

R&S[®] RT-ZPR20 R&S[®] RT-ZPR40 Power-Rail Probe User Manual



1800503502

This manual describes the following R&S®RT-ZPR models:

- R&S®RT-ZPR20 (1800.5006.02)
- R&S®RT-ZPR40 (1800.5406.02)

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1800.5035.02 | Version 03 | R&S®RT-ZPR20 R&S®RT-ZPR40

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol and without product type numbers, e.g. R&S®RT-ZPR20/40 is indicated as R&S RT-ZPR20/40.

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1 Safety Information

The product documentation helps you use the R&S RT-ZPR20/40 safely and efficiently. Follow the instructions provided here and in the "Safety Instructions". Keep the product documentation nearby and offer it to other users.

Intended use

The R&S RT-ZPR20/40 is intended for the development, production and verification of electronic components and devices in industrial, administrative, and laboratory environments. Use the R&S RT-ZPR20/40 only for its designated purpose. Observe the operating conditions and performance limits stated in the data sheet.

Where do I find safety information?

Safety information is part of the product documentation. It warns you about the potential dangers and gives instructions how to prevent personal injuries or damage caused by dangerous situations. Safety information is provided as follows:

- The printed "Basic Safety Instructions" provide safety information in many languages and are delivered with the R&S RT-ZPR20/40.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation. Read the documentation of the probe, and also of the oscilloscope the probe is connected to.

Maximum input voltage

The maximum input voltage is ± 60 V DC or ± 5 V AC (peak) between the signal and the ground.

Using the probe

Take the following measures for your safety:

- Do not connect a probe to any voltage that exceeds the maximum permissible input voltage specified in the data sheet.
- Do not cause any short circuits when measuring on sources with high output currents.
- The probe pins are extremely pointed and can easily penetrate clothes and the skin. Handle the probe pins with great care. To exchange a probe pin, use tweezers or pliers to avoid injuries. When transporting the accessories, always use the box supplied with the probe.

The R&S RT-ZPR20/40 can withstand a moderate amount of physical and electrical stress. To avoid damage, treat the probe with care:

- Always observe the specified input voltage limits and measurement ranges.
- Connect the R&S RT-ZPR20/40 only to an instrument with Rohde & Schwarz probe interface. Never connect it to a usual BNC jack. Although the 7 mm coaxial connector looks like a standard BNC connector, it is constructed differently and does not fit to the standard BNC jack. The interface of the R&S RT-ZPR20/40 can withstand a higher frequency limit.
- Handle the probe by the probe box. Avoid excessive strain on the probe cable, and kinking.
- Prevent the probe from receiving mechanical shock.
- Do not spill liquids on the probe.
- Store the probe in a shock-resistant case, e.g. in the shipping case.

Electrostatic discharge

Electrostatic discharge (ESD) can damage the electronic components of the probe and the instrument, and also the device under test (DUT). Electrostatic discharge is most likely to occur when you connect or disconnect a DUT or test fixture to the probe and to the instrument's test ports. To prevent electrostatic discharge, use a wrist strap and cord and connect yourself to the ground, or use a conductive floor mat and heel strap combination. Discharge cables and probe tips before you connect them.

2 Product Description

2.1 Key Features and Key Characteristics

The R&S RT-ZPR20/40 power-rail probe is designed for power integrity measurements. The R&S RT-ZPR20/40 is specifically built to measure small signals in the millivolt range with very large DC-offset components up to ± 60 V. It is thus perfectly suited to measure small perturbations on DC power rails.

The probe consists of a probe box with an SMA connector and various accessories for different applications.

Since the probe is equipped with the Rohde & Schwarz probe interface, it can be connected to any Rohde & Schwarz base unit that is compatible with this interface and has the required firmware. When connected to the front panel of a supported Rohde & Schwarz oscilloscope, the probe is controlled via the software dialog of the oscilloscope. For a list of compatible base units, see the data sheet of the probe.

The key characteristics of the probe are the following:

- Bandwidth:
 - DC to 2.0 GHz for R&S RT-ZPR20
 - DC to 4.0 GHz for R&S RT-ZPR40
- Extremely low noise, only 10 % additional to your scope noise
- Dynamic range: ± 850 mV
- High offset capability: ± 60 V
- Maximum non-destructive input voltage: ± 60 V DC or ± 5 V AC (peak) between center conductor and ground
- AC coupling with low-frequency cutoff at 10 Hz
- DC input resistance: 50 kOhm
- Extremely low zero and gain errors over temperature
- R&S ProbeMeter with dynamic range ± 60 V and measurement error < 0.1 %
- Rohde & Schwarz probe interface

2.2 Unpacking

The carrying case contains the following items:



- R&S RT-ZPR20/40 power-rail probe
- Accessory container
- Pigtail cables
- User manual
- R&S RT-ZPR20/40 data sheet
- Calibration certificate
- R&S RT-ZA25 power rail browser kit
- Documented calibration values (if ordered)

2.2.1 Inspecting the Contents

- Inspect the package for damage.
Keep the package and the cushioning material until the contents have been checked for completeness and the device has been tested.
If the packaging material shows any signs of stress, notify the carrier and your Rohde & Schwarz service center. Keep the package and cushioning material for inspection.
- Inspect the probe.
If there is any damage or defect, or if the R&S RT-ZPR20/40 power-rail probe does not operate properly, notify your Rohde & Schwarz service center.
- Inspect the accessories.
If the contents are incomplete or damaged, notify your Rohde & Schwarz service center.
Accessories supplied with the device are listed in [Chapter 2.3.2, "Supplied Accessories"](#), on page 10.

2.3 Description of the Probe

The probe consists of the active probe box with an Rohde & Schwarz probe interface to connect to the oscilloscope, and an SMA connector to connect to the DUT. Use the SMA interface to connect the supplied solder-in and extension cables or the power rail browser.

All available accessories are documented in the following chapters.

2.3.1 Probe Box

The probe box connects the probe to the oscilloscope via the Rohde & Schwarz probe interface. The Rohde & Schwarz probe interface contains a male precision 7 mm (276 mil) BNC connector and six pogo pin connectors. This interface provides the required supply voltage and is also used for simultaneously transmitting analog signals and digital data. All the analog voltages required by the probe are generated in the probe box. This approach ensures you can operate future probes on any base unit that features a Rohde & Schwarz probe interface. The probe box provides an SMA connector to screw on different accessories suitable for various measurement tasks.



- (1) Rohde & Schwarz probe interface with 7 mm (276 mil) coaxial connector and 6 pogo pins
- (2) Release knob
- (3) SMA connector

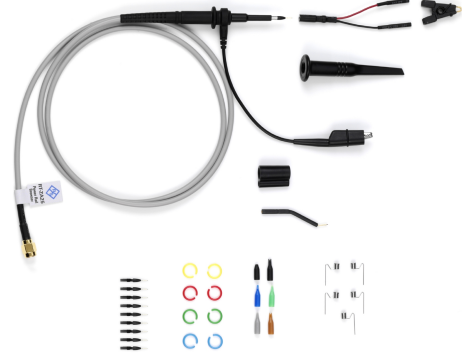


Connect the R&S RT-ZPR20/40 only to an instrument with Rohde & Schwarz probe interface. Never connect it to a usual BNC jack. Although the 7 mm coaxial connector looks like a standard BNC connector, it is constructed differently and does not fit to the standard BNC jack. The interface of the R&S RT-ZPR20/40 can withstand a higher frequency limit.

2.3.2 Supplied Accessories


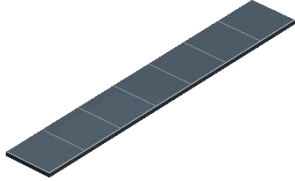
Before you can use the probe for measurements, connect one of the accessories to the SMA connector at the probe box.

Table 2-1 shows the accessories that are supplied with the R&S RT-ZPR20/40 power-rail probe.

Table 2-1: Supplied accessories

Item	Quantity	Description
	1	R&S RT-ZA25 power rail browser kit includes: <ul style="list-style-type: none"> • Power rail browser • Ground lead with alligator clip • Ground spring (5) • IC cap (5) • Tip insulating cap • Tip (5) • Spring tip (5) • Sprung hook • Micro SMD clip • Dual adapter • Flexible ground lead with adapter • Coding rings (8) • Short tube • Long tube
	3	R&S RT-ZA26 pigtail cable, 15 cm
	1	SMA extension cable, 1 m (R&S RT-ZPR20) SMA extension cable low loss, 1 m (R&S RT-ZPR40)

Description of the Probe


Item	Quantity	Description
	1	Solder wire, lead free, 5 m
	7	Adhesive pads

For a list of spare parts, see [Chapter 6.6, "Spare Parts"](#), on page 30.

2.3.3 Optional Accessories

If the delivered accessories do not meet individual customer requirements, Rohde & Schwarz offers different accessory sets for sale. The order numbers are provided in the data sheet.

Table 2-2: Optional accessories

Item	Description
	<p>R&S RT-ZA9 probe box to N / USB adapter</p> <p>The adapter connects the R&S RT-ZPR20/40 power-rail probe to any other oscilloscope or any other measurement instrument (e.g. a network or spectrum analyzer).</p> <p>Using the USB interface of the adapter, the probe can be powered and controlled from any conventional PC. Full software functionality is only provided by the supported base units (see data sheet).</p>

Description of the Probe

Item	Description
	<p>R&S RT-ZA10 SMA adapter SMA adapter with SMA (female) jack to BNC (male) plug.</p>
	<p>R&S RT-ZAP probe positioner Use the R&S RT-ZAP probe positioner to position and stabilize your probe.</p>
	<p>R&S RT-ZF20 power deskew fixture The R&S RT-ZF20 power deskew fixture is a tool to align the time delay (skew) of any combination of Rohde & Schwarz voltage and current probes. The fixture can be used with any oscilloscope.</p>

2.3.4 Service Accessories

To order accessories for servicing the probe, contact your Rohde & Schwarz service center. The following accessories are available:

Table 2-3: Service accessories

Item	Description
R&S RT-ZK1	The service kit is used to calibrate the probe, to do performance tests, and for servicing. The service kit includes all adapters and accessories to connect the probe to the required measuring instruments.
R&S RT-ZPR20/40 Service Manual	The service manual contains a detailed description of the performance test to verify the specifications, and other important service procedures.

3 Putting into Operation

The probe is designed for usage with oscilloscopes that have a Rohde & Schwarz probe interface. Supported Rohde & Schwarz oscilloscopes are listed in the probe's data sheet.

Read and observe [Chapter 1, "Safety Information"](#), on page 5.

During usage, the probe slightly heats up. Warming is normal behavior and not a sign of malfunction.

3.1 Connecting the Probe to the Oscilloscope

Connecting

1. If the extension cable is connected to the probe box, disconnect it.
To avoid damage to the device, connect the cable only to a grounded probe.
2. If your DUT is floating and not grounded, connect the DUT ground to the oscilloscope ground before connecting the probe to your DUT.
3. Connect the probe box (1) to the Rohde & Schwarz probe interface of the base unit (2).
The probe snaps in when connected properly to the port.
4. Connect the extension cable to the probe box.

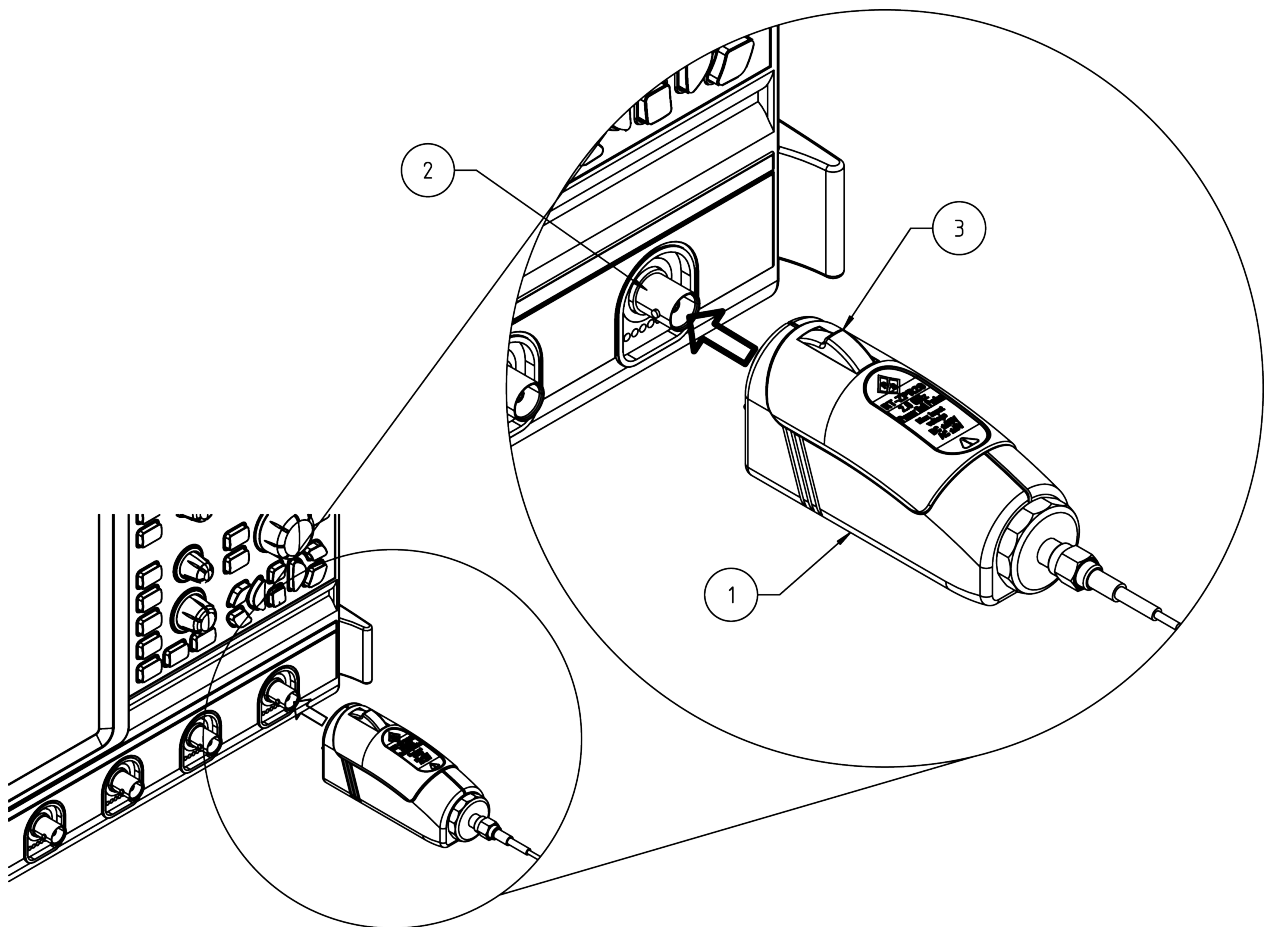


Figure 3-1: Connecting the probe to the Rohde & Schwarz oscilloscope

Disconnecting

1. Disconnect the accessories from the probe box before changing a probing point, or before disconnecting the probe box from the oscilloscope.
2. To disconnect the probe:
 - a) Press and hold the release button (3).
 - b) Pull the probe box away from the oscilloscope.

3.2 Identification of the Probe

When the probe is connected to the oscilloscope, the oscilloscope recognizes the probe and reads out the probe-specific parameters.

The oscilloscope settings for attenuation and offset are automatically adjusted. After the probe is connected to the oscilloscope and the settings are adjusted, the waveform is shown for the channel to which the probe is connected.

The complete probe information is shown in the probe settings dialog. For more information, refer to the user manual of your oscilloscope.

3.3 Offset Compensation and Dynamic Range

The dynamic range for the R&S RT-ZPR20/40 power rail probe determines the maximum voltage swing that may occur between the input terminal and ground.

The dynamic range of the R&S RT-ZPR20/40 is ± 0.850 V. If this range is exceeded, an unwanted signal clipping may occur.

The R&S RT-ZPR20/40 probe features a very comprehensive offset compensation function. The compensation of DC components directly inside the probe box even in front of the active probe amplifier is possible with an extremely wide compensation range of ± 60 V. This function is useful when measuring AC signals with a high superimposed DC component.

- ▶ Adjust the offset at the oscilloscope. You can use the vertical [Position] knob, or the offset setting in the channel or probe setup. For details, refer to the user manual of your oscilloscope.

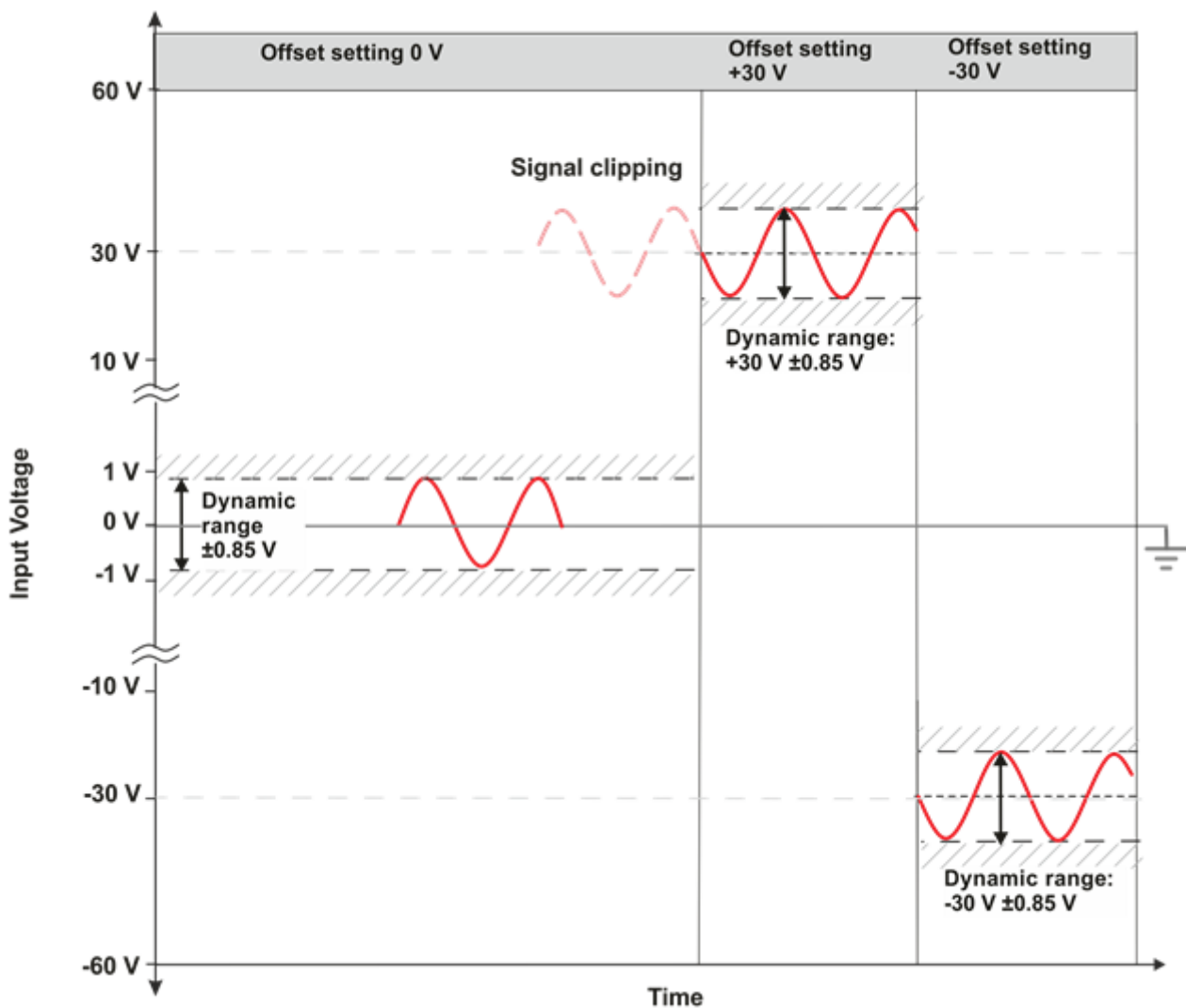


Figure 3-2: Offset compensation voltage and dynamic range

3.4 AC Coupling Mode

The R&S RT-ZPR20/40 power-rail probe features an internal AC coupling mode with a low frequency cutoff at 10 Hz to block DC components of the input signal. The AC coupling is set inside the probe, the full bandwidth of the probe remains.

"AC coupling" is part of the probe settings of the channel to which the probe is connected. For more details, see the oscilloscope's user manual.

3.5 R&S ProbeMeter

The R&S ProbeMeter is an integrated voltmeter that measures DC voltages with higher precision compared to the oscilloscope's DC accuracy. The DC measurement is performed continuously and in parallel to the time domain measurement of the oscilloscope.

High-precision measurements are achieved by immediate digitization of the measured DC voltage at the probe tip.

When the R&S ProbeMeter is active, the measured values are displayed on the oscilloscope. The R&S ProbeMeter state is part of the probe settings of the channel to which the probe is connected. For details, refer to the user manual of the Rohde & Schwarz oscilloscope.

Advantages of the R&S ProbeMeter:

- Measures DC voltages of different levels, no need to adjust the measurement range of the oscilloscope.
- True DC measurement (integration time > 100 ms), not mathematical average of displayed waveform.
- High measurement accuracy and low temperature sensitivity.
- Simple means of setting the oscilloscope's trigger level and vertical scaling if a waveform is not visible.
- Independent of oscilloscope settings for offset, position, vertical scale, horizontal scale, and trigger.
- Measurement range ± 60 V

4 Connecting the Probe to the DUT

This chapter describes how to connect the probe to the DUT using different accessories supplied for the R&S RT-ZPR20/40 probe. The various accessories are described and their use is explained.

The recommended configurations are designed for best probe performance in various probing situations. Thus, you can measure quickly and with confidence in the performance and signal fidelity. Use the recommended connection configurations for accurate oscilloscope measurements with known performance levels.

Using solder-in accessories

Some solder-in accessories are very fine and sensitive. Stabilize the probe using appropriate means (e.g. adhesive pads, probe positioner) in order to protect the solder joint from excessive mechanical stress.

Before soldering or unsoldering the pigtail cable, disconnect the pigtail cable from the probe box.

Observe operating temperature range

The R&S RT-ZPR20/40 probe box has a specified operating temperature range from 0 °C to 40 °C, whereas the pigtail and extension cables can withstand wider temperature ranges (see [Chapter 4.2, "R&S RT-ZA26 Pigtail Cable"](#), on page 21). Do not subject the probe box to temperatures outside of its operating range.

4.1 R&S RT-ZA25 Power Rail Browser Kit

The R&S RT-ZA25 power rail browser kit allows handheld probing with maximum convenience at the DUT and is sufficient up to 350 MHz bandwidth.

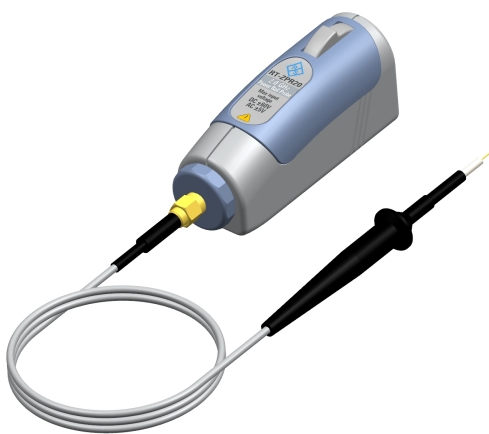
⚠ CAUTION**Risk of injuries**

Always observe the maximum rating of ± 60 V DC, 30 V AC (RMS), or ± 42 V AC (peak). The R&S RT-ZA25 is not equipped with a protective impedance and must not be used to measure higher voltages.

The included browser pins are exceptionally sharp and must be handled with extreme care. To prevent injuries, always use tweezers when inserting or removing pins.

To avoid damaging the browser parts, use them carefully:

- Do not apply a side load to the browser.
- Do not apply too much force when browsing. The weight of the probe in your hand is sufficient.
- Always remove the browser from the DUT before disconnecting the probe from the oscilloscope.

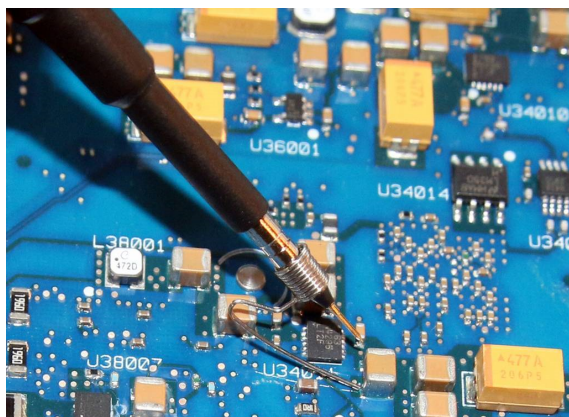


Connect the R&S RT-ZA25 power rail browser to the SMA interface of the R&S RT-ZPR20/40 probe box. You can use the browser in the same way as conventional passive probes.

Bandwidth: >350 MHz




Length: 1 m

Temperature range: 0 °C to +40 °C



For highest bandwidth and signal integrity, use the ground spring and spring loaded or rigid signal tips.

R&S RT-ZA26 Pigtail Cable



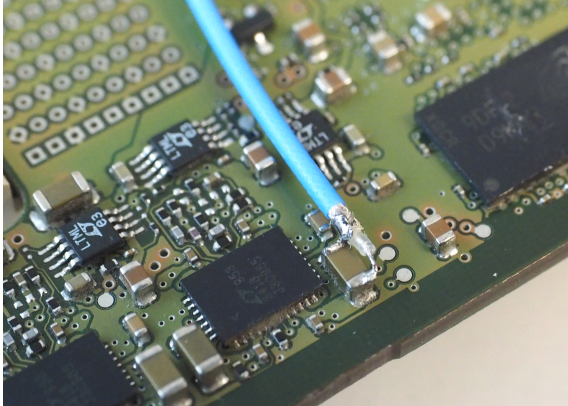
	<p>For convenient probing and medium bandwidth, use the flexible ground lead with adapter.</p>
	<p>Use the long-distance ground lead with alligator clip to contact far away ground points. Due to the larger loop inductance, bandwidth is decreased.</p>
	<p>Use the dual adapter to plug onto pin strips or to connect the micro SMD clip. Use the micro SMD clip to connect surface mount devices, e.g. 0805, 0402 capacitors.</p>

4.2 R&S RT-ZA26 Pigtail Cable

The R&S RT-ZA26 pigtail cable is a semi-permanent solder-in connection that supports the full bandwidth of the probe.

Before soldering or unsoldering the pigtail cable, always disconnect the cable from the probe box.

R&S RT-ZA26 Pigtail Cable

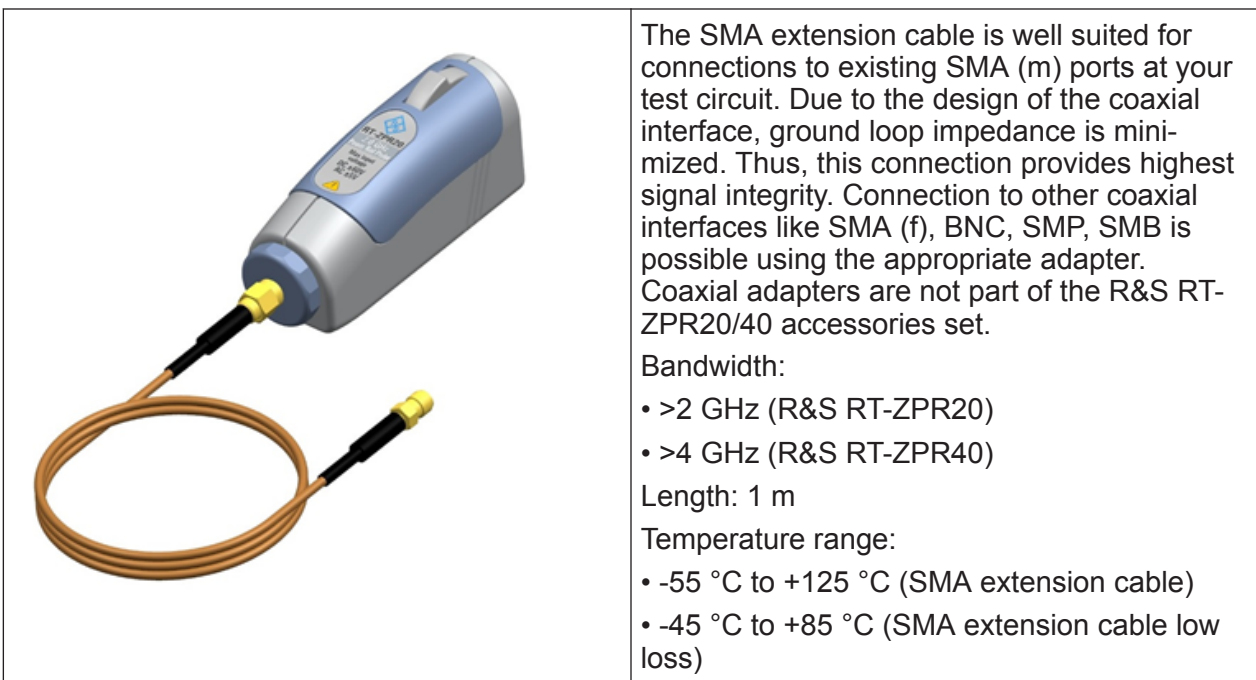
 A photograph of the R&S RT-ZA26 pigtail cable. It features a thin, flexible metal probe tip at one end, a black SMA extension cable in the middle, and a yellow SMA connector at the other end.	<p>The R&S RT-ZA26 pigtail cable is well suited for creating solid contact with test points that are hard to reach (e.g. IC pins, SMT parts).</p> <p>Bandwidth:</p> <ul style="list-style-type: none">• >2 GHz (R&S RT-ZPR20)• >3.5 GHz (R&S RT-ZPR40) <p>Length: 15 cm (1.15 m with SMA extension cable)</p> <p>Temperature range: -55 °C to +125 °C</p>
 A photograph showing the R&S RT-ZA26 pigtail cable connected to a blue probe box. The black SMA extension cable is plugged into the probe box, and the yellow SMA connector is plugged into the pigtail cable. A blue SMA extension cable is also visible, connected to the other end of the pigtail cable.	<p>Do not connect the R&S RT-ZA26 pigtail cable directly to the probe box.</p> <p>Connect the R&S RT-ZA26 pigtail cable to the SMA extension cable. Connect the other end of the SMA cable to the R&S RT-ZPR20/40 probe box.</p>
 A close-up photograph of the R&S RT-ZA26 pigtail cable's probe tip soldered to a green printed circuit board (PCB). The center conductor is soldered to a signal pad, and the outer shield is soldered to a ground pad.	<p>For measurements, solder the center conductor to the signal and the outer shield conductor to the ground.</p>

NOTICE**Risk of damaging the probe due to excess heat**

When using the R&S RT-ZA26 pigtail cable, do not expose the R&S RT-ZPR20/40 probe box to temperatures outside the valid range (see "[Observe operating temperature range](#)" on page 19). Excess heat can damage the probe.

4.3 SMA Extension Cable

The supplied SMA extension cable is a semi-permanent screw connection that supports the full bandwidth of the probe.



5 Measurement Principles

The R&S RT-ZPR20/40 power-rail probe provides an electrical connection between the DUT and the oscilloscope. The probe transfers the voltage of the electrical signal tapped off the DUT to the oscilloscope, where it is displayed graphically.

Although a probe has a wide variety of specifications, these specifications can be grouped into two classes of basic requirements:

- High signal integrity of the transferred signal: With an ideal probe, the output signal that is transferred to the base unit would be identical to the input signal between the probe tips. Furthermore, signal integrity would be extremely high. Every real probe, however, transfers the input signal in altered form. A good probe causes only minimum alterations. How the probe can fulfill this requirement is mainly determined by its bandwidth.
- Low loading of the input signal: Every probe is a load for the signal to be measured. This means that the signal to be measured changes as soon as the probe is connected. A good probe should cause only a minimum change to the signal, so that the function of the DUT is not adversely affected. How well the probe can fulfill this requirement is mainly determined by its input impedance.

The parameters of a probe are usually specified for a minimized connection between the probe and the DUT. With longer connections, the connection inductance has a significant effect on the measurement. The high-frequency behavior of the power rail probe is typically characterized with $0\ \Omega$ source impedance. [Figure 5-1](#) shows the R&S RT-ZPR20/40 power-rail probe that is connected to the DUT.

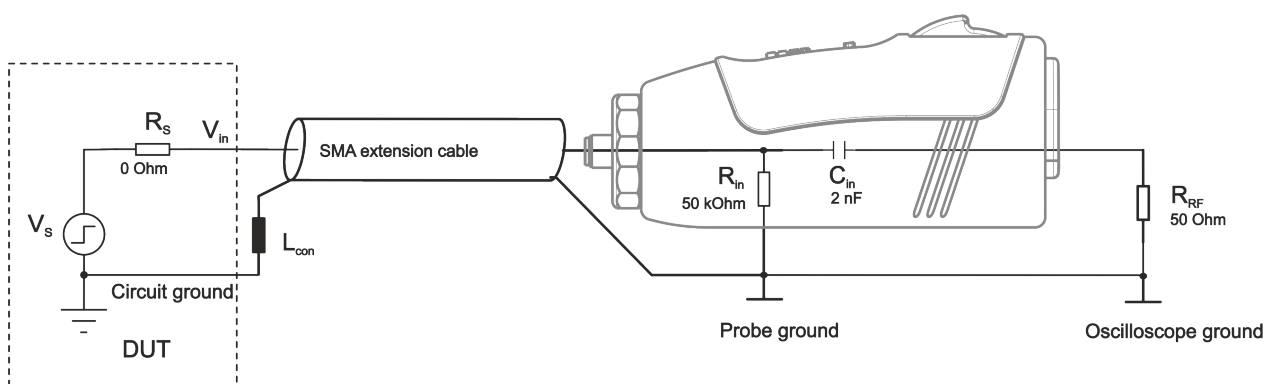


Figure 5-1: Equivalent circuit model of the R&S RT-ZPR20/40 probe

Abbreviation	Description
V_S	Voltage at the test point without probe connected
V_{in}	Voltage at the test point with probe connected, corresponds to the input voltage of the probe
R_S	Source impedance of the DUT
R_{in}	DC input resistance of the probe
R_{RF}	RF input resistance
C_{in}	Coupling capacitance
L_{con}	Parasitic inductance of the ground connection

5.1 Step Response

Figure 5-2 shows the step response of the R&S RT-ZPR20/40 with an ideal input step.

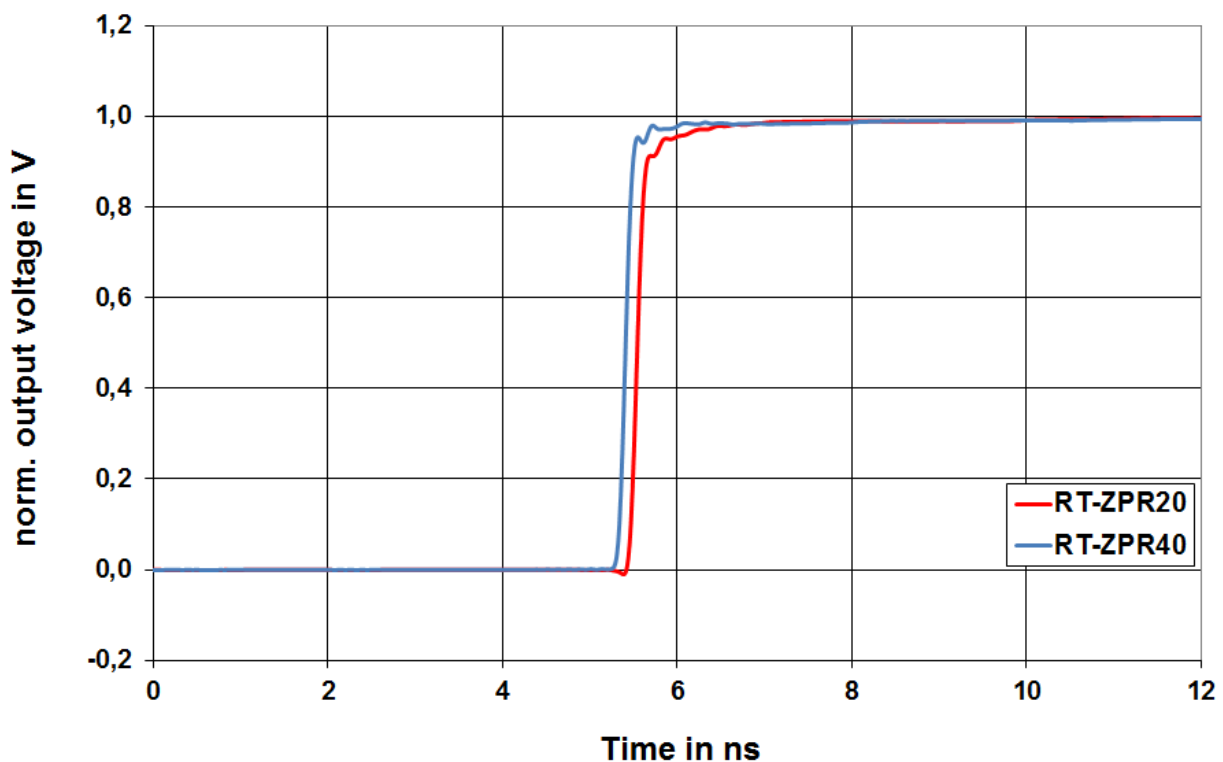


Figure 5-2: Example of the step response of the R&S RT-ZPR20/40 probe with the supplied SMA extension cable

5.2 Frequency Response

The R&S RT-ZPR20/40 probe is a dedicated power rail probe, designed for measurements at low impedance voltage sources such as DC power supplies with an output impedance $< 1 \text{ Ohm}$.

A DUT with an output impedance (R_S) higher than 1 Ohm leads to a mismatch between DC gain and AC gain. The mismatch causes a step at 1 MHz and thus non-flat frequency response.

In the time domain, a non-ideal frequency response occurs as a step which only gradually approaches the final DC value.

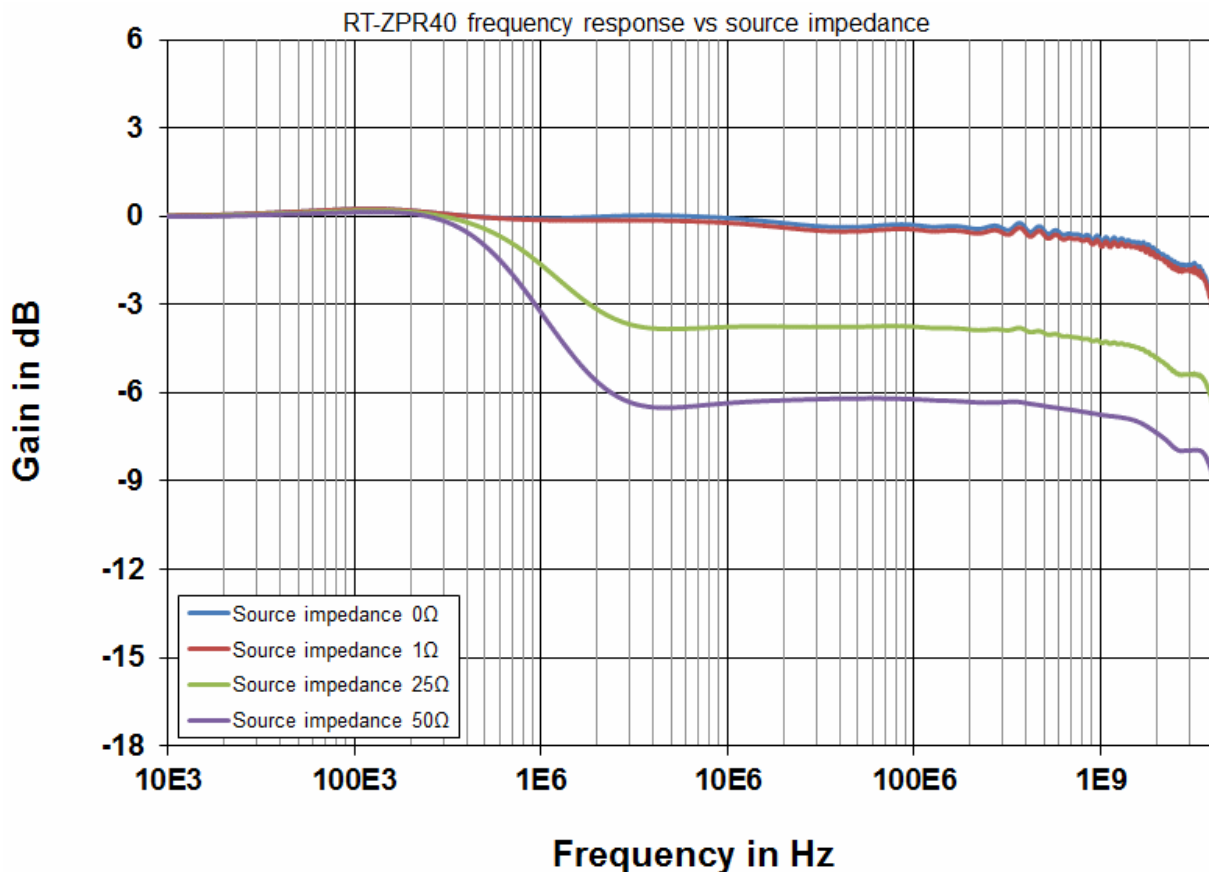


Figure 5-3: Example of the frequency response of the R&S RT-ZPR40 probe with SMA extension cable for different source impedances

5.3 Input Impedance

The input signal loading caused by the probe is determined by its input impedance Z_{in} . Figure 5-1 illustrates an equivalent circuit model. The resulting input impedance versus frequency is indicated in Figure 5-4.

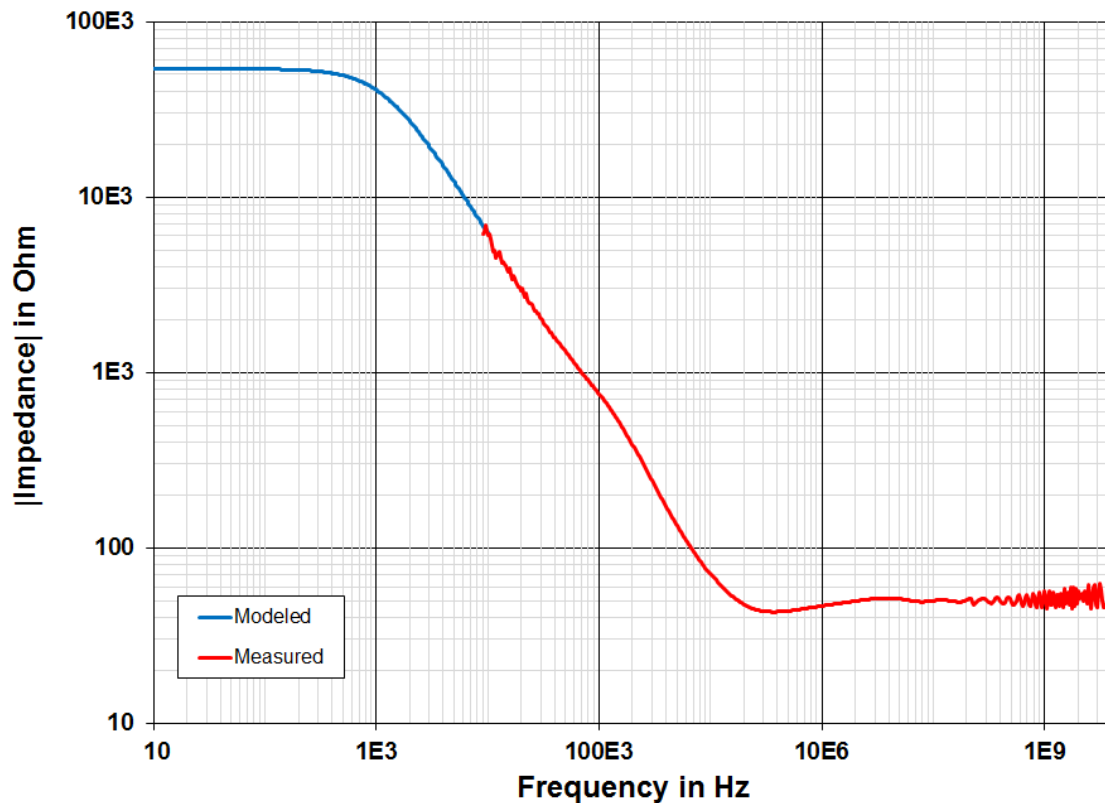


Figure 5-4: Example of the input impedance of the R&S RT-ZPR20/40 probe with SMA extension cable as a function of frequency

6 Maintenance and Service

Like all Rohde & Schwarz products, Rohde & Schwarz probes and adapters are of high quality and require only minimum service and repair. However, if service or calibration is needed, contact your Rohde & Schwarz service center. Return a defective product to the Rohde & Schwarz service center for diagnosis and exchange.

6.1 Cleaning

1. Clean the outside of the product using a soft cloth moistened with either distilled water or isopropyl alcohol. Keep in mind that the casing is not waterproof.
Note: Do not use cleaning agents. Solvents (thinners, acetone), acids and bases can damage the labeling or plastic parts.
2. Dry the product completely before using it.

6.2 Contacting Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will make sure that you get the right information.

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China

Phone +86-800-810-8228 / +86-400-650-5896

customersupport.china@rohde-schwarz.com

6.3 Returning for Servicing

Use the original packaging to return your R&S RT-ZPR20/40 to your Rohde & Schwarz service center. A list of all service centers is available on:

www.services.rohde-schwarz.com

If you cannot use the original packaging, consider the following:

1. Use a sufficiently sized box.
2. Protect the product from damage and moisture (e.g. with bubble wrap).
3. Use some kind of protective material (e.g. crumpled newspaper) to stabilize the product inside the box.

4. Seal the box with tape.
5. Address the package to your nearest Rohde & Schwarz service center.

6.4 Calibration Interval

The recommended calibration interval for R&S RT-ZPR20/40 power-rail probe is two years. For servicing, send the probe to your nearest Rohde & Schwarz service center (see [Chapter 6.3, "Returning for Servicing"](#), on page 29).

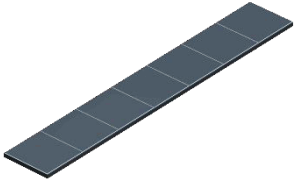

6.5 Discarding the Product




Handle and dispose the product in accordance with local regulations.

6.6 Spare Parts

The following accessories can be ordered at the Rohde & Schwarz service center. Use the order numbers provided in the following table.

Table 6-1: Accessories spare parts

Pos	Item	Description	Part Number
1		Adhesive pads	1800.4268.00
2		Solder wire, lead free, 5 m	1800.4097.00

Pos	Item	Description	Part Number
3		SMA extension cable, 1 m For R&S RT-ZPR20	1800.5241.00
4		SMA extension cable low loss, 1 m For R&S RT-ZPR40	1337.9081.00
Spare parts for the R&S RT-ZA25 power rail browser kit			
5		Ground lead with alligator clip	1800.5335.00
6		Dual adapter	1800.5341.00
7		Micro SMD clip	1800.5358.00
8		Flexible ground lead with adapter	1800.5364.00

The following accessories can be ordered from Rohde & Schwarz. The order numbers are listed in the data sheet.

- R&S RT-ZA25 power rail browser kit
- R&S RT-ZA26 pigtail cable, 15 cm

Table 6-2: Parts for ESD prevention

Pos.	Item	Material number
1	ESD wrist strap	0008.9959.00
2	ESD grounding cable	1043.4962.00