



## Voltage Sensors URV5-Z

### Universal voltage measurements from RF to microwaves

The voltage sensors of the URV5-Z series are indispensable tools in RF and microwave laboratories, test departments and service. They cover a frequency range from 9 kHz to 3 GHz and thus close the gap between low-frequency voltage measurements and microwave power measurements.

Consequently they may be used for:

- High-impedance DC and AC voltage measurements in non-coaxial circuits
- Level measurements in 50  $\Omega$  lines
- Terminated power measurements

Voltage sensors are the right tools for everyday use. They permit the measurement of voltages from 200  $\mu\text{V}$  to 1000 V and of powers from 1 nW (-60 dBm) up to 200 W (+53 dBm).



**ROHDE & SCHWARZ**

## General

### Sensors

<b>URV5-Z7</b> 0395.2615.02	<b>RF Probe</b> 200 $\mu$ V to 10 (1000) V, 20 kHz to 1 GHz
<b>URV-Z6</b> 0292.5364.02	<b>Accessory Set</b> 20/40 dB plug-on dividers and 50 $\Omega$ BNC adapter for RF probe
<b>URV-Z50</b> 0394.9816.50	<b>50 <math>\Omega</math> Adapter</b> for power measurements with RF probe at 50 $\Omega$ sources
<b>URV-Z3</b> 0243.9118.70	<b>75 <math>\Omega</math> Adapter</b> for power measurements with RF probe at 75 $\Omega$ sources
<b>URV5-Z1</b> 0395.0512.02	<b>DC Probe</b> 1 mV to 400 V
<b>URV5-Z2</b> 0395.1019.02/05	<b>Insertion Unit 50 <math>\Omega</math></b> 200 $\mu$ V to 10 V, 9 kHz to 3 GHz
<b>URV5-Z4</b> 0395.1619.02/05	<b>Insertion Unit 50 <math>\Omega</math></b> 2 mV to 100 V, 100 kHz to 3 GHz



Low-load voltage measurement with RF Probe URV5-Z7

#### Measurement accuracy

Voltage sensors and measuring devices have a long tradition in RF measurements but for a long time they were not considered very accurate. Already 15 years ago, Rohde&Schwarz set standards with its voltage sensors: state-of-the-art zero-bias Schottky diodes guaranteeing highly stable, reproducible measurements. Instead of using analog methods for linearization and compensating temperature errors of the rectifier in the sensors, correction values are calculated. Each sensor has a built-in calibration data memory which holds all individual parameters to be taken into account by the meter.

This numerical correction offers high accuracy over the entire dynamic range of 90 dB and at the same time simplifies operation: the meter identifies the type of sensor connected and automatically adapts to it. When a test frequency is entered by the user, the frequency response determined during calibration may be selected for increasing the measurement accuracy.

#### Waveform weighting

All AC sensors URV5-Z are calibrated so that the rms value is indicated for a sinewave voltage. With other waveforms, eg squarewaves, the peak value is decisive for the type of weighting employed. Below about 30 mV, the RF probe and the 10 V insertion unit measure rms values. Above 1 V, the peak-to-peak value  $V_{pp}$  is measured and  $V_{pp}/(2\sqrt{2})$  is indicated, which corresponds to the rms value of a sinewave voltage. Between 30 mV and 1 V the type of weighting is determined by the waveform.

The measurement of modulated sine-wave voltages follows a pattern similar to that of non-sinusoidal waveforms. Up to a peak value of 30 mV at the envelope's maximum (corresponding to 10  $\mu$ W PEP in 50  $\Omega$  systems), true rms value is measured. With power indication in W or dBm, the average power is displayed. Above 1 V (10 mW PEP) and with a modulation frequency of at least 10 kHz, peak value is measured again. In the case of power measurements, the peak envelope power PEP is indicated

without any calculations being required, and for voltages the value  $V_{pp}/(2\sqrt{2})$ .

Limit values specified for the 100 V Insertion Unit URV5-Z4 are 20 dB higher than for the 10 V insertion unit, ie by a factor of 10 for voltages and by a factor of 100 for power levels. When a plug-on divider is used with the RF probe, limit values are to be increased by the amount of the preceding attenuation.



Level Meter URV35 with Insertion Unit URV5-Z2 in mobile use

Four types of meters are available for voltage and power measurements.

## Meters

### URV35

Compact voltmeter and power meter for use in service, testshops and labs. Unique combination of analog and digital display in form of moving-coil meter plus LCD. Many measurement functions, display in all standard units, choice of battery or AC supply operation, RS-232 interface. All sensors are suitable.



### URV55

Attractively priced, single-channel voltmeter. Many measurement functions, display of results in all standard units, analog output comes as standard, IEC/IEEE-bus connector. All sensors are suitable.



### NRVD

Modern dual-channel power meter with menu operation and IEC/IEEE-bus connector (SCPI). Ideal for relative measurements in two test channels (attenuation, reflection). Large variety of measurement functions, display of results in all standard units. Many extras like 1 mW test generator, indication of measurement uncertainty, etc. All sensors are suitable.



### NRVS

Attractively priced, single-channel power meter, similar to URV55. All sensors are suitable.

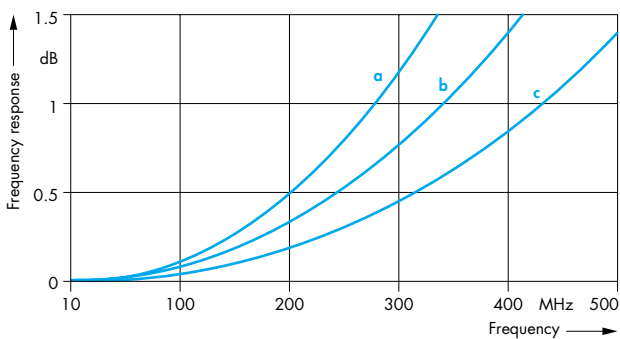


## RF Probe URV5-Z7

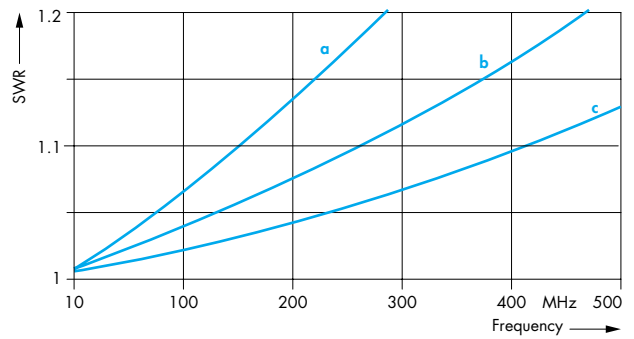
The RF Probe is a universal tool for measuring RF voltages. The low input capacitance of 2.5 pF makes it virtually non-loaded and ideally suitable for measurements on non-coaxial circuits up to 500 MHz or up to 1 GHz when appropriate accessories are used. A plug-on divider extends the voltage measurement range from 10 V to 1000 V and at the same time reduces the input capacitance to 0.5 pF.

Compared to active, high-impedance probes, the dynamic range of the URV5-Z7 is greater by a factor of 10 to 100, ie higher voltages can be measured with the same sensitivity.

With a dynamic range from 200  $\mu$ V to 10 V without the use of a plug-on divider, the probe covers all voltage levels common in state-of-the-art electronic equipment.

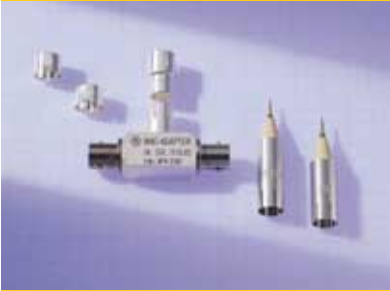


Typical frequency response of RF Probe URV5-Z7 with voltage measurements on a matched 50  $\Omega$  line (without adapter, short ground connection); a) direct, b) with 20 dB plug-on divider, c) with 40 dB plug-on divider



Typical SWR of a matched 50  $\Omega$  line after connecting RF Probe URV5-Z7 (without adapter, short ground connection); a) direct, b) with 20 dB plug-on divider, c) with 40 dB plug-on divider

## Accessories for RF probe



20/40 dB plug-on dividers and BNC adapter

### Accessory Set URV-Z6

20 dB and 40 dB plug-on dividers for extending the voltage measurement range and reducing the input capacitance to 100 V/1 pF or 1000 V/0.5 pF.

BNC adapter for level measurements in 50  $\Omega$  coaxial lines (see also Insertion Units URV5-Z2/-Z4).



URV-Z50 50  $\Omega$ , 20 kHz to 1 GHz, 1 nW to 2 W

**Adapters URV-Z50 and URV-Z3** with integrated termination for power measurements on matched sources make the probe a power sensor with an extremely wide dynamic range of



URV-Z3 75  $\Omega$ , 20 kHz to 500 MHz, 0.5 nW to 1.3 W

93 dB. For increasing the measurement accuracy with the 50  $\Omega$  adapter connected, frequency response correction data are stored in each probe.

## DC Probe URV5-Z1

The low input capacitance of the DC Probe URV5-Z1 makes it particularly suitable for measurements in RF circuits. Since the probe is virtually non-loaded, the circuit under test remains largely unaffected. This avoids the operating point of active circuits being shifted which can occur with high capacitive loading.



### DC Probe URV5-Z1

1 mV to 400 V

3 pF || 9 M $\Omega$

## Insertion Units URV5-Z2 and URV5-Z4

The Insertion Units URV5-Z2 and URV5-Z4 are used for uninterrupted level measurements between source and load and for terminated power measurements. Due to their wide frequency range they are ideal especially for the measurement of EMC test levels as well as many general-purpose applications.

Compared to the terminating power sensors of the NRV line the URV5-Z2 and URV5-Z4 insertion units offer a larger dynamic range, a much lower frequency limit (9 kHz with URV5-Z2) and the possibility of using them during operation of the load.

Both units are made up of a short, coaxial line between the two RF connectors, in the middle of which the voltage is tapped: directly with URV5-Z2, and via a capacitive 20 dB divider with URV5-Z4. If the insertion units are match-terminated, the voltage is constant over the whole length of the line, so a fixed relationship is obtained between applied RF power and test voltage:  $P = V_{\text{rms}}^2 / 50 \Omega$ . In this configuration, the insertion units provide precise absolute power and level measurements.

The insertion units are calibrated so that the power incident upon them is indicated. With a poorly matched load, precise absolute-value measurements are not possible, but relative measurements can be performed and system applications implemented in which subsequent calibration of the complete test setup takes place. Switchover between voltage, level and power indication is made at the basic unit.

**Insertion Unit URV5-Z2**  
200  $\mu\text{V}$  to 10 V  
9 kHz to 3 GHz

**Insertion Unit URV5-Z4**  
2 mV to 100 V  
100 kHz to 3 GHz



The built-in detectors offer a dynamic range of more than 90 dB for spectrally pure sinusoidal signals with an unmodulated envelope (CW, FM,  $\phi\text{M}$ , GMSK, FSK, etc). This gives a voltage measurement range of 200  $\mu\text{V}$  to 10 V (–60 dBm to +33 dBm into 50  $\Omega$ ) for URV5-Z2, and of 2 mV to 100 V (–40 dBm to +53 dBm into 50  $\Omega$ ) for URV5-Z4. With modulated envelope or high harmonic content, the insertion units should be operated only within the square-law region of the detectors, which for URV5-Z2 ends at approx. 22 mV (–20 dBm into 50  $\Omega$ ) and for URV5-Z4 at 220 mV (0 dBm into 50  $\Omega$ ). In this region, the behaviour of the insertion units is similar to that of a thermal power meter, ie the rms voltage or the equivalent average power is measured.

Thanks to the high decoupling of the detector from the RF connectors, insertion loss of URV5-Z4 is very low, ie not exceeding that of a line of equivalent length. URV5-Z4 is therefore truly transparent and can be inserted into any test circuit without influencing the parameters to be measured.

Both insertion units are equipped with a calibration data memory that contains information about the individual sensor characteristics like frequency response, linearity, temperature coefficient etc. The stored data are automatically considered by the basic unit during operation so that the user can plug the sensor in and immediately start measuring.



## Power sensors

Power sensors of the NRV-Z series listed in the table below are available for further applications. (For more detailed information refer to Data Sheet NRV-Z, PD 756.9797).

<b>NRV-Z1</b> <b>828.3018.02</b>	<b>Diode Power Sensor 50 Ω</b> 10 MHz to 18 GHz, 200 pW to 20 mW	Power measurements of highest sensitivity up to 18 GHz in 50 Ω systems
<b>NRV-Z2</b> <b>828.3218.02</b>	<b>Diode Power Sensor 50 Ω</b> 10 MHz to 18 GHz, 20 nW to 500 mW	Power measurements with minimum mismatch, for high powers in 50 Ω systems
<b>NRV-Z3</b> <b>828.3418.02</b>	<b>Diode Power Sensor 75 Ω</b> 1 MHz to 2.5 GHz, 100 pW to 13 mW	Power measurements in 75 Ω systems
<b>NRV-Z4</b> <b>828.3618.02</b>	<b>Diode Power Sensor 50 Ω</b> 100 kHz to 6 GHz, 100 pW to 20 mW	Power measurements of highest sensitivity in the frequency range 100 kHz to 6 GHz, very large dynamic range
<b>NRV-Z5</b> <b>828.3818.02</b>	<b>Diode Power Sensor 50 Ω</b> 100 kHz to 6 GHz, 10 nW to 500 mW	Like NRV-Z4, but for high powers and minimum mismatch
<b>NRV-Z6</b> <b>828.5010.02</b>	<b>Diode Power Sensor 50 Ω</b> 50 MHz to 26.5 GHz, 400 pW to 20 mW	Power measurements up to 26.5 GHz with high sensitivity in 50 Ω systems (PC 3.5)
<b>NRV-Z15</b> <b>1081.2305.02</b>	<b>Diode Power Sensor 50 Ω</b> 50 MHz to 40 GHz, 400 pW to 20 mW	Power measurements up to 40 GHz with high sensitivity in 50 Ω systems (2.92 mm)
<b>NRV-Z31</b> <b>857.9604.02/3/4</b>	<b>Peak Power Sensor 50 Ω</b> 30 MHz to 6 GHz, 1 μW to 20 mW	Peak power measurements, pulse width ≥2 (200) μs, pulse repetition rate ≥10 (100) Hz, 3 models
<b>NRV-Z32</b> <b>1031.6807.04/5</b>	<b>Peak Power Sensor 50 Ω</b> 30 MHz to 6 GHz, 100 μW to 2(4) W	Peak power measurements, pulse width ≥2 (200) μs, pulse repetition rate ≥25 (100) Hz, 2 models
<b>NRV-Z33</b> <b>1031.6507.03/4</b>	<b>Peak Power Sensor 50 Ω</b> 30 MHz to 6 GHz, 1 mW to 20 W	Peak power measurements up to 20 W, pulse width ≥2 (200) μs, pulse repetition rate ≥100 Hz, 2 models
<b>NRV-Z51</b> <b>857.9004.02</b>	<b>Thermal Power Sensor 50 Ω</b> DC to 18 GHz, 1 μW to 100 mW	High-precision power measurements also with non-sinusoidal signals, N connector
<b>NRV-Z52</b> <b>857.9204.02</b>	<b>Thermal Power Sensor 50 Ω</b> DC to 26.5 GHz, 1 μW to 100 mW	Same as NRV-Z51, but with PC 3.5 connector for measurements up to 26.5 GHz
<b>NRV-Z53</b> <b>858.0500.02</b>	<b>Thermal Power Sensor 50 Ω</b> DC to 18 GHz, 100 μW to 10 W	High-power measurements up to 10 W also with non-sinusoidal signals
<b>NRV-Z54</b> <b>858.0800.02</b>	<b>Thermal Power Sensor 50 Ω</b> DC to 18 GHz, 300 μW to 30 W	High-power measurements up to 30 W also with non-sinusoidal signals
<b>NRV-Z55</b> <b>1081.2005.02</b>	<b>Thermal Power Sensor 50 Ω</b> DC to 40 GHz, 1 μW to 100 mW	Same as NRV-Z51, but with 2.92 mm connector for measurements up to 40 GHz

## Specifications

Type	Frequency range Impedance	Voltage measurement range Max. rating	Power /Level measurement range	SWR (reflection coefficient) max.	Ins. loss in dB (max) <sup>8)</sup>	RF connector
<b>RF Probe URV5-Z7</b>	20 kHz to 500 MHz <sup>5)</sup> 2.5 pF    80 kΩ <sup>1)</sup>	200 μV to 10 V 15 V (rms) 22 V (pk), 60 V (DC) <sup>15)</sup>	1 nW to 2 W -60/+33 dBm	—	—	BNC (female/ female)
with 20 dB plug-on divider (URV-Z6)	1 MHz to 500 MHz <sup>5)</sup> 1 pF    1 MΩ <sup>1)</sup>	2 mV to 100 V 150 V (rms) <sup>2)</sup> 220 V (pk), 1000 V (DC)	100 nW to 20 W <sup>4)</sup> -40/+43 dBm	—	—	BNC (female/ female)
with 40 dB plug-on divider (URV-Z6)	0.5 MHz to 500 MHz <sup>5)</sup> 0.5 pF    10 MΩ <sup>1)</sup>	20 mV to 1000 V 1050 V (rms) <sup>2)</sup> <sup>3)</sup> 1500 V (pk), 1000V(DC)	10 μW to 20 W <sup>4)</sup> -20/+43 dBm	—	—	BNC female/ female)
with 50 Ω Adapter URV-Z50	20 kHz to 1 GHz 50 Ω	200 μV to 10 V 10 V (rms) 22 V (pk)	1 nW to 2 W -60/+33 dBm	0.02 MHz to 50 MHz: 1.03 (0.015) > 50 MHz to 100 MHz: 1.06 (0.03) >100 MHz to 500 MHz: 1.11 (0.05) >500 MHz to 700 MHz: 1.22 (0.10) >700 MHz to 1 GHz: 1.44 (0.18)	—	BNC (female or male)
with 75 Ω Adapter URV-Z3	20 kHz to 500 MHz 75 Ω	200 μV to 10 V 12 V (rms) 22 V (pk)	500 pW to 1.3W -62/+31 dBm	0.02 MHz to 100 MHz: 1.03 (0.015) >100 MHz to 200 MHz: 1.06 (0.03) >200 MHz to 500 MHz: 1.22 (0.10)	—	BNC (male) 2.5/6 1.6/5.6
<b>DC Probe URV5-Z1</b>	— 3 pF    9 MΩ	1 mV to 400 V 400 V (pk)	—	—	—	BNC (male)
<b>10 V Insertion Unit URV5-Z2</b>	9 kHz to 3 GHz 50 Ω	200 μV to 10 V <sup>6)</sup> 15 V (rms) up to 1 GHz $\frac{15V(rms)}{f/GHz}$ from 1 GHz to 3 GHz 22 V (pk), 50 V (DC)	1 nW to 2 W <sup>6)</sup> -60/+33 dBm <sup>6)</sup>	9 kHz to 200 MHz: 1.04 (0.02) >200 MHz to 500 MHz: 1.10 (0.048) >500 MHz to 1 GHz: 1.22 (0.10) >1 GHz to 1.6 GHz: 1.35 (0.15) >1.6 GHz to 2 GHz: 1.35 (0.15) >2 GHz to 2.4 GHz: 1.35 (0.15) >2.4 GHz to 3 GHz: 1.35 (0.15)	0.07 0.2 0.5 1.0 1.5 2.5 3.5	N (female/ male)
<b>100 V Insertion Unit URV5-Z4</b>	100 kHz to 3 GHz 50 Ω	2 mV to 100 V <sup>7)</sup> 150 V (rms) up to 1 GHz $\frac{150V(rms)}{\sqrt{f/(GHz)}}$ from 1 GHz to 3 GHz 220 V(pk), 600 V(DC) <sup>15)</sup>	100 nW to 200 W <sup>7)</sup> -40/+53 dBm <sup>7)</sup>	0.1 MHz to 500 MHz: 1.04 (0.02) >500 MHz to 1.6 GHz: 1.07 (0.035) >1.6 GHz to 2 GHz: 1.07 (0.035) >2 GHz to 3 GHz: 1.10 (0.048)	0.05 0.1 0.15 0.15	N (female/ male)

### Measurement uncertainties

in the temperature range 18°C to 28°C for spectrally pure sinewave signals and DC voltage (DC Probe URV5-Z1 only). Values in dB and in % (in parentheses; referred to measured voltage). The effects of basic unit, zero offset, display noise and ambient temperature (out of specified range) are to be considered separately.

Type	Frequency range	without frequency response correction <sup>9)</sup>	with frequency response correction <sup>10)</sup>
<b>RF Probe URV5-Z7<sup>12)</sup></b>	20 kHz to 50 kHz >50 kHz to 100 kHz >100 kHz to 200 kHz >0.2 MHz to 32 MHz >32 MHz to 100 MHz >100 MHz to 200 MHz >200 MHz to 500 MHz	-0.2/+0.9 <sup>11)</sup> (-2.3/+10) <sup>11)</sup> ±0.2 (±2.3) ±0.11 (±1.3) ±0.07 (±0.8) ±0.16 (±1.8) ±0.29 (±3.3) -1/+1.1 (±12)	— — — — — — —
<b>with 20 dB plug-on divider<sup>12)</sup></b>	1 MHz to 2 MHz >2 MHz to 100 MHz >100 MHz to 200 MHz >200 MHz to 500 MHz	-1/+1.9 <sup>11)</sup> (-12/+20) <sup>11)</sup> -1/+1.1 (±12) -1.2/+1.4 (±15) -1.6/+1.9 (±20)	— — — —
<b>with 40 dB plug-on divider<sup>12)</sup></b>	0.5 MHz to 1 MHz >1 MHz to 100 MHz >100 MHz to 200 MHz >200 MHz to 500 MHz	-0.6/+1.9 <sup>11)</sup> (-7/+20) <sup>11)</sup> ±0.6 (±7) -0.8/+0.9 (±10) -1.2/+1.4 (±15)	— — — —
<b>with 50 Ω Adapter URV-Z50<sup>13)</sup></b>	20 kHz to 50 kHz >50 kHz to 100 kHz >100 kHz to 200 kHz >0.2 MHz to 32 MHz >32 MHz to 100 MHz >100 MHz to 200 MHz >200 MHz to 500 MHz >0.5 GHz to 1 GHz	-0.2/+0.9 <sup>11)</sup> (-2.3/+10) <sup>11)</sup> ±0.2 (±2.3) ±0.16 (±1.8) ±0.11 (±1.3) ±0.2 (±2.3) ±0.38 (±4.3) -0.8/+0.9 (±10) -1.6/+1.9 (±20) -1.6/+1.9 (±20)	— — — — 0.2 (2.3) 0.29 (3.3) 0.66 (7.3) 1.0 (12) 200 μV to 1 V 1.2 (14) >1 V to 10 V
<b>with 75 Ω Adapter URV-Z3<sup>13)</sup></b>	20 kHz to 50 kHz >50 kHz to 100 kHz >100 kHz to 200 kHz >0.2 MHz to 32 MHz >32 MHz to 100 MHz >100 MHz to 200 MHz >200 MHz to 500 MHz	-0.2/+0.9 <sup>11)</sup> (-2.3/+10) <sup>11)</sup> ±0.2 (±2.3) ±0.16 (±1.8) ±0.11 (±1.3) ±0.2 (±2.3) ±0.38 (±4.3) -1/+1.1 (±12)	— — — — — — —



## Measurement uncertainties

Values in dB and in % (in parentheses; referred to measured voltage)

Type	Frequency range	with frequency response correction <sup>10)</sup> up to 1 V (20 mW/+13 dBm)	with frequency response correction <sup>10)</sup> above 1 V (20 mW/+13 dBm)
10 V Insertion Unit URV5-Z2 <sup>14)</sup> at URV35, URV55, NRVS, NRVD	9 kHz to 20 kHz	0.35 <sup>11)</sup> (4.0) <sup>11)</sup>	0.20 <sup>11)</sup> (2.3) <sup>11)</sup>
	>20 kHz to 50 kHz	0.20 <sup>11)</sup> (2.3) <sup>11)</sup>	0.17 <sup>11)</sup> (2.0) <sup>11)</sup>
	>50 kHz to 100 kHz	0.17 (2.0)	0.17 (2.0)
	>100 kHz to 100 MHz	0.13 (1.5)	0.13 (1.5)
	>100 MHz to 200 MHz	0.17 (2.0)	0.17 (2.0)
	>200 MHz to 500 MHz	0.20 (2.3)	0.25 (2.9)
	>0.5 GHz to 1.0 GHz	0.25 (2.9)	0.30 (3.5)
	>1.0 GHz to 1.6 GHz	0.30 (3.5)	0.40 (4.6)
>1.6 GHz to 2.0 GHz	0.35 (4.0)	0.50 (5.8)	
>2.0 GHz to 2.4 GHz	0.40 (4.6)	0.60 (6.9)	
>2.4 GHz to 3.0 GHz	0.50 (5.8)	0.75 (8.6)	
10 V-Insertion Unit URV5-Z2 <sup>14)</sup> at URV5, NRV	>9 kHz to 20 kHz	0.45 <sup>11)</sup> (5.2) <sup>11)</sup>	0.30 <sup>11)</sup> (3.5) <sup>11)</sup>
	>20 kHz to 50 kHz	0.20 <sup>11)</sup> (2.3) <sup>11)</sup>	0.20 <sup>11)</sup> (2.3) <sup>11)</sup>
	>50 kHz to 100 kHz	0.17 (2.0)	0.17 (2.0)
	>100 kHz to 100 MHz	0.13 (1.5)	0.13 (1.5)
	>100 MHz to 200 MHz	0.20 (2.3)	0.20 (2.3)
	>200 MHz to 500 MHz	0.25 (2.9)	0.30 (3.5)
	>0.5 GHz to 1.0 GHz	0.35 (4.0)	0.40 (4.6)
	>1.0 GHz to 1.6 GHz	0.45 (5.2)	0.55 (6.3)
>1.6 GHz to 2.0 GHz	0.55 (6.3)	0.65 (7.5)	
>2.0 GHz to 2.4 GHz	0.65 (7.5)	0.80 (9.2)	
>2.4 GHz to 3.0 GHz	0.85 (9.8)	1.05 (12)	
		up to 10 V (2 W/+33 dBm)	above 10 V (2 W/+33 dBm)
100 V Insertion Unit URV5-Z4 <sup>14)</sup> at URV35, URV55, NRVS, NRVD	100 kHz to 200 kHz	1.50 <sup>11)</sup> (18) <sup>11)</sup>	0.50 <sup>11)</sup> (5.8) <sup>11)</sup>
	>200 kHz to 500 kHz	0.60 <sup>11)</sup> (6.9) <sup>11)</sup>	0.25 <sup>11)</sup> (2.9) <sup>11)</sup>
	>500 kHz to 1 MHz	0.20 <sup>11)</sup> (2.3) <sup>11)</sup>	0.17 <sup>11)</sup> (2.0) <sup>11)</sup>
	>1 MHz to 3 MHz	0.17 (2.0)	0.13 (1.5)
	>3 MHz to 200 MHz	0.13 (1.5)	0.13 (1.5)
	>200 MHz to 500 MHz	0.17 (2.0)	0.20 (2.3)
	>0.5 GHz to 1 GHz	0.20 (2.3)	0.25 (2.9)
	>1.0 GHz to 1.6 GHz	0.30 (3.5)	0.40 (4.6)
>1.6 GHz to 2.0 GHz	0.35 (4.0)	0.50 (5.8)	
>2.0 GHz to 2.4 GHz	0.45 (5.2)	0.70 (8.1)	
>2.4 GHz to 3.0 GHz	0.65 (7.5)	1.05 (12)	
100 V Insertion Unit URV5-Z4 <sup>14)</sup> at URV5, NRV	100 kHz to 200 kHz	2.20 <sup>11)</sup> (26) <sup>11)</sup>	0.80 <sup>11)</sup> (9.2) <sup>11)</sup>
	>200 kHz to 500 kHz	0.80 <sup>11)</sup> (9.2) <sup>11)</sup>	0.40 <sup>11)</sup> (4.6) <sup>11)</sup>
	>500 kHz to 1 MHz	0.25 <sup>11)</sup> (2.9) <sup>11)</sup>	0.20 <sup>11)</sup> (2.3) <sup>11)</sup>
	>1 MHz to 3 MHz	0.17 (2.0)	0.13 (1.5)
	>3 MHz to 200 MHz	0.13 (1.5)	0.13 (1.5)
	>200 MHz to 500 MHz	0.17 (2.0)	0.20 (2.3)
	>0.5 GHz to 1.0 GHz	0.25 (2.9)	0.30 (3.5)
	>1.0 GHz to 1.6 GHz	0.45 (5.2)	0.55 (6.3)
>1.6 GHz to 2.0 GHz	0.60 (6.9)	0.70 (8.1)	
>2.0 GHz to 2.4 GHz	0.80 (9.2)	1.00 (12)	
>2.4 GHz to 3.0 GHz	1.15 (14)	1.50 (18)	

Type	Voltage measurement range	Measurement uncertainty <sup>9)</sup>
DC Probe URV5-Z1	1 mV to 100 V	±0.013 (±0.15)
	>100 V to 400 V	±0.030 (±0.35)

<sup>1)</sup> Applies to 10 MHz. For impedance at higher frequencies see SWR diagram on page 4.

<sup>2)</sup> Not with BNC Adapter.

<sup>3)</sup> Up to 40 MHz.  $<210 \text{ V (rms)}/\sqrt{f/\text{GHz}}$  applies at higher frequencies.

<sup>4)</sup> With BNC adapter (50 Ω). Maximum power limited by losses in the adapter.

<sup>5)</sup> Upper limit frequency depending on adapter and source impedance.

<sup>6)</sup> Up to 1.5 GHz. At higher frequencies the upper limit of the measurement range is to be reduced according to max.rating.

<sup>7)</sup> Up to 2 GHz. At higher frequencies the upper limit of the measurement range is to be reduced according to max.rating.

<sup>8)</sup> The insertion loss of Insertion Unit URV5-Z2 is level-dependent above 0.5 GHz. The specified values refer to low test voltages at which the highest loss is obtained.

<sup>9)</sup> Measurement uncertainty limits without consideration of correction values for the frequency-dependent response of RF probes. Measurement uncertainty limits are identical with error limits, but with opposite sign.

<sup>10)</sup> Expanded uncertainty with a coverage factor  $k = 2$ , with the frequency-dependent correction values stored in the probe being taken into account. An expanded uncertainty with  $k=2$  corresponds to a coverage probability of approx. 95 % for a normal distribution of combined errors.

<sup>11)</sup> In this frequency range the measurement accuracy is strongly voltage- and temperature-dependent. Therefore, at temperatures above 28°C an increase in the measurement uncertainty is to be expected that is far above the value specified for the temperature effect. In the worst case it can be assumed that the measurement uncertainty will double with every temperature increase of 5 K, i.e. at 33°C, 38°C etc, for URV5-Z7 without plug-on divider between 20 kHz and 30 kHz, for URV5-Z2 between 9 kHz and 15 kHz and for URV5-Z4 between 100 kHz and 300 kHz.

<sup>12)</sup> In BNC adapter terminated with 50 Ω load. Specifications referred to incident wave at source terminal. With mismatched load, measurement uncertainty limits may rise due to standing waves by about ±4 dB (SWR=1). The approximation refers to SWR of up to 1.25; for SWR = 1.2 the increase would be ±0.8 dB.

<sup>13)</sup> Specifications referred to incident wave.

<sup>14)</sup> With reflection-free load at the female connector, frequency correction switched on, specifications referred to incident wave at male connector. Due to standing waves, mismatch of the load can lead to an additional measurement uncertainty that can be approximated by  $2.8 \text{ dB} \times (\text{SWR}-1)$  for the standard uncertainty (formula valid for SWR of up to 1.25).

<sup>15)</sup> Limited to the specified value for reasons of conformity with international safety standards. Deviating specifications on the type plates of older sensors are to be regarded as the maximum possible physical rating.

**Zero offset and display noise** (relevant with small voltages/powers only)

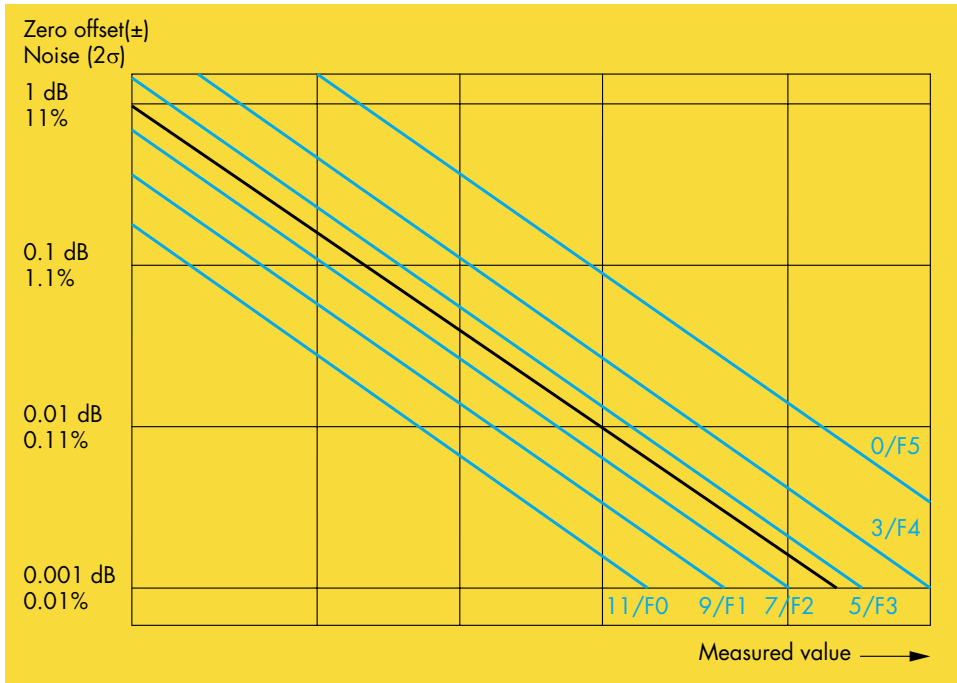
DC probe: zero offset  $\pm 0.5$  mV, display noise negligible. All other probes: see diagram. For display noise of Level Meter URV35 see relevant specifications.

Black curve:

Zero offset (within 1 h after zero adjustment; temperature variation  $<1^\circ\text{C}$ ; meter with probe run in for about 2 hours)

Blue curves:

Display noise (2 standard deviations, monitoring time 1 min, probe temperature  $18^\circ\text{C}$  to  $28^\circ\text{C}$ , values about double at  $0^\circ\text{C}$ )  
Filter designations: 0 to 11 for URV55, NRVS and NRVD, F0 to F5 for URV5 and NRV



200 $\mu\text{V}$ -60 dBm 1 nW	500 $\mu\text{V}$ -53 dBm 5 nW	1 mV -47 dBm 20 nW	2 mV -40 dBm 100 nW	5 mV -33 dBm 500 nW	10 mV -27 dBm 2 $\mu\text{W}$
2 mV -40 dBm 100 nW	5 mV -33 dBm 500 nW	10 mV -27 dBm 2 $\mu\text{W}$	20 mV -20 dBm 10 $\mu\text{W}$	50 mV -13 dBm 50 $\mu\text{W}$	100 mV -7 dBm 200 $\mu\text{W}$
20 mV -20 dBm 10 $\mu\text{W}$	50 mV -13 dBm 50 $\mu\text{W}$	100 mV -7 dBm 200 $\mu\text{W}$	200 mV 0 dBm 1 mW	500 mV +7 dBm 5 mW	1 V +13 dBm 20 mW

RF probe without plug-on divider  
RF probe in 50  $\Omega$  or 75  $\Omega$  adapter  
10 V Insertion Unit URV5-Z2

RF probe with 20 dB plug-on divider  
100 V Insertion Unit URV5-Z4

RF probe with 40 dB plug-on divider

All level and power values refer to 50 $\Omega$ ; values for 75 $\Omega$  slightly differ.

**Temperature effect <sup>1)</sup>**

18 $^\circ\text{C}$  to 28 $^\circ\text{C}$   
10 $^\circ\text{C}$  to 40 $^\circ\text{C}$   
0 $^\circ\text{C}$  to 50 $^\circ\text{C}$

RF Probe URV5-Z7  
without/with accessories

Insertion Units  
URV5-Z2/-Z4

DC Probe  
URV5-Z1

0.17 dB (2%)  
0.44 dB (5%)

included in measurement uncertainty

0.17 dB (2%)  
0.44 dB (5%)

0.02 dB (0.25%)  
0.04 dB (0.5%)

<sup>1)</sup> Residual uncertainty (approx. two standard deviations) after internal temperature correction taking into account the temperature characteristic of the sensor and its temperature. The specified temperature effect does not apply to the frequency ranges specified in footnote 11.

## General data

Temperature range	meets DIN IEC 68-2-1/68-2-2
Operating	0°C to +50°C
Storage	-40°C to +70°C
Permissible humidity	max. 80%, without condensation
Vibration, sinusoidal	5 Hz to 55 Hz, max. 2 g; 55 Hz to 150 Hz, 0.5 g const. (meets DIN IEC 68-2-6, IEC 1010-1, MIL-T-28800 D, class 5)
Vibration random	10 Hz to 500 Hz, acceleration 1.9 g rms (meets DIN IEC 68-2-36)
Shock	40 g shock spectrum (meets MIL-STD-810 D; DIN IEC 68-2-27)
EMC	meets EN 50081-1 and 50082-1, EMC directive of EC (89/336/EEC), EMC law of the Federal Republic of Germany and MIL-STD-461 C (RE 02, CE 03, RS 03, CS 02)
Safety	meets EN 61010-1
Length of connecting cable	approx. 1.2 m for URV5-Z1 and URV5-Z7, 1.3 m or 5 m for URV5-Z2 and URV5-Z4, depending on model; other lengths on request



## Ordering information

### Order designations

RF Probe with case, ground cable, ground sleeve and strip, hook and solder tip	URV5-Z7	0395.2615.02
DC Probe with ground cable, clip-on tip and BNC adapter	URV5-Z1	0395.0512.02
10 V Insertion Unit 50 Ω, 3 GHz with 1.3 m cable	URV5-Z2	0395.1019.02
10 V Insertion Unit 50 Ω, 3 GHz with 5 m cable	URV5-Z2	0395.1019.05
100 V Insertion Unit 50 Ω, 3 GHz with 1.3 m cable	URV5-Z4	0395.1619.02
100 V Insertion Unit, 50 Ω, 3 GHz with 5 m cable	URV5-Z4	0395.1619.05

### Recommended extras

for RF probe:

Accessory Set including  
20/40 dB plug-on dividers,  
50 Ω BNC adapter with sleeve  
for plug-on divider, ground  
sleeve and strip

URV-Z6 0292.5364.02

50 Ω Adapter (BNC female)  
with adapter to BNC male

URV-Z50 0394.9816.50

75 Ω Adapter  
with adapters to BNC male,  
2.5/6 and 1.6/5.6 connector

URV-Z3 0243.9118.70

for Insertion Units URV5-Z2, URV5-Z4:

Precision Termination  
1 W, 50 Ω, 0 to 18 GHz  
(SWR <1.02 to 1 GHz)

RNA 0272.4510.50

Termination  
1 W, 50 Ω, 0 to 4 GHz  
(SWR <1.05 to 1 GHz)

RNB 0272.4910.50

Certified Quality System  
**ISO 9001**  
DQS REG. NO 1954

Certified Environmental System  
**ISO 14001**  
REG. NO 1954

## Fax Reply (Voltage Sensors URV5-Z)

- Please send me an offer**
- I would like a demo**
- Please call me**
- I would like to receive your free-of-charge CD-ROM catalogs**

Others: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name: \_\_\_\_\_

Company/Department: \_\_\_\_\_

Position: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Country: \_\_\_\_\_

Telephone: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_



# ROHDE & SCHWARZ