

R&S® RT-ZC20 Current Probe User Manual



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Version 03

ROHDE & SCHWARZ

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This manual describes the following R&S products:

- R&S®RT-ZC20, Current Probe (1409.7766.02)
- R&S®RT-ZA13, Probe Power Supply (1409.7789.02)

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1409.7814.02 | Version 03 | R&S®RT-ZC20

The following abbreviations are used in this manual: R&S®RT-ZC20 is abbreviated as R&S RT-ZC20, and R&S®RT-ZA13 is abbreviated as R&S RT-ZA13.

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1 Notes on Safety

Thank you for purchasing the R&S RT-ZC20 current probe.

To obtain maximum performance from the device, please read this manual first, and keep it handy for future reference.

⚠ WARNING**Risk of physical injury**

This device is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety before shipment. However, mishandling during use could result in injury or death, and damage to the device. Be certain that you understand the instructions and precautions in the manual before use.

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

⚠ DANGER**Risk of fatal injury**

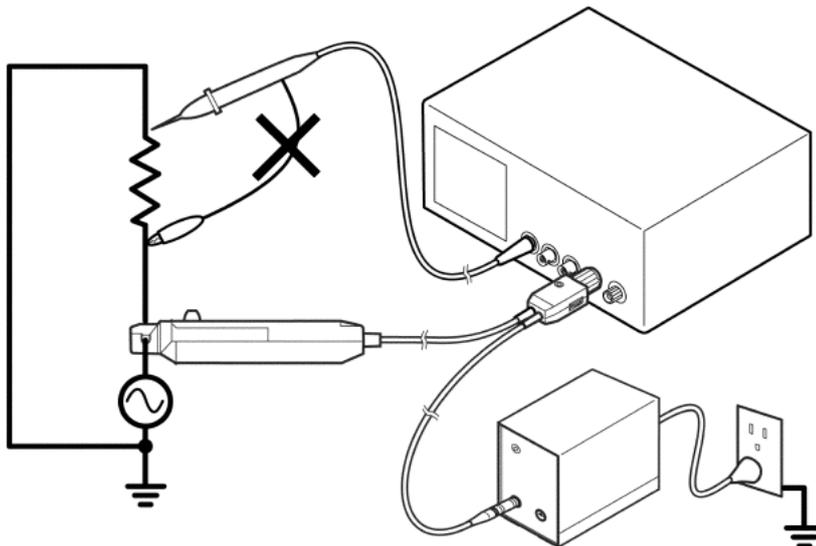
- To avoid electric shock and short circuits, never attach the clamp to bare, unisolated conductors.
Make sure to measure at a location on an insulated wire where the insulation is sufficient for the circuit voltage.



- Be careful to avoid damaging the insulation surface while taking measurements.
- Refer to the derating characteristics when measuring current that includes a high-frequency component and never measure any current that exceeds the rated current. Use with high frequencies or strong magnetic fields may cause the device to become abnormally hot, resulting in fire, equipment damage, or burns.
- To prevent fire or damage of the measurement target and device as well as burns, exercise caution concerning the following when measuring high-frequency currents or currents that contain high-frequency components:
 - Eddy current loss may cause heating of the sensor head.
 - Dielectric heating may cause heating of cord insulation and other materials.
- Be sure to observe all operating precautions for the oscilloscope and other instruments to which this device is connected.

⚠ DANGER**Risk of fatal injury**

- This device is made for use with the R&S RT-ZA13 probe power supply.
- When using a measurement instrument that does not provide isolation between its input terminals and chassis or other input terminals, please pay attention to the following points. If a signal is applied to an input terminal other than that to which this device is connected, do not connect the ground-side terminal to any nonground potential. Otherwise, short-circuit current flows through the R&S RT-ZA13 probe power supply, or this device from the ground terminal, which could cause an electrical accident or damage.

**⚠ WARNING****Shock hazard**

Do not allow the device to get wet, and do not take measurements with wet hands. This may cause an electric shock.

To avoid electric shock when measuring live lines, wear appropriate protective gear, such as insulated rubber gloves, boots, and a safety helmet.

NOTICE**Risk of instrument damage**

- To avoid damage to the device, protect it from vibration or shock during transport and handling, and be especially careful to avoid dropping.
- This device should be installed and operated indoors only, between 0°C and 40°C (32°F to 104°F) and 80% RH or less.
- Do not store or use the device where it could be exposed to direct sunlight, high temperature, humidity, or condensation. Under such conditions, the device may be damaged and insulation may deteriorate so that it no longer meets its specifications.
- Before using the device the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your dealer or R&S representative.
- This device is not designed to be entirely water- or dust-proof. To avoid damage, do not use it in a wet or dusty environment.
- The sensor head is a precision assembly including a molded component, a ferrite core, and a Hall effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock, and therefore great care should be exercised in handling it.
- Do not apply a static electricity or other source of high voltage to the sensor. Doing so may damage the internal Hall elements and circuitry of the sensor.
- The mating surfaces of the sensor head are precision, and should be treated with care. If these surfaces are scratched, performance may be impaired.
- Measurements are degraded by dirt on the mating surfaces of the sensor head, so keep the surfaces clean by gently wiping with a soft cloth.
- When the power is on, keep the core section of the sensor closed, except when clamping it onto the conductor to be measured. The mating surface of the core section can be scratched while it is open.
- Keep the clamp jaws and core slits free from foreign objects, which could interfere with clamping action.
- Keep the sensor head closed when not in use, to avoid accumulating dust or dirt on the mating core surfaces, which could interfere with clamp performance.

- To avoid damaging the sensor cable and power supply cable, do not bend or pull the cables.
 - Avoid stepping on or pinching the cable, which could damage the cable insulation.
 - Keep the cable well away from heat sources, as bare conductors could be exposed if the insulation melts.
-

**Strong electromagnetic fields**

Correct measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.

2 Product Description

2.1 Product Overview

The R&S RT-ZC20 is an AC/DC current probe. It allows the user to make current measurements from DC to 100 MHz. By clamping on the conductor to be measured, the current waveform is captured easily without interrupting the electric circuit.

2.2 Key Features

- Highly accurate current detection.
- Easy current measurement without interrupting the electric circuit.
- Broadband frequency characteristics DC to 100 MHz.
- Permits measurement of low current levels.
- Easy protection function to avoid self-heating during excessive input.
- Unique thin film Hall effect element.

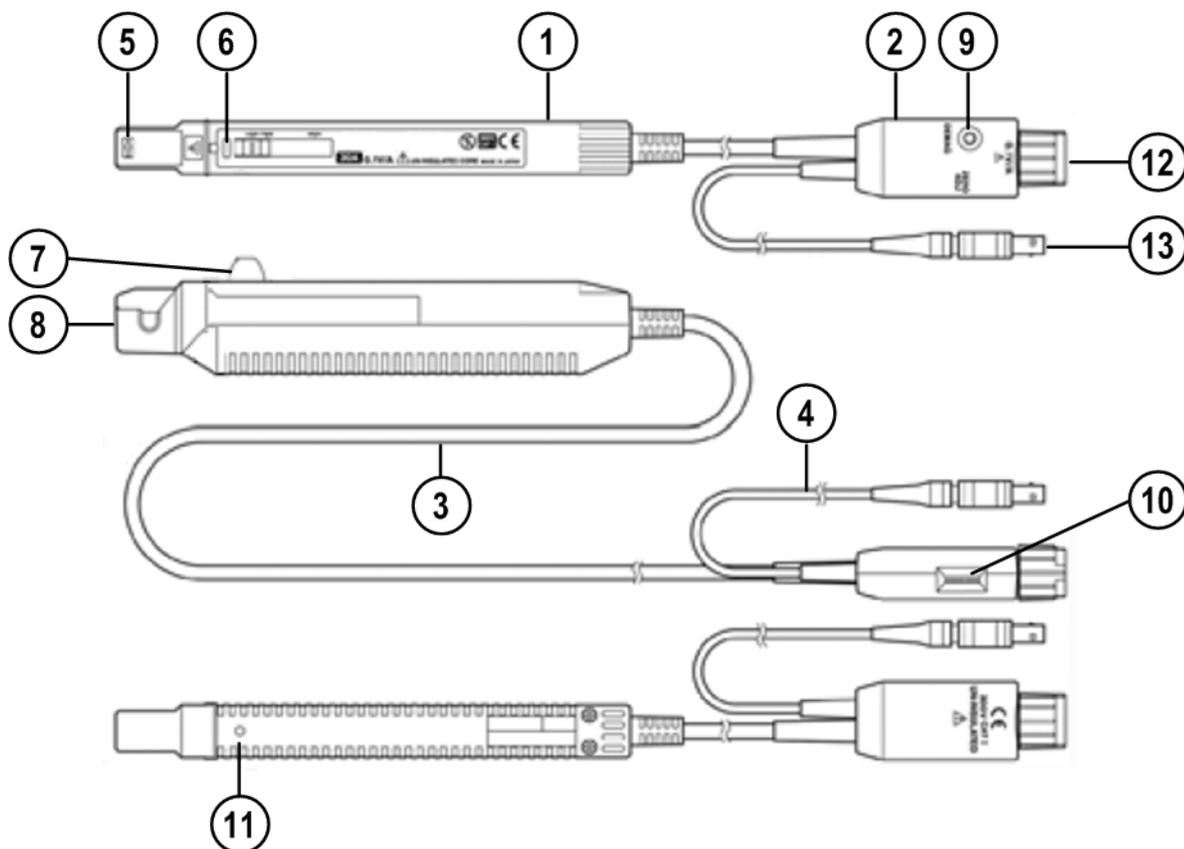
2.3 Inspecting the Contents

- 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-ZC20 current 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.

The following accessories are delivered with the probe:

- User manual
- Carrying case
- R&S RT-Zxx data sheet
- Calibration certificate
- Documentation of calibrated values

2.4 Description of the Probe



- 1 = Sensor
- 2 = Terminator
- 3 = Sensor cable
- 4 = Power supply cable
- 5 = Current direction indication
- 6 = UNLOCK indication
- 7 = Opening lever
- 8 = Sensor head
- 9 = Demagnetizing switch (DEMAG)

Description of the Probe

10 = Zero adjustment dial (ZERO ADJ)

11 = Coarse adjustment trimmer

12 = Output connector

13 = Power plug

Sensor head

The sensor head clamps on the conductor being measured, and carries out the actual current measurement. It is a precision assembly including a molded component, a ferrite core, and a Hall effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock, and therefore great care should be exercised in handling it.

Opening lever

Operating lever for opening the sensor head. Always use this lever to open the sensor head.

Demagnetizing switch (DEMAG)

This demagnetizes the core if it has been magnetized by switching the power on and off, or by an excessive input. Always carry out demagnetizing before measurement.

Zero adjustment dial (ZERO ADJ)

Use the zero adjustment dial to correct for the effect of a voltage offset or temperature drift.

When beginning measurement, after demagnetizing always carry out a zero adjustment.

Coarse adjustment trimmer

Use this only when adjustment is not possible within the range of the zero adjustment. Use a nonconductive screwdriver (e.g. ceramic driver) for adjustment.

Output connector

Connect to the BNC input connector of the waveform measuring instrument.

The current waveform of the measured conductor is output at a constant rate (0.1 V/A).

Power plug

Connect the plug to the R&S RT-ZA13 probe power supply receptacle to supply power to the sensor.

3 Putting into Operation

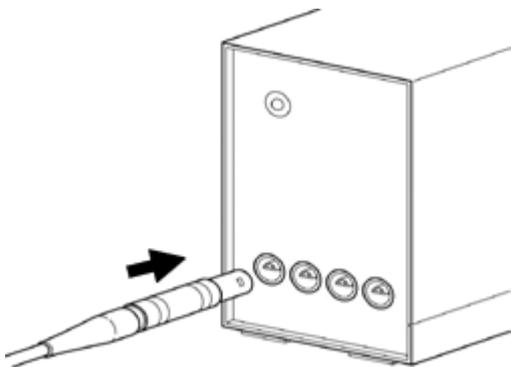
3.1 Preparing the Measurement

NOTICE

Voltage check

When using a different power supply than the R&S RT-ZA13 probe power supply, before turning on the power, make sure that the voltage of the used power supply matches the supply voltage indicated in the data sheet "R&S RT-Zxx high voltage and current probes".

-  The output of this device is terminated internally. Use a high impedance input of the measuring instrument. With an input impedance of 50 Ω , accurate measurement is not possible.
 - If using BNC-banana plug adapters or similar to connect to input terminals other than BNC connectors, make sure the polarity is correct.
 - Turn the collar until it clicks, and check that it is locked securely.
1. Have the R&S RT-ZA13 probe power supply, and an oscilloscope or waveform measuring instrument ready.
 2. Turn off the power switch. Connect the power cord.
 3. Connect the power plug of the R&S RT-ZC20 to the power receptacle of the R&S RT-ZA13 probe power supply.



Preparing the Measurement

4. Check that the conductor being measured is not clamped when supplying power to the R&S RT-ZC20. When power is turned on, a demagnetizing waveform is initially applied to the output. This is intentional in the design, and not a fault.
5. Turn on the power switch R&S RT-ZA13 probe power supply. Ensure that the front panel power indicator lights.
6. Connect the output connector of the R&S RT-ZC20 to one of the BNC input connectors of the oscilloscope. Turn the collar until it clicks, and check that it is locked securely.

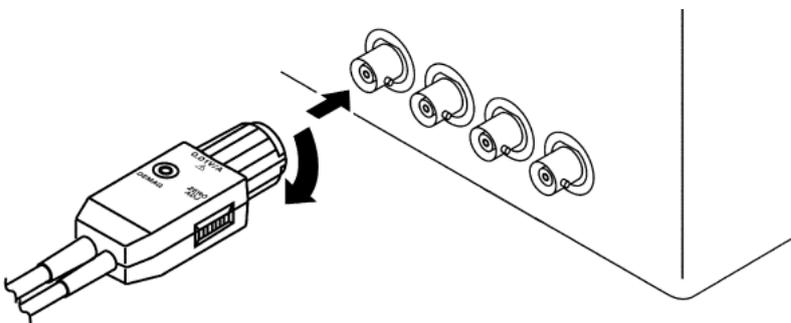


Figure 3-1: Oscilloscope inputs

The current waveform of the measured conductor is output at a constant rate (0.1 V/A).

7. Configure the probe connection at the oscilloscope. Make sure to set the following:
 - Vertical unit = Ampere
 - Coupling = DC
 - Termination = 1 M Ω
 - Manual Gain = 1 V/A

Alternatively, select "Predefined probe" = R&S RT-ZC20 if this selection is available on the instrument.

The procedure depends on the used instrument and is described in the oscilloscope's user manual. Supported oscilloscopes are listed in the R&S RT-Zxx data sheet.

8. When disconnecting the output connector, be sure to release the lock before pulling off the connector. Forcibly pulling the connector without releasing the lock, or pulling on the cable can damage the terminator.

3.2 Connecting the Probe to the Oscilloscope

- ▶ Connect the probe box (1) to the Rohde & Schwarz probe interface of the oscilloscope (2).

The probe snaps in when connected properly to the port.

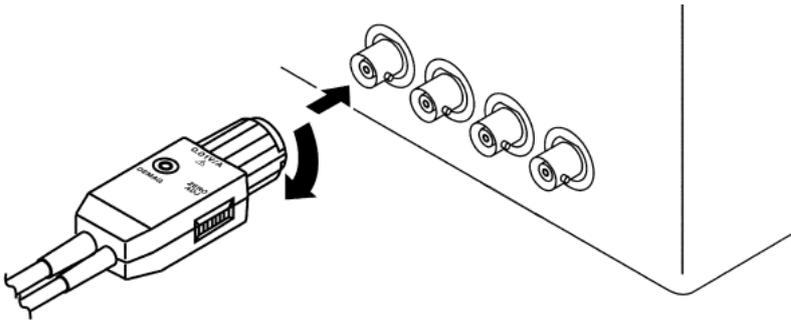


Figure 3-2: Connecting the probe to the Rohde & Schwarz oscilloscope

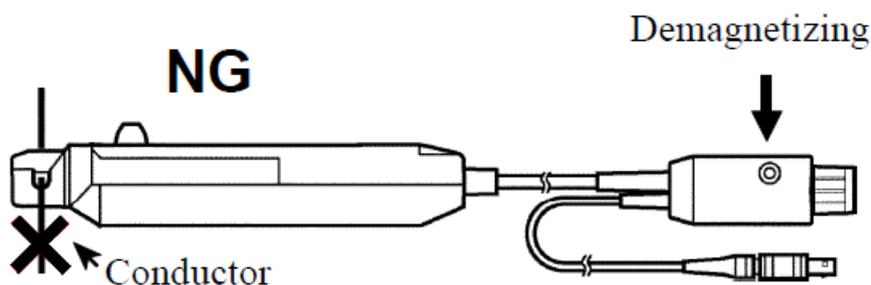
- ▶ To disconnect the probe:
 - a) Press and hold the release button (3).
 - b) Pull the probe box away from the oscilloscope.

3.3 Demagnetizing and Zero Adjustment

NOTICE

Risk of circuit damage

- Do not demagnetize while the R&S RT-ZC20 is clamping a conductor to be measured. Demagnetizing causes current to flow into the conductor, which may damage parts in the circuit to be measured.



- Check that the conductor being measured is not clamped when supplying power to the R&S RT-ZC20. When power is turned on, a demagnetizing waveform is initially applied to the output. This is intentional in the design, and not a fault.
-
1. With the waveform measuring instrument input at ground, adjust the waveform to the zero position.
 2. Connect the R&S RT-ZC20 current probe. Configure the oscilloscope as described in [Chapter 3.1, "Preparing the Measurement"](#), on page 13.
 3. Make sure that there is no conductor in the sensor aperture.
 4. Press the opening lever until the UNLOCK indication disappears. Ensure that the sensor head is properly closed.
 5. Press the demagnetizing switch (DEMAG) on the terminator.
The demagnetizing process takes about one second. During demagnetizing, a demagnetizing waveform is shown on the oscilloscope. The positive and negative components of this waveform may be asymmetrical.
 6. Turn the zero adjustment dial on the terminator to adjust the trace to the zero position.

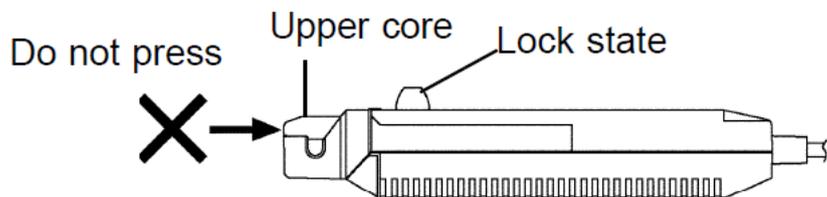
Connecting the Probe to the DUT

- If zero adjustment is not possible, turn the coarse adjustment trimmer to bring the trace within the range of adjustment by the zero adjustment dial, see [Chapter 2.4, "Description of the Probe"](#), on page 11.

Note: Use the trimmer carefully to prevent damaging it. Use a flathead screwdriver that is made of non-conductive material like ceramics. Recommended tip shape: thickness 4 mm, width 1.8 mm, length 10 mm or longer.

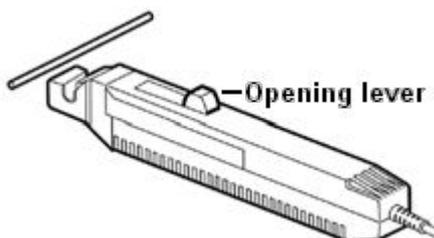
NOTICE**Risk of instrument damage**

When opening the sensor head of the probe, be sure to operate with the opening lever. If an upper core is forced to open when the sensor head is locked, the open-close mechanism can be damaged.



3.4 Connecting the Probe to the DUT

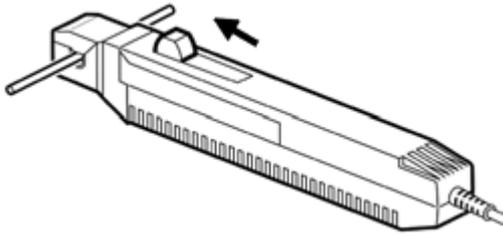
- Check that the system is safe, and that the preparations described in the preceding sections have been carried out.
- Pull the sensor slider, so that the clamp opens.



- Align the sensor so that the current direction indication matches the direction of current flow through the conductor that you measure. The conductor should be in the center of the clamp aperture because the measurement may be affected by the position within the clamp aperture of the conductor being measured.

Connecting the Probe to the DUT

- Press the opening lever until the UNLOCK indication disappears. Make sure that the sensor head is properly closed.



If the sensor head is not properly closed, accurate measurement is not possible.

- i** The current consumption of clamp-on probes depends on the current to be measured. Confirm that the total current consumption of the probes does not exceed the rated output current of the R&S RT-ZA13 probe power supply.

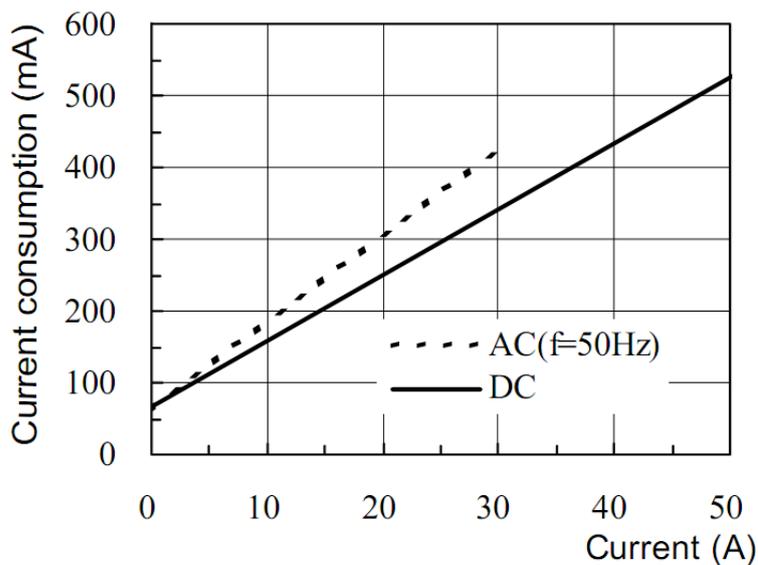


Figure 3-3: Current consumption* vs. current to be measured (typical)

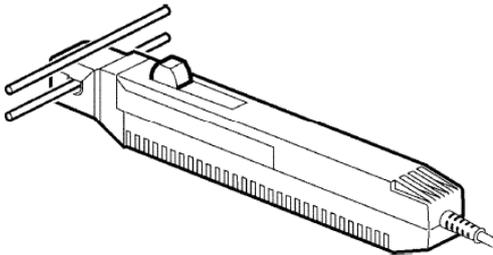
*The sum total of positive and negative current consumption.

NOTICE**Risk of instrument damage due to continuous input current**

- The maximum continuous input range is based on heat that is internally generated during measurement. Always keep the input current below this level. Exceeding the rated level may result in damage to the probe.
 - The maximum continuous input range varies according to the frequency of the current being measured. Refer to the data sheet "R&S RT-Zxx high voltage and current probes".
 - The device may sustain damage from self-heating even at current levels that are lower than the maximum rated current. The maximum rated current is a recommended value that assumes sine-wave input under standard conditions. Self-heating may happen if the ambient temperature increases or the measurement current waveform contains other frequency components.
 - If the input current exceeds a certain level, generated heat activates a built-in safety function that blocks normal output. If this happens, remove the input immediately (remove the sensor from the conductor being measured, or reduce the input current to zero). Wait until the sensor has had sufficient time to cool before resuming operation.
 - Even if the input current does not exceed the rated continuous maximum current, continuous input for an extended period of time may result in activation of the safety circuit to prevent damage resulting from heating of the sensor.
-

NOTICE**Risk of instrument damage due to continuous input current**

- At high ambient temperatures, the built-in safety circuit may activate at current input levels below the rated continuous maximum current.
- Continuous input of current exceeding the rated maximum or repeated activation of the safety function may result in damage to the device.
- Current measurement exceeding approx. 1 kHz may result in temperature rise on the sensor-head. This is attributed to excitation loss that cannot be prevented due to natural physical principles. Be careful to avoid injury, electric shock due to short-circuits, or damage to the device that may be caused by the increased temperature.
- Do not place any unclamped conductor with an electric current of a frequency of 10 kHz or more near the sensor head. Current flowing in the conductor nearby may heat up the sensor head and cause its temperature to rise, leading to damage to the sensor. For example, when one side of a go-and-return conductor is clamped and the other side is also placed near the sensor head as shown in the diagram, even if the electric current is lower than the consecutive maximum current, electric currents in both sides will heat up the sensor and raise the temperature, thereby causing damage to the sensor.



Connecting the Probe to the DUT



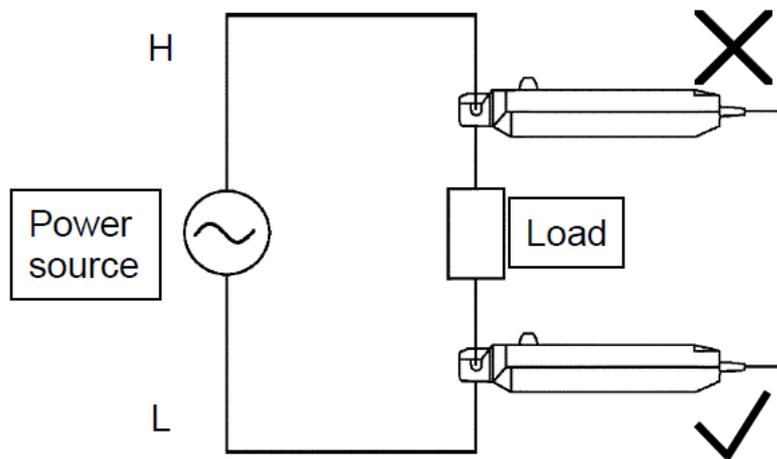
- Immediately after powering on, this device may be subject to an appreciable offset drift due to the effect of self-heating. To counteract this, allow the device to warm up for about 30 minutes before carrying out measurements.
- When performing continuous measurements, it is necessary to be aware that the offset voltage drifts, depending on factors such as the ambient temperature.
- Under certain circumstances, oscillation may occur while the power supply is on. This does not indicate a malfunction. Oscillation can be stopped and operation restored to normal by opening and closing the sensor head.
- Depending on the amplitude and frequency of the current being measured, the sensor head may emit a resonant sound. This sound may also occur during demagnetizing operation, but it does not represent a malfunction or device failure.

If foreign matter is adhered to the facing surfaces on the sensor head so that a slight gap exists between the upper and lower sensors, the sensor head may also emit a resonant sound. Remove any foreign matter using the cleaning method described in this manual.

An increase in the volume of the resonant sound during use may indicate that the gap between the upper and lower sensors has increased. Since the sensor characteristics may change, it is recommended to calibrate the device.

Connecting the Probe to the DUT

- i** At high frequencies, common mode noise may affect measurements taken on the high voltage side of circuits. If this occurs, reduce the frequency range of the waveform measuring instrument, or clamp onto the low-voltage side of the circuit, as appropriate.



4 Maintenance and Service

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.

4.1 Cleaning

1. Discharge any static electricity at your hands before cleaning the facing surfaces of the sensor head.

Thus, you ensure that no high voltage caused by static electricity is applied to the product. Application of a high voltage can damage the internal Hall elements or circuitry. You can attract static electricity to your hands by touching a nearby metal object.

2. 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.
3. Dry the product completely before using it.

4.2 Contacting Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:



Figure 4-1: QR code to the Rohde & Schwarz support page

4.3 Returning for Servicing

Use the original packaging to return your R&S RT-ZC20 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.

4.4 Calibration Interval

The recommended calibration interval for R&S RT-ZC20 current probe is one year. For servicing, send the probe to your nearest Rohde & Schwarz service center (see [Chapter 4.3, "Returning for Servicing"](#), on page 24).

4.5 Discarding the Product

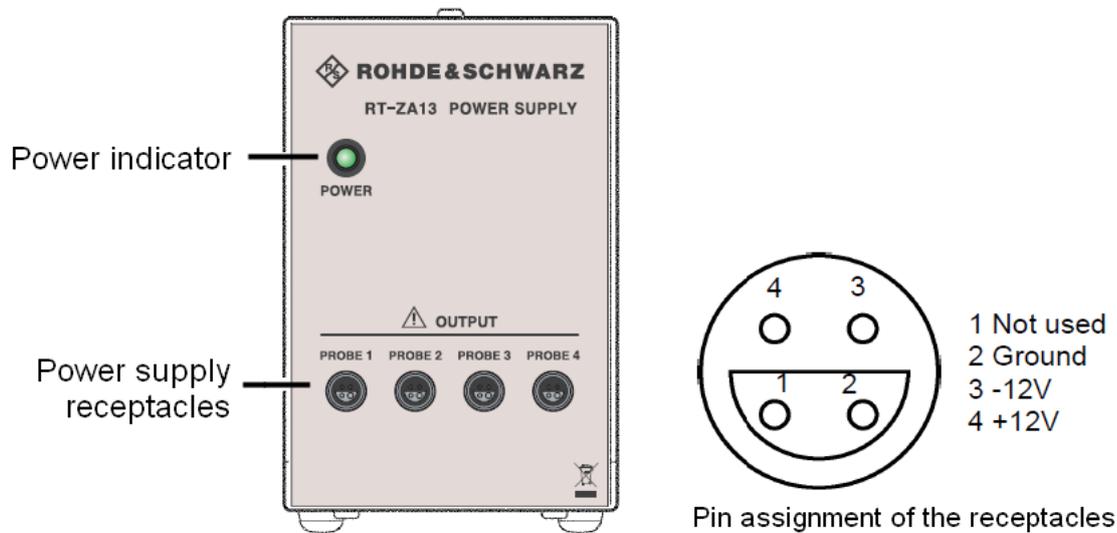
Handle and dispose the product in accordance with local regulations.

5 R&S RT-ZA13 Probe Power Supply

This unit is a special-purpose power supply for the current probes.

You can connect up to four current probes to the power supply.

Front view



Rear view

