

EMI/Radio Monitoring Solutions

ESVB • ESVD • ESVN • ESN

Features

ESVB

- Frequency Range 20 MHz to 1 GHz (2.05 GHz with Option 02)

ESVD

- Frequency Range 20 MHz to 1 GHz (2.05 GHz with Option 02)
- Frequency Accuracy to GSM Recommendations
- In-phase and Quadrature Output for Evaluating Any Modulated Signal

ESVN

- Frequency Range 20 MHz to 1 GHz
- Remote Control via IEEE 488 Interface
- Operation from AC Supply or Internal/External Battery

ESN

- Frequency Range 9 kHz to 1 GHz (2.05 GHz with Option 01)
- Remote Control via IEEE 488 Interface
- Operation from AC Supply or External Battery

Applications

- Field-strength Measurements Using Test Antennas
- Radio Monitoring to CCIR
- Coverage Measurements
- Selective Voltage Measurements in Labs and Test Shops
- Radio Interference Measurements to EN 55011 to 55022, ETS, FCC and ANSI C63.4, VCCI, and VDE 0871 to 0879
- Digital Audio Broadcasting Networks (ESVB)
- Mobile Radio Networks – GSM, PCN (ESVD)

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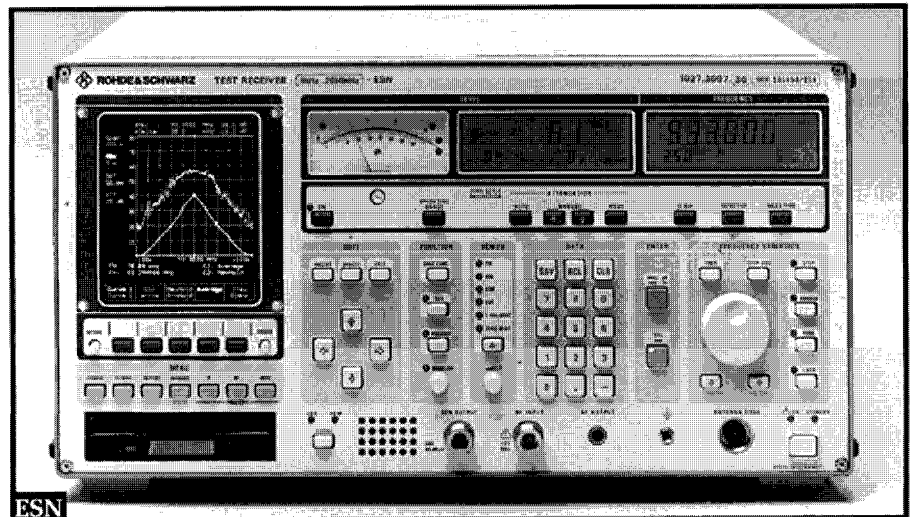
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Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



Introduction

The ESVB/ESVD/ESVN/ESN Test Receivers are ideal instruments for all applications in the fields of radio monitoring and radio network planning, civil RFI measurements to all relevant standards, as well as for selective voltage and two-port measurements in manual and automatic mode. ESVB/ESVD/ESVN/ESN are used to measure and demodulate both amplitude-modulated (DSB, SSB pulse) and frequency-modulated signals, as well as narrow-band and broadband interference in the range from 20 MHz to 1 GHz (ESVN), 9 kHz to 2.050 MHz (ESN), and 20 MHz to 2.05 GHz (ESVB/ESVD Option 02).

Manual operation or automatic mode, with spectrum display on screen and reports of results on printer or plotter, make these Test Receivers extremely versatile for many applications.

TEST RECEIVER FEATURES

The ESVB/ESVD/ESVN/ESN Test Receivers combine three different types of test receivers in one:

- A compact, manually tuned and battery-operated test receiver
- A test receiver which automatically performs measurements and reports the results
- A system-compatible test receiver

Following are the primary features which are shared by both instruments unless noted otherwise:

RF UNIT

- High measurement accuracy: error <1 dB, <0.5 dB typical
- Refined preselection
- Switchable preamplifier with wide dynamic range
- Crystal-stabilized synthesizer (ESN): sweep mode for fast frequency scans, frequency resolution down to 10 and 100 Hz
- Wide dynamic range: noise figure typically 7 dB with preamplifier, 12 dB without preamplifier, third-order intercept point typically 20 dBm (without preamplifier)
- Tracking generator for attenuation and gain measurements with ESVN 30 and ESN (9 kHz to 1 GHz)
- High-level mixer ensuring high suppression of 1st LO
- IF analysis with resolution bandwidth of 1, 3, and 10 kHz; span 0.01 to 10 MHz; runs in parallel with level measurements

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DEMODULATION

- High-linearity envelope detector with dynamic range of more than 70 dB
- Peak, average, RMS, and quasi-peak detectors
- Automatic overload detection in mixer stages and in test channel by permanently activated peak detectors
- Logarithmic amplifier with dynamic range of more than 70 dB
- Frequency and frequency-offset measurements with built-in frequency counter
- Demodulators for measuring modulation depth and frequency and phase deviation
- Demodulator circuits for FM, AM, SSB (LSB and USB), zero beat, and 1-kHz beat
- Built-in loudspeakers and headphones connector; demodulation using signal processors
- Separate signal channel with 5 MHz bandwidth and demodulator for TV signals with switchover to all common TV standards

POWERFUL PROCESSOR SYSTEM

- Macros for automatic test runs
- Test runs over up to 400 freely selectable channels with programmable thresholds
- Automatic level calibration and consideration of frequency-dependent transducer factors (e.g., of antennas)
- Non-volatile storage of 10 complete instrument setups, 22 different antenna factors and limit lines
- Built-in 3.5 in. floppy disk drive
- Output of results as lists and diagrams on plotter or printer including limit lines and user-defined labeling
- 12-Bit A/D converter with short conversion time
- Measurement time adjustable between 1 ms and 100 s, 50 μ s for overview measurements
- 16-Bit processor; flash EPROM allowing convenient and fast firmware updating
- Automatic calibration at a keystroke with the aid of an internal high-precision generator
- Automatic monitoring of all synthesizer loop and supply voltages during operation

OPTIMAL DISPLAY OF RESULTS FOR EVERY APPLICATION

- Measurement of voltage, field-strength, and current with full indication of units
- Level indication on analog meter and digital display with 0.1 dB resolution
- Display of modulation depth, deviation, and frequency or frequency offset with very high resolution
- Display of frequency spectra (RF ANALYSIS) including limit values
- IF analysis with spans of up to 10 MHz
- Connector for TV monitor to identify TV programs

MANUAL MODE

These test receivers perform measurements at a fixed frequency with the desired bandwidth, attenuation, measurement time, and display mode. Level measurement, modulation, and deviation measurement, as well as frequency and frequency offset measurement, are carried out simultaneously.

While measurements are being performed, the IF analysis function allows the spectrum about the receive frequency to be analyzed. Measurement of level, modulation, or frequency, as well as signal assessment using the built-in loudspeaker, are made at the center frequency of the extended spectrum with the settings selected. Two test curves can be displayed simultaneously on the screen, the display mode for the two curves being selectable independently of one another.

Max Hold, Max/Min, and Average display modes allow fast identification and measurement of useful and interference signals in a signal spectrum. Marker functions are provided for fast evaluation and measurement of the identified signals in the receive channel.

AUTOMATIC MODE

The receive frequency range is scanned and the result displayed as a spectrum on the screen. The measurement parameters such as start frequency, stop frequency, IF bandwidth, measurement time, attenuation, and display mode can be freely selected.

Single-shot or repetitive scanning can be selected. Two test traces can be displayed at a time. For comparison measurements, waveforms can also be loaded from a floppy disk.

THREE OPERATING MODES FOR FREQUENCY SCANNING

Overview Mode: Frequency scanning over the desired frequency range is at maximum speed and with fixed attenuation.

Scan Mode: Frequency scanning is quasi-continuous with selectable step size and measurement time as well as automatic attenuation setting.

Channel Mode: Frequency scanning over a defined data set with up to 400 frequencies.

DOCUMENTATION OF RESULTS

The results, along with all relevant information, can be output in graphical form or as lists on a plotter or printer. In addition, data can be stored on a floppy disk along with the complete receiver setup. Information can be entered via a line editor or, more conveniently, via an optional keyboard. Date, time, and receiver settings are automatically recorded.

USE IN COMPUTER-CONTROLLED SYSTEMS

Full use of the high measurement rate of these test receivers is possible only in the remote mode using a high-speed controller. In the determination of field-strength profiles, the receivers furnish 5,000 measured values per second after being triggered by a positioning system or a time base. The field strength can be determined at different frequencies with a particular frequency band at a rate of 2.5 ms per measured value. In cellular radio networks, it is thus possible to measure the field strength of several base stations according to Lee's statistical method using a single receiver at the normal speed of the test vehicle.

For radio monitoring, up to 10,000 frequencies can be stored in the receivers and scanned at high speed with range-related receiver settings. The results are then output to the process controller.

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Maximum Input Level (with and without preamplifier) –

RF attenuation 0 dB (AC-coupled); DC Voltage: 50 V. Sinewave AC Voltage: 130 dB μ V. Spectral Pulse Density: 97 dB μ V/MHz. RF Attenuation >0 dB (DC-coupled); DC Voltage: 7 V (corresponds to 1 W). Sinewave AC Voltage: 137 dB μ V. Maximum Pulse Voltage: Range I, 700 V; Range II and III, 150 V. Maximum Pulse Energy: Range I, 100 mWs; Range II and III, 1 mWs.

RF Shielding – Voltage Indication at a Field Strength of 10 V/m with 0-dB RF attenuation (f not equal to f_{in}): <0 dB μ V. Additional Error in CISPR Indication Range (10 V/m): <1 dB. Interference: Complies with tolerances to EN50081-1. Interference Immunity: Complies with tolerances to EN50082-1.

IF Bandwidths – ESVB/ESVD: See Table 1, ESVN/ESN: See Table 3.

Noise Indication – ESVB/ESVD: See Table 2, ESN/ESVN: See Table 4.

RMS Value (noise indication average value): +1 dB typical.

Peak (PK) Value (noise indication average value): +12 dB typical.

Voltage Measurement Range –

Lower Limit (additional error caused by inherent noise <1 dB); Average Value (AV): 4 dB above noise indication. RMS Value (RMS): 5 dB above noise indication. Peak Value (PK): 15 dB above noise indication. Quasi-peak (QP) (100 Hz pulse frequency): 3 dB above noise indication. Upper Limit (AV, RMS, PK, QP): 137 dB μ V (RF attenuation >0 dB). Inherent Spurious Response (equivalent input voltage); Range I: <-10 dB μ V. Range II and III: <0 dB μ V.

DISPLAY RELATED

Level Display –

Digital; Digits: 3. Resolution: 0.1 dB. Units: dB μ V, dB μ A, dBm, dB μ V/m, dB μ A/m, dBpW. Analog: Moving-coil meter in operating range of IF detector with additional digital display of lower range limit. Operating ranges: 30, 60 dB.

Screen –

Display: 5 inch CRT with digital memory. Resolution: 1024 x 1024 pixels. Display range; X-axis (frequency): Freely selectable, linear or logarithmic. Y-axis (level): 10 to 200 dB, adjustable in 10 dB steps. Test Curves: Maximum 2 traces. Display Modes: Clr/Write, Max Hold, View. Frequency Scan Modes; Overview: Scan with fixed attenuation and step size at maximum speed. Scan: Scan with automatic attenuation setting and selectable step size. Channel: Scan at up to 400 predefinable frequency values. Marker: 2 markers with digital display of frequency and level. Marker Functions: Normal marker, delta marker, marker-to-peak, marker-to-receiver frequency.

Indication Modes – Average value (AV), RMS value (RMS), peak value (PK), quasi-peak value (QP, $f_{in} > 150$ kHz). Measurement time: 1 ms to 100 s (1-2-5 steps).

Measurement Error (average value for S/N >16 dB) –

Digital Display; Range I: <1 dB. Range II: 0 to +55°C: <1 dB. -10 to 0°C: \leq 1.5 dB. Range III: <2 dB. Internal Level Calibration: Short or total calibration by keystroke. Generator: Sinewave and harmonics generator.

Frequency Drift (digital in kHz) –

Resolution: 0.1 to 100 Hz. Measurement Range: 0.5 IF bandwidth. Measurement Time: 1 ms to 100 s. Measurement error: Same as frequency error.

Frequency Deviation (digital in kHz) –

Resolution: 0.1/0.01 kHz. Measurement Range: Deviation + $f_{mod} < 0.5$ IF bandwidth. Measurement Frequency f_{mod} : 1<100 kHz. Measurement Error (signal-to-noise >40 dB, AF = 1 kHz); IF Bandwidths 1, 3, 9, and 15 kHz: 100 Hz + 3% of measured value. IF Bandwidths 120 and 1250 kHz: 2 kHz + 3% of measured value.

Phase Deviation

(bandwidths 1, 3, 9, 15 kHz) –

Resolution: 0.1. Maximum Deviation: 8 rad. Modulation Frequency: 300 Hz to 5 kHz. Measurement Error (signal-to-noise >40 dB, m = 50%, AF = 1 kHz): 0.1 rad + 5% of measured value.

Modulation Depth (digital in %) –

Resolution: 0.1%. Measurement range 1 to 99%. Modulation Frequency f_{mod} : <100 kHz. Measurement Error (signal-to-noise >40 dB, m = 50%, AF = 1 kHz): 5% (absolute).

IF Analysis –

Frequency Display; Range I: 10 kHz to 2 MHz (1-2-5 steps). Range II and III: 10 kHz to 10 MHz (1-2-5 steps). Level Display Range: 80 dB.

Attenuation Switchover (in IF path): 0/20 dB. Resolution Bandwidth (-3 dB): 1, 3, 10 kHz. Sweep Time: 50 ms to 10 s (1-2-5 steps). Number of Test Curves: Maximum 2 traces. Display Modes: Clr/Write, Max Hold, Min Hold, Average, View.

Marker: 2 markers with digital display of frequency and level.

Marker Functions: Normal marker, delta marker, marker-to-peak, marker-to-center frequency (= receiver frequency).

AF Demodulation Modes – Zero beat, 1 kHz beat, AM (for A3E emissions), USB and LSB (for SSB emissions), FM (for F3E emissions). Squelch: Adjustable with front-panel knob.

Trigger Functions – External: TTL level, positive- or negative-going edge. Internal: Controlled by RF level, threshold adjustable.

Date, Time of Day – Internal clock, permanently operated from internal battery.

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Characteristics

FREQUENCY RELATED

Frequency Range –

	ESVB/ESVD/ESVN	ESN
Range I	–	9 kHz to 30 MHz
Range II	20 MHz to 1 GHz	30 MHz to 1 GHz
Range III	1 GHz to 2.050 GHz (ESVB/ESVD)	1 GHz to 2.050 GHz (with Opt. 01)

Frequency Setting – With tuning knob: Fine, coarse or any step size selectable. Numerical: Via keyboard entry. Step size: Any selectable size. Automatic scanning: For RF analysis.

Frequency Display – 8-digit LCD.

Resolution – Range I: 10 Hz. Range II and III: 100 Hz.

Frequency Error – ESVN: $<3 \times 10^{-6}$. ESN and ESVN with Option 01 (after 30 minutes warm-up): $<1 \times 10^{-7}$.

Temperature Drift – $<1 \times 10^{-9}/^{\circ}\text{C}$.

Aging – $<1 \times 10^{-7}/\text{year}$.

RF INPUT

Connector – N connector, female.

Impedance – 50 Ω .

RF Attenuator – 0 to 120 dB, switchable in 10 dB steps.

VSWR –

9 kHz to 1 GHz – 10 dB RF attenuation:

<1.2 . 0 dB RF attenuation: <2 .

1 GHz to 2.050 GHz – 10 dB RF attenuation: <1.35 . 0 dB RF attenuation: <2 .

Input Filters – Range I: Five fixed-frequency bandpass filter. Range II: One fixed-frequency and five tracking bandpass filters. Range III: Four fixed-frequency bandpass filters.

Preamplifier – Can be connected between input filter and 1st mixer. Gain: 10 dB.

TABLE 1

ESVB/ESVD Nominal Bandwidth	-3 dB ($\pm 10\%$)	-6 dB ($\pm 10\%$)	Shape Factor $BW_{6\text{ dB}}/BW_{50\text{ dB}}$
10 kHz	7 kHz	9.5 kHz	1:4 typ.
120 kHz	90 kHz	120 kHz	1:5 typ.
300 kHz	300 kHz	400 kHz	1:6 typ.
1 MHz	800 kHz	1 MHz	1:4 typ. (ESVD)
1.5 MHz	1.5 MHz	1.8 MHz	1:2.7 typ. (ESVB)

TABLE 2

ESVB/ESVD Noise Indication	Preamplifier off	Preamplifier on
20 to 1000 MHz Average value, BW – 10 kHz	$< -12\text{ dB}\mu\text{V}$, typ. $-16\text{ dB}\mu\text{V}$	$< -16\text{ dB}\mu\text{V}$, typ. $-20\text{ dB}\mu\text{V}$
BW – 120 kHz	typ. $-5\text{ dB}\mu\text{V}$	typ. $-9\text{ dB}\mu\text{V}$
BW – 300 kHz	typ. 0 dB μV	typ. $-4\text{ dB}\mu\text{V}$
BW – 1 MHz	typ. 4 dB μV (ESVD)	typ. 0 dB μV (ESVD)
BW – 1.5 MHz	typ. 7 dB μV (ESVB)	typ. 3 dB μV (ESVB)
1000 to 2050 MHz Average value, BW – 10 kHz	$< -10\text{ dB}\mu\text{V}$, typ. $-15\text{ dB}\mu\text{V}$	$< -16\text{ dB}\mu\text{V}$, typ. $-20\text{ dB}\mu\text{V}$
BW – 120 kHz	typ. $-3\text{ dB}\mu\text{V}$	typ. $-9\text{ dB}\mu\text{V}$
BW – 300 kHz	typ. 2 dB μV	typ. $-4\text{ dB}\mu\text{V}$
BW – 1 MHz	typ. 6 dB μV (ESVD)	typ. 0 dB μV (ESVD)
BW – 1.5 MHz	typ. 9 dB μV (ESVB)	typ. 3 dB μV (ESVB)

TABLE 3

ESN/ESVN Nominal Bandwidth	-3 dB ($\pm 20\%$)	-6 dB	Shape Factor $BW_{6\text{ dB}}/BW_{50\text{ dB}}$
1 kHz	1 kHz	1.2 kHz $\pm 20\%$	01:02.8
3 kHz	3 kHz	3.15 kHz $\pm 10\%$	01:01.8
9 kHz* ¹	7 kHz	9.5 kHz $\pm 20\%$	01:02.2
15 kHz	15 kHz	17 kHz $\pm 10\%$	01:01.8
120 kHz* ¹	90 kHz	120 kHz $\pm 20\%$	1:05
250 kHz	250 kHz	330 kHz $\pm 10\%$	01:03.7

*¹ Meets tolerances to CISPR 16.

TABLE 4

ESN/ESVN Noise Indication	Preamplifier off	Preamplifier on
Average value, BW 1 kHz		
Range I (fin $>50\text{ kHz}$)	$< -22\text{ dB}\mu\text{V}$, $-27\text{ dB}\mu\text{V}$ typical	$< -28\text{ dB}\mu\text{V}$, $-33\text{ dB}\mu\text{V}$ typical
Range II	$< -18\text{ dB}\mu\text{V}$, $-23\text{ dB}\mu\text{V}$ typical	$< -22\text{ dB}\mu\text{V}$, $-28\text{ dB}\mu\text{V}$ typical
Range III	$< -16\text{ dB}\mu\text{V}$, $-22\text{ dB}\mu\text{V}$ typical	$< -22\text{ dB}\mu\text{V}$, $-28\text{ dB}\mu\text{V}$ typical

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INPUT/OUTPUT

Remote Control – IEC 625-2 (IEEE 488).
Connector: 24-contact Amphenol connector.
Interface functions: AH1, L4, SH1, T6, SR1, PP1, RL1, DC1, DT1, C1, C2, C3, C11.

Plotter – Via IEC/IEEE-bus interface. Plotter Language: HP-GL.

Printer – Connector: 15-contact Cannon connector, Parallel interface.

Keyboard – Connector: 5-contact DIN female.

Floppy Disk Drive – 3.5 in., 1.44 MB formatted, MS-DOS compatible.

Front-panel Outputs – Supply and Coding Connector for Antennas, etc.: 12-contact Tuchel connector.

AF output –

Connector: JK34 jack. Impedance: 10 Ω .
EMF: Adjustable up to 1.5 V.
Generator output (tracking generator): (ESVN 30, ESN); Connector: N female. Impedance: 50 Ω . Bandwidth: ESVN 30, 20 MHz to 1 GHz; ESN, 9 kHz to 1 GHz. EMF: 96 dB μ V \pm 1 dB.

Rear-panel Outputs –

IF 10.7 MHz (switch selected between leveled and unleveled IF voltage); Connector: BNC female. Impedance: 50 Ω . Bandwidth (-3 dB): IF bandwidth. EMF in range of analog level display for unmodulated sinewave signal: Operating range 30 dB, 1 to 30 mV; Operating range 60 dB, 1 mV to 1 V. Regulated Output: 700 mV.

AM/FM; Signal: Demodulated AF voltage. AM output voltage (EMF) ($m = 50\%$, DC-coupled): 2 V p-p. FM (DC-coupled); Bandwidth 1, 3 kHz: 2 V/kHz. Bandwidth 9, 15 kHz: 0.2 V/kHz. Bandwidth 120, 250 kHz: 0.3 V/10 kHz. $\phi * M$ (AC-coupled): 0.2 V/rad. I/Q Demodulator Outputs, AC-coupled (with Option 01 only); Connector: BNC female. Impedance: 50 Ω with external load $>200 \Omega$. EMF (peak value regulated): 3 V, can be switched to external control). Bandwidth: 0.5 IF bandwidth. Phase error between I and Q for signal-to-noise >40 dB, output frequency 10 to 100 kHz: $<1^\circ$ typical. CCVS Output; Connector: BNC female. Signal: Video polarity and vision/sound carrier offset can be selected for all TV standards. Reference Output; Connector: BNC female. Function: Can be switched to input for external reference. Frequency: 10 MHz. Level: 7 dBm. User Port; Connector: 25-contact Cannon connector. Function: Six TTL control lines for an external device (e.g., driven by RF level), analog voltage indication, input for external triggering, input for IF control, RS-232-C interface for firmware update.

Rear-panel Inputs –

External battery; Connector: 3-contact connector. Required voltage: 11 to 33 V. Reference input; Connector: BNC female. Function: Can be switched to reference output. Level required: EMF >1 V from 50 Ω . Frequency: 5/10 MHz.

POWER REQUIREMENTS

AC Operation – Line voltage: 100 V, 120 V, 220 V, 240 V $\pm 10\%$; 230 V $+6\%/-10\%$. Line frequency: 47 to 440 Hz. Power consumption: ESVN, 125 VA; ESN, 155 VA.

DC Operation – External Battery (switch-on voltage >12 V); Voltage Range: 11 to 33 V. Current Drain 24/12 V: ESVN, 3.7 A/6.8 A; ESN, 4.4A/8 A.

GENERAL SPECIFICATIONS

Environmental Characteristics – Rated Temperature Range: -10 to $+55^\circ\text{C}$ without condensation. Storage Temperature Range: -25 to $+70^\circ\text{C}$. Mechanical Resistance: Shock-tested to MIL-STD-810 D (shock spectrum 40 g), Vibration-tested to MIL-T-28800 D, class 5; complies with IEC Publication 68-2-6. RFI Suppression: Complies with VDE 0876, Part 1a, Regulation 527/1979 and MIL-STD-461 B (CE03 and RE02).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	236	9.3
Width	435	17.1
Depth		
ESVN	460	18.1
ESN	572	22.5
Weight	kg	lb.
ESVN	29	63.9
ESN	32	70.5

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ESVB

Test Receiver.

Includes: Power Cable, Manual.

OPT. 01/ESVD-B1 – I/Q Demodulator.

OPT. 02/ESVD-B2 – Frequency Extension to 2.05 GHz. (Opt. 01 required).

ESVD

Test Receiver.

Includes: Power Cable, Manual.

OPT. 01/ESVD-B1 – I/Q Demodulator.

OPT. 02/ESVD-B2 – Frequency Extension to 2.05 GHz. (Opt. 01 required).

ESVN 20

Test Receiver.

Includes: Power Cable, Manual.

OPT. 01/ESS-B1 – Reference Oscillator OCXO.

ESVN 30

Test Receiver with Tracking Generator.

Includes: Power Cable, Manual.

OPT. 01/ESS-B1 – Reference Oscillator OCXO.

ESN

EMI Test Receiver.

Includes: Power Cable, Connector for External Battery, N-BNC Adapter, Viewing Hood, Operating Manual.

OPT. 01/ESN-B1 – Frequency Extension. 1 GHz to 2.050 GHz operation.

MEASUREMENT SERVICE OPTIONS

OPT. C3 – Three years of Calibration Services.

OPT. C5 – Five years of Calibration Services.

OPT. D3 – Test Data (requires Opt. C3).

OPT. D5 – Test Data (requires Opt. C5).

OPT. R3 – Repair warranty extended to cover three years.

OPT. R5 – Repair warranty extended to cover five years.

ADDITIONAL ACCESSORIES

Also see page 500.

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