm
Preselector			
20 to 1000 MHz: 1 fixed-tuned filter 5 tracking filters	20 to <51.3 MHz 51.3 to <125.3 MHz 125.3 to <273.3 MHz 273.3 to <495.3 MHz 495.3 to <717.3 MHz 717.3 to 1000 MHz		
1000 to 2050 MHz: 4 fixed-tuned filters	1000 to <1250 MHz 1250 to <1522 MHz 1522 to <1795 MHz 1795 to 2050 MHz		
Maximum input level			
RF attenuation 0 dB			
DC voltage	7 V		
Sinewave AC voltage	130 dB μV		
Pulse spectral density	97 dB $\mu\text{V}/\text{MHz}$ (100 V-0.5 ns)		
RF attenuation ≥ 10 dB			
DC voltage	7 V		
Sinewave AC voltage	137 dB μV (= 1 W)		
Max. pulse voltage	150 V		
Max. pulse energy (10 μs)	1 mW $\cdot\text{s}$		

RF shielding

Voltage indication at a field strength of 10 V/m with 0-dB RF attenuation ($f \neq f_0$)	<0 dB μV
Additional error in quasi-peak indication range at 10 V/m	<1 dB

Intermediate frequencies

1st IF 20 to 1000 MHz	1354.7 MHz
1000 to 2050 MHz	394.7 MHz
2nd IF	74.7 MHz
3rd IF	10.7 MHz

IF bandwidths

Nominal bandwidth	-3 dB ($\pm 20\%$)	-6 dB ($\pm 10\%$)	Shape factor (B_{6dB}/B_{0dB})
10 kHz	7 kHz	9.5 kHz	typ. 1:4
120 kHz	90 kHz	120 kHz	typ. 1:5
300 kHz	300 kHz	400 kHz	typ. 1:6
1 MHz	800 kHz	1 MHz	typ. 1:4

Noise indication

	Off	Preamplifier	On
20 to 1000 MHz			
Average value, BW = 10 kHz	<-10 dB μV typ. -15 dB μV		<-16 dB μV typ. -20 dB μV
BW = 120 kHz	typ. -5 dB μV		typ. -9 dB μV
BW = 300 kHz	typ. 0 dB μV		typ. -4 dB μV
BW = 1 MHz	typ. 4 dB μV		typ. 0 dB μV
1000 to 2050 MHz			
Average value, BW = 10 kHz	<-10 dB μV typ. -15 dB μV		<-16 dB μV typ. -20 dB μV
BW = 120 kHz	typ. -3 dB μV		typ. -9 dB μV
BW = 300 kHz	typ. 2 dB μV		typ. -4 dB μV
BW = 1 MHz	typ. 6 dB μV		typ. 0 dB μV

Voltage measurement range

Lower limit (additional error caused by inherent noise <1 dB)

	Off	Preamplifier	On
20 to 1000 MHz			
Average indication (AV) BW _{IF} = 10 kHz	<-6 dB μV typ. -12 dB μV		<-12 dB μV typ. -16 dB μV
BW _{IF} = 120 kHz	typ. -1 dB μV		typ. -5 dB μV
BW _{IF} = 300 kHz	typ. +4 dB μV		typ. 0 dB μV
BW _{IF} = 1 MHz	typ. +8 dB μV		typ. +4 dB μV
Peak indication (PK)			
BW _{IF} = 10 kHz	typ. +14 dB μV		typ. +10 dB μV
BW _{IF} = 120 kHz	typ. +25 dB μV		typ. +21 dB μV
BW _{IF} = 300 kHz	typ. +30 dB μV		typ. +26 dB μV
BW _{IF} = 1 MHz	typ. +34 dB μV		typ. +30 dB μV
Quasi-peak indication (QP) CISPR band C/D (100-Hz pulse frequency)	$<+8$ dB μV typ. +4 dB μV		$<+4$ dB μV typ. 0 dB μV
1000 to 2050 MHz	same values as for 20 to 1000 MHz		same values as for 20 to 1000 MHz
Upper limit (AV, PK, QP) Inherent spurious response	137 dB μV (RF attenuation ≥ 10 dB) <0 dB μV (equivalent input voltage)		

Level indication

digital	3 digits in dBV, dBA, dBm, dBV/m, dB $\mu\text{V}/\text{m}$, dB μA , dBpW; resolution 0.1 dB
analog	on moving-coil meter in operating range of IF detector with digital display of zero scale deflection
Operating ranges Detectors	30, 60 dB average (AV), peak (PK), spectral density (PK/MHz), quasi-peak (QP)
Measuring times	1 ms to 100 s (1/2/5 steps)

Measurement error

(AV for S/N > 16 dB)

20 to 1000 MHz

- 0 to 55°C
- 10 to 0°C
- 10 to 55°C

1000 to 2050 MHz

Level calibration

Demodulation modes

Date, time of day

≤1 dB (digital display)
 ≤1.5 dB (digital display)
 typ. <2 dB (analog display)
 <2 dB (digital display)
 typ. <3 dB (analog display)
 sinewave and harmonics generator
 A0 (zero beat)
 A3 (for A3E emissions)
 F3 (for F3E emissions)
 internal clock, permanently
 operated from internal battery

RFI suppression

Power supply
 AC supply

Battery

Internal
 Operating time
 External
 Dimensions (W × H × D)
 Weight without options

complies with VDE 0876, Part 1a,
 PTT decree 527/1979 and MIL-STD-
 461 B1 (CE03 and RE02)

100/120/240 V ±10%,
 230 V +6/-10%,
 47 to 420 Hz (70 VA),
 safety class I to VDE 0411 (IEC 348)

12 V, 10 Ah
 approx. 2 h
 11 to 33 V
 435 mm × 236 mm × 460 mm
 26 kg with / 23 kg w/o battery

Connectors and interfaces

Remote control

Plotter connection
 Plotter language
 Printer connection

Front-panel outputs

Supply and coding connector

for antennas etc

AF output

EMF

Rear-panel outputs

IF 74.7 MHz

Gain ref. to RF input
 (RF attenuation 0 dB)

Bandwidth (-3 dB)

IF 10.7 MHz

EMF in range of analog level display
 for unmodulated sinewave signal,
 bandwidth = IF bandwidth,
 operating range 30 dB

Envelope detector output

EMF in range of analog
 level display,
 operating range 30 dB

Inphase/quadrature demodulator
 outputs (option ESVD-B1)

EMF (peak value, regulated)
 Bandwidth

Phase error between I and Q
 for S/N > 40dB

Output frequency
 10 to 100 kHz
 100 to 200 kHz

for signals to GSM Rec. 5.04,
 IF bandwidth 300 kHz

Reference output

Frequency
 EMF

Frequency error

User interface

interface to IEC 625-2 (IEEE 488),
 24-contact Amphenol connector, female
 via IEC/IEEE-bus interface
 HPGL

parallel interface
 (15-contact Cannon connector, female)

12-contact Tuchel connector, female
 jack JK34, 10 Ω
 adjustable up to 1.5 V

BNC connector, female, 50 Ω

10 dB without preamplifier
 20 dB with preamplifier
 2 MHz

1 to 30 mV
 1 mV to 1 V
 BNC connector, female

4 to 126 mV
 4 mV to 4 V

BNC connectors, female,
 50 Ω, loadable >200 Ω
 3 V
 1/2-IF bandwidth, max. 200 kHz

typ. <1°
 typ. <3°

3° rms, 7° peak
 BNC connector, female
 10 MHz
 >1 V

see setting error
 25-contact Cannon connector includes
 6 control lines for an external device,
 analog display voltage with and with-
 out simulation of meter response,
 input for external triggering, RS-232-C
 interface for firmware update

5-contact DIN connector, female

3-contact round connector, female
 11 to 33 V

Ordering information

Order designation

Accessories supplied

Options

1/Q Demodulator
 UHF Frontend
 1000 to 2050 MHz
 (only in conjunction with ESVD-B1)

Recommended extras

For interference measurements:

Current Probe (20 Hz to 100 (200) MHz) for EMS measurements	EZ-17	816.2063.02
VHF Current Probe (20 to 300 MHz)	ESV-Z1	353.7019.02
Absorbing Clamp (30 to 1000 MHz)	MDS-21	194.0100.50
Adapter (BNC female to N male)	HUF-Z1	118.2812.00
Broadband Dipole (20 to 80 MHz)		358.0512.52
Log-Periodic Broadband Antenna (80 to 1300 MHz)	HL023A1	577.8017.02
Tripod	HFU-Z	100.1114.02
Mast (for tripod)	HFU-Z	100.1120.02
Biconical Antenna (20 to 300 MHz)	HK116	4000.7752.02
Log-Periodic Antenna (200 to 1300 MHz)	HL223	4001.5501.02
Conical Log Spiral Antenna (200 to 1000 MHz)	HUF-Z4	837.2210.52
Wooden Tripod	HZ-1	837.2310.02
RF Connecting Cable (7 m)	HFU2-Z5	252.0055.55
RF Probe (BNC connector)	HFV-Z	204.1010.02
Adapter (BNC female to N male)		118.2812.00
V-Network 5μH II 50 Ω	ESH3-Z6	836.5016.52
Preamplifier 10 dB	ESV-Z3	397.7014.52

Other accessories

6-V lead-acid storage battery 10 Ah (2 required)		338.4012.00
Keyboard (English)	PSA-Z1	1009.5001.32
Headphones		110.2959.00
Service manual		1016.5783.24
Service Kit	EZ-8	816.1067.02
19" Rack Adapter with front handles	ZZA-95	396.4911.00
without front handles	ZZA-951	396.9488.00
Set of Front Handles	ZZG-95	396.5176.00
Transit Case	ZZK-953	1013.9389.00
Trolley	ZZK-0011	1014.0510.00
Printer Cable	EZ-11	816.1767.02
IEC-Bus Connecting Cable, 1 m	PCK	292.2013.10
2 m	PCK	292.2013.20

General data

Rated temperature range

Storage temperature range

Mechanical resistance

-10 to +55°C
 (without condensation)
 -25 to +70°C
 shock-tested to MIL-STD-810 D
 (40 g), vibration-tested to
 MIL-T-28800 D, Class 5;
 IEC Publ. 68-2-6





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