

EMC accessories for disturbance voltage/current/power and field strength measurements

EMC Accessories

Disturbance voltage measurements

R&S®ENV216 Two-Line V-Network



Disturbance voltage measurements on single-phase EUTs

- Several models for Germany, United Kingdom, France, China/Australia, USA
- Air-core design and artificial hand
- Switch-selectable highpass filter of 150 kHz
- Built-in 10 dB attenuator pad
- Built-in pulse limiter (can be switched off)
- Remote control with TTL levels (compatible with Rohde & Schwarz EMI test receivers)
- Compact, low weight

Specifications in brief

- Frequency range 9 kHz to 30 MHz
- Power-handling capacity: 16 A, constant current
- Simulated impedance: $(50 \mu\text{H} + 5 \Omega) \parallel 50 \Omega$ in line with CISPR 16-1-2 Amd. 2:2006
- V-network in line with CISPR, EN, VDE, ANSI, FCC Part 15 and MIL-STD-461 D, E and F
- Calibrated in line with CISPR 16-1-2 and ANSI C63.4

More information: www.rohde-schwarz.com, search term: env216

R&S®ENV4200 200-A Four-Line V-Network



RFI voltage measurements at high currents

The R&S®ENV4200 V-network meets the requirements of CISPR 16-1-2, EN55016-1-2, and ANSI C63.4 for V-networks with the impedance in the frequency range 150 kHz to 30 MHz. CISPR 16-1-2 specifies two types of V-networks for the frequency range 150 kHz to 30 MHz. They have the following impedance:

- Type 1: $50 \mu\text{H} \parallel 50 \Omega$
 Type 2: $(50 \mu\text{H} + 5 \Omega) \parallel 50 \Omega$

Type 2 is also suitable for the frequency range 9 kHz to 150 kHz, but not for very high currents since it requires an isolating choke of 250 μH .

The R&S®ENV4200 V-network corresponds to type 1. The maximum attainable current of the V-network is limited by the voltage drop at the standardized inductances (CISPR 16-1-2 limits the voltage drop to 5% of the AC supply voltage) and by unavoidable heat losses.

Specifications in brief

- Frequency range 150 kHz to 30 MHz
- Impedance: $50 \mu\text{H} \parallel 50 \Omega$ (magnitude and phase) in line with CISPR 16-1-2 Amd. 2: 2006
- Artificial hand
- Continuous current up to $4 \times 200 \text{ A}$
- Air-core design
- Built-in pulse limiter (can be switched off)
- Remote control with TTL levels (compatible with Rohde & Schwarz EMI test receivers)

More information: www.rohde-schwarz.com, search term: env4200

R&S®ESH2-Z5 25-A Four-Line V-Network



Interference measurements on DC or AC-powered loads

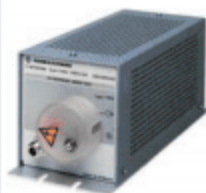
The R&S®ESH2-Z5 four-line V-network is used to measure RFI voltages on supply connections of EUTs and is based on air-core inductances. It contains an artificial hand as well as a PE simulating network that can be bypassed.

Specifications in brief

- Frequency range 9 kHz to 30 MHz
- V-network in line with CISPR, EN, VDE, ANSI
- Impedance $(50 \mu\text{H} + 5 \Omega) \parallel 50 \Omega$ (magnitude and phase) in line with CISPR 16-1-2:2006
- Continuous current up to $4 \times 25 \text{ A}$
- Short time current (max. 2 min.) up to $4 \times 50 \text{ A}$
- Artificial hand and PE simulation network
- Air-core design
- Remote control via TTL levels (compatible with the Rohde & Schwarz EMI test receivers)
- Calibrated to CISPR 16-1-2 and ANSI C63.4

More information: www.rohde-schwarz.com, search term: esh2-z5

R&S®ESH3-Z6 150-A Single-Line V-Network



For measurements of RFI voltage and immunity to RFI in low-impedance power supply networks

The R&S®ESH3-Z6 is a single-phase V-network with an equivalent circuit of $(5 \mu\text{H} + 1 \Omega) \parallel 50 \Omega$ for the frequency range 100 kHz to 200 MHz. The R&S®ESH3-Z6 is rated for a continuous current of up to 150 A and can handle surges of up to 500 A for a maximum time of 30 s. Its screw terminals ensure a low-impedance connection of the test device and the power supply.

Specifications in brief

- Frequency range 0.1 MHz to 200 MHz
- Continuous current of up to 150 A
- Impedance $(5 \mu\text{H} + 1 \Omega) \parallel 50 \Omega$
- In line with
 - CISPR 25 (onboard power supply systems)
 - CISPR 16-1-2 and EN 55016-1-2 (low-impedance power supplies)
 - MIL-I-6181D, MIL-I-16910C, MIL-E-55301
 - DEF-STAN 59-411 and DO-160

More information: www.rohde-schwarz.com, search term: esh3-z6

EMC Accessories

Disturbance voltage measurements

R&S*ENY21 2-Wire Coupling Network



Radio disturbance and immunity measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006 (150 kHz to 30 MHz)
- Immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- CISPR 16-1-2 complied with
- Adapter sets to meet standardized LCL requirements (55 dB and 65 dB) and to accommodate various telecommunications interfaces
- High transmission bandwidth for wanted signal (100 MHz)

Specifications in brief

- Frequency range
 - Radio disturbance: 150 kHz to 30 MHz
 - Immunity: 150 kHz to 80 MHz
- Asymmetrical impedance
 - Imped. (0.15 MHz to 30 MHz): $150 \Omega \pm 20 \Omega$
 - Phase angle (0.15 MHz to 30 MHz): $0^\circ \pm 20^\circ$
 - Imped. (> 30 MHz to 80 MHz): $150 \Omega \pm 40 \Omega$
- Voltage division factor in asymmetrical circuit
 - 150 kHz to 80 MHz: typ. $10 \text{ dB} \pm 1 \text{ dB}$
- Maximum permissible values
 - Max. RF input voltage: < 15 V
 - Max. DC voltage between line/ground: 100 V
 - Max. AC voltage between line/ground: 63 V
 - Max. DC current 400 mA (current on each individual wire of one pair or on different pairs)

More information: www.rohde-schwarz.com, search term: eny*1

R&S*ENY41 4-Wire Coupling Network



Radio disturbance and immunity measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006 (150 kHz to 30 MHz)
- Immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- CISPR 16-1-2 complied with
- Adapter sets to meet standardized LCL requirements (55 dB and 65 dB) and to accommodate various telecommunications interfaces
- High transmission bandwidth for wanted signal (100 MHz)

Specifications in brief

- Frequency range
 - Radio disturbance: 150 kHz to 30 MHz
 - Immunity: 150 kHz to 80 MHz
- Asymmetrical impedance
 - Imped. (0.15 MHz to 30 MHz): $150 \Omega \pm 20 \Omega$
 - Phase angle (0.15 MHz to 30 MHz): $0^\circ \pm 20^\circ$
 - Imped. (> 30 MHz to 80 MHz): $150 \Omega \pm 40 \Omega$
- Voltage division factor in asymmetrical circuit
 - 150 kHz to 80 MHz: typ. $10 \text{ dB} \pm 1 \text{ dB}$
- Maximum permissible values
 - Max. RF input voltage: < 15 V
 - Max. DC voltage between line/ground: 100 V
 - Max. AC voltage between line/ground: 63 V
 - Max. DC current 400 mA (current on each individual wire of one pair or on different pairs)

More information: www.rohde-schwarz.com, search term: eny*1

R&S*ENY81 8-Wire Coupling Network



Radio disturbance measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006 (150 kHz to 30 MHz)
- CISPR 16-1-2 complied with
- Adapter sets to meet standardized LCL requirements (55 dB and 65 dB) and to accommodate various telecommunications interfaces
- High transmission bandwidth for wanted signal (100 MHz)

Specifications in brief

- Frequency range: 150 kHz to 30 MHz
- Asymmetrical impedance
 - Imped. (0.15 MHz to 30 MHz): $150 \Omega \pm 20 \Omega$
 - Phase angle (0.15 MHz to 30 MHz): $0^\circ \pm 20^\circ$
- Voltage division factor in asymmetrical circuit
 - 150 kHz to 30 MHz: typ. $10 \text{ dB} \pm 1 \text{ dB}$
- Maximum permissible values
 - Max. RF input voltage: < 15 V
 - Max. DC voltage between line/ground: 100 V
 - Max. AC voltage between line/ground: 63 V
 - Max. DC current 400 mA (current on each individual wire of one pair or on different pairs)

More information: www.rohde-schwarz.com, search term: eny*1

R&S*ENY81-CA6 8-Wire Coupling Network for Cable Category CAT 6



Radio disturbance measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006
- Immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- CISPR 16-1-2 complied with
- 75 dB longitudinal conversion loss (LCL)
- High transmission bandwidth for wanted signal (250 MHz)

Specifications in brief

- Frequency range
 - Radio disturbance: 150 kHz to 30 MHz
 - Immunity: 150 kHz to 80 MHz
- Asymmetrical impedance
 - Imped. (0.15 MHz to 30 MHz): $150 \Omega \pm 20 \Omega$
 - Phase angle (0.15 MHz to 30 MHz): $0^\circ \pm 20^\circ$
 - Imped. (> 30 MHz to 80 MHz): $150 \Omega \pm 40 \Omega$
- Voltage division factor in asymmetrical circuit
 - 150 kHz to 30 MHz: typ. $9.5 \text{ dB} \pm 1 \text{ dB}$
- Maximum permissible values
 - Max. RF input voltage: < 15 V
 - Max. DC voltage between line/ground: 100 V
 - Max. AC voltage between line/ground: 63 V
 - Max. DC current 400 mA (current on each individual wire of one pair or on different pairs)

More information: www.rohde-schwarz.com, search term: eny*1

EMC Accessories

Disturbance voltage measurements

R&S®EZ-12 Antenna Impedance Converter



Broadband matching unit for test receivers and spectrum analyzers with low-impedance inputs

R&S®EZ-12 is used for high-impedance measurements of interference voltage at the feed-point of a vehicle-mounted antenna in the long-, medium-, shortwave and FM bands to VDE0879 Part 2 and CISPR 25. For measurements in the VHF-FM range antenna signal can be switched to a separate 50-Ω input.

- Flat frequency response
- High sensitivity and overload capacity
- Calibration in line with CISPR 25: 2008
- Remote-controlled FM range switch

Specifications in brief

- Frequency range: 150 kHz to 30 MHz (120 MHz)
- RF input: SO 10599-1
- Input impedance: > 100 kΩ, < 10 pF (at 1 MHz)
- Gain factor for direct input to antenna connector: +11.2 dB ± 1 dB
- Correction factor (nom. gain to CISPR 25 is 10 dB): 10 dB
- VSWR: ≤ 1.4
- Noise voltage at output (input terminated with antenna simulator; AVG, BW = 10 kHz)
 - f > 150 kHz: < -5 dBμV
 - f > 500 kHz: < -7 dBμV
- 1 dB compression point: > 107 dBμV

More information: www.rohde-schwarz.com, search term: ez-12

R&S®EZ-25 150 kHz Highpass



Conducted emission measurements in the presence of longwave mains disturbance signals

For the measurement of equipment that requires higher selectivity at the transition between 130 kHz and 150 kHz as shown in figure 2 of CISPR 16-1-1 (e.g. signalling equipment as defined in EN50065-1), a highpass filter may be added in front of the measuring receiver to improve the selectivity and so achieve the values stipulated in EN 50065 Part 1 without impairing the passband of the measuring receiver.

- Conducted emission measurements to EN50065 Part 1
- Very steep slope in line with CISPR 16-1-1
- Suitable for any CISPR measuring receiver
- Relative attenuation > 50 dB below 130 kHz
- Built-in 10 dB attenuation pad for exact 50 Ω termination of the LISN
- High pulse energy capability (50 mWs)
- Calibrated response

Specifications in brief

- Passband: 150 kHz to 30 MHz
- Insertion loss in passband: 9.5 dB to 11.5 dB
- VSWR in passband: < 1.2
- Stopband: below 130 kHz
- Minimum attenuation in stopband: 60 dB
- Attenuation in the transition region:
 - 146 kHz: < 12 dB
 - 145 kHz: > 12 dB
 - 140 kHz: > 24 dB
 - 130 kHz: > 60 dB
- Max. input voltage (continuous): 137 dBμV
- Max. impulse energy (50 μs): 50 mWs
- Dimensions (L x W x H): 145 mm x 95 mm x 52 mm (5.7 in x 3.74 in x 2.05 in)
- Weight: 500 g (1.1 lb)

More information: www.rohde-schwarz.com, search term: ez-25

R&S®ESH2-Z2/Z3 Voltage Probes
R&S®ESH2-Z31 Attenuator

R&S®ESH2-Z2 Active Voltage Probe

The active voltage probe is used for measuring RFI voltages on lines that do not carry AC supply voltage.

R&S®ESH2-Z3 Passive Voltage Probe

The passive voltage probe is suitable for measuring RFI voltages (on AC supply lines) in line with CISPR 16-2-1 and EN 55016-2-1.

R&S®ESH2-Z31 Attenuator

For checking the interference source impedance to EN 55016-2-1 and CISPR 16-2-1

Specifications in brief (R&S®ESH2-Z2/Z3)

- Frequency range: 9 kHz to 30 MHz
- Measurement range (AVG, IF bandwidth 200 Hz with Rohde&Schwarz test receivers): -20 dBμV to +120 dBμV / +10 dBμV to +150 dBμV
- Attenuation, uncertainty of calibration: 10 dB, 0.5 dB/30 dB, 0.5 dB
- Input impedance: 118 kΩ ± 5% || 8 pF / 1.5 kΩ ± 5% || 8 pF
- Max. input voltage
 - f < 63 Hz: 100 V/250 V
 - f < 500 Hz: 5 V/250 V
 - 9 kHz to 30 MHz: 3 V/30 V

More information: www.rohde-schwarz.com, search terms: esh2-z2, esh2-z3, esh-z31

R&S®ESH3-Z2 Pulse Limiter



High RF input levels and high-energy interfering pulses generated on artificial mains networks when the DUT is switched on and off can damage the RF input circuits of test receivers. The R&S®ESH3-Z2 pulse limiter limits and reduces the interference level.

Specifications in brief

- Frequency range: 0 Hz to 30 MHz
- Insertion loss: 10 dB ± 0.3 dB

- Frequency response: ≤ ± 0.3 dB
- SWR with 50 Ω termination, input/output: ≤ 1.06/≤ 1.25
- Power-handling capacity in continuous mode: 1 W
- Pulse power-handling capacity: E = 0.1 Ws (6 ms)
- Dimensions (L x W x H or L x Ø): 94 mm x 25 mm x 25 mm (3.70 in x 0.98 in x 0.98 in)
- Weight: 120 g (0.26 lb)

More information: www.rohde-schwarz.com, search term: esh3-z2

EMC Accessories

Disturbance current measurements

R&S®EZ-17 Current Probe



Emission and susceptibility measurements
The R&S®EZ-17 model .02 with its extremely flat frequency response is optimal for current measurements as well as for measuring shielding effectiveness.

Due to its high load capacity, model .03 is recommended for EMS measurements (bulk current injection).

- Model .02 for emission measurements
- Model .03 for emission and susceptibility measurements
- High sensitivity and overload capability
- Wide frequency range
- High load capacity for DC and AC current
- Small dimensions in spite of large inner diameter (30 mm)
- Simple clamping thanks to spring-loaded mechanism

Specifications in brief (model .02/model .03)

- Frequency range: 20 Hz to 100 MHz
- Range with constant transducer factor (–3 dB): 1 MHz/2 MHz to 100 MHz
- Transducer factor reduced by 20 dB/decade in range: 20 Hz to 1 MHz/2 MHz
- Source impedance: $\leq 0.8 \Omega/\text{s}$ 1 Ω
- Transfer impedance ZT in range with constant transducer factor: 3.16 $\Omega/7.1 \Omega$
- Transducer factor k in range with flat frequency response: –10 dB/–17 dB
- Load capacity (RF current measurement)
 - Max. DC current or peak, AC current: 300 A ($f < 1 \text{ kHz}$)
 - Max. RF current (rms): 2 A ($f > 1 \text{ MHz}$)/1 A ($f > 1 \text{ MHz}$)
- Load capacity model 03 (EMS measurement)
 - Max. power at RF connector: 10 W ($f > 1 \text{ MHz}$)

More information: www.rohde-schwarz.com, search term: ez-17

R&S®ESV-Z1 VHF Current Probe



R&S®ESV-Z1 current probe is used for selective or broadband measurement of very small as well as of very large RF currents in electric lines. They are shielded against electrostatic effects and comply with CISPR 16-1-2 and VDE 0876.

Specifications in brief

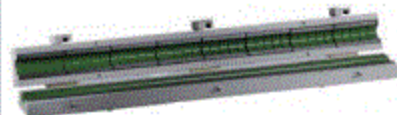
- Frequency range: 9 kHz to 600 MHz
- Measurement range (AVG, IF bandwidth 7.5 kHz): –33 dB μ A to +117 dB μ A

- Transfer admittance ($Y_t = I_{in}/V_{out}$): 0.1 S (20 MHz to 600 MHz)
- Transducer factor ($k = 20 \log(Y_t/s)$): –20 dB (20 MHz to 600 MHz)
- Max. current (superimposed on RF current or peak AC current): 50 A
- Max. diameter of conductor: 13.5 mm (0.53 in)
- Dimensions (dia./height): 55 mm/20 mm (2.17 in/0.79 in)
- Weight: 130 g (0.29 lb)

More information: www.rohde-schwarz.com, search term: esv-z1

Disturbance power measurements

R&S®EZ-24 Ferrite Clamp



The R&S®EZ-24 ferrite clamp is used to improve the reproducibility of disturbance field strength measurements and the measurements of disturbance power and screening effectiveness.

In a 50 Ω circuit, the clamp produces decoupling attenuation of more than 15 dB in the range from 30 MHz to 1 GHz. The ferrite clamp can be opened to insert the cable to be loaded.

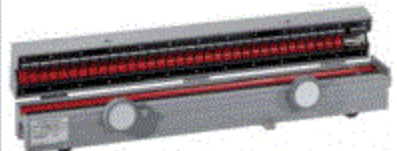
Drafts on the measurement of radiated emission call for ferrite absorbers to load cables in order to improve the reproducibility of disturbance field strength measurements. Ferrite absorbers are also useful to improve the measurements of disturbance power and screening effectiveness.

Specifications in brief

- Frequency range: 1 MHz to 1 GHz
- High reproducibility of disturbance field strength measurements
- Calibrated in line with CISPR Publ.16-1-3
- Maximum diameter of cable: 22 mm

More information: www.rohde-schwarz.com, search term: ez-24

R&S®MDS-21 Absorbing Clamp



The R&S®MDS-21 absorbing clamp can be used in conjunction with EMI test receivers to measure the disturbance power on cables in line with CISPR 13 or EN 55013, in line with CISPR 14-1 or EN 55014-1, as well as in line with EN 50083-2 and in conjunction with two-port measurement devices to measure the shielding effectiveness of cables in line with DIN 47250 Part 6, IEC 96-1 and EN 50083-2.

It can also be used for measuring the efficiency of disturbance suppression devices for high-voltage ignition systems in line with CISPR 12 or EN 55012.

High-energy pulses are coupled out and taken to the measuring receiver. This means that measuring receiver inputs must be thoroughly protected.

The MDS clamps are also suitable for use as coupling clamps in order to test the immunity of electronic devices.

Specifications in brief

- Frequency range: 30 MHz to 1000 MHz
- Calibrated in line with CISPR Publ.16-1-3
- Ball bearing rollers for continuous use in automatic measurements
- Maximum diameter of cable: 20 mm

More information: www.rohde-schwarz.com, search term: mds-21

EMC Accessories

Field strength measurements

R&S®HZ-10 Shielded, Calibrated Magnetic Field Pickup Coil (MIL)



Measurement of magnetic field strengths to relevant standards

The R&S®HZ-10 shielded and individually calibrated magnetic field pickup coil allows magnetic field strengths in the frequency range from 20 Hz to 200 kHz to be measured in line with commercial and military standards MIL-STD-461/462, DEF-STAN 59-61, GAM-EG 13, VG 95377 Part 13 and EN 55103-1. These standards specify limits for the magnetic flux density in the frequency range from 30 Hz to 50 kHz or 200 kHz and prescribe an electrostatically shielded coil with a defined number of turns for measuring the magnetic flux density. The coil comes with a calibration certificate for the range from 5 Hz to 10 MHz.

Specifications in brief

- Frequency range: 5 Hz to 10 MHz
- Antenna factor: calibration certificate supplied with coil
- Coil
 - Diameter: 133 mm (5.23 in)
 - Number of turns: 36
 - Type of wire: 7-41, litz wire
 - Resistance: 10 Ω
 - Inductance: 415 μ H
- Connector: Twinax female
- Dimensions (W x H x D): 142 mm x 178 mm x 29 mm (5.59 in x 7.01 in x 1.14 in)
- Weight: 260 g (0.57 lb)

More information: www.rohde-schwarz.com, search term: hz-10

R&S®HZ-11 E Near-Field Probe Set



Diagnostic tools for solving EMC problems and RFID measurements

The R&S®HZ-11 near-field probe set can be used in conjunction with test receivers, spectrum analyzers or oscilloscopes to determine electromagnetic emissions of any type. The main applications is in the diagnosis of emissions from printed circuit boards, cables and leakage spots in shielded enclosures. The passive probes can be used for a local susceptibility test. R&S®HZ-11 probe set is for a qualitative analysis. The probe set comes in a handy transit case.

Equipment supplied

- Three passive H-field probes
- Two passive E-field probes
- One probe extension
- One preamplifier
- One power supply

Specifications in brief

- Probe type, measurement of E/H-field rejection, 1st resonant frequency
 - Loop 6 cm, H-field, 41 dB, 790 MHz
 - Loop 3 cm, H-field, 29 dB, 1.5 GHz
 - Loop 1 cm, H-field, 11 dB, 2.3 GHz
 - Sphere 3.6 cm, E-field, 30 dB, > 1 GHz
 - Rod 6 mm, E-field, 30 dB, > 2 GHz
- Gain of broadband preamplifier

100 kHz	1 MHz	100 MHz	1 GHz	2 GHz	3 GHz
35 dB	38 dB	39 dB	33 dB	26 dB	14 dB
- Noise figure at 500 MHz: typ. 3.5 dB
- Saturated output level at 100 MHz: typ. 12 dBm
- 1 dB compression point at 100 MHz: typ. 8 dBm

More information: www.rohde-schwarz.com, search term: hz-11

R&S®HZ-14 H Near-Field Probe Set



Diagnostic tools for detecting EMC trouble spots

The R&S®HZ-14 near-field probe set can be used in conjunction with test receivers, spectrum analyzers or oscilloscopes to determine electromagnetic emissions of any type. The main applications is in the diagnosis of emissions from printed circuit boards, cables and leakage spots in shielded enclosures. The two passive H-field probes can be used for a local susceptibility test. R&S®HZ-14 probe set is for a quantitative analysis. The probe set comes in a handy transit case.

Equipment supplied

- Two passive H-field probes (9 kHz to 30 MHz and 30 MHz to 1 GHz)
- One active E-field probe (9 kHz to 1 GHz)
- One 30 dB preamplifier for the H-field probe (can be powered from all Rohde & Schwarz test receivers and spectrum analyzers)
- A test jig for functional testing of the H-field probes and simplified normalization of H-field measurements with the aid of a tracking generator and normalization functions provided in spectrum analyzers

Specifications in brief

- H-field probes
 - Max. input power: ≤ 30 MHz: 0.5 W, > 30 MHz: 0.25 W
 - VSWR ($f > 30$ MHz) < 2
- E-field probe
 - Frequency response: ± 3 dB
 - Sensitivity: 13 mV/V
- Connectors: SMA female
- Preamplifier
 - Frequency range: 9 kHz to 1 GHz
 - Gain: 30 dB ± 2 dB (typ. ± 1 dB)
 - Noise figure: typ. < 4 dB
 - 1 dB compression point: typ. 0 dBm
 - Input/output: BNC female/N male
 - Impedance: 50 Ω
 - VSWR: < 2
 - DC Powering: 10 V ± 0.1 V, < 100 mA
 - DC connector: LEMO

More information: www.rohde-schwarz.com, search term: hz-14