

R&S®EZ-17

RF current probe

User Manual



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Version 01

ROHDE & SCHWARZ

Make ideas real



This document describes the following R&S®EZ-17 models:

- **Model 02:** RF current probe 20 Hz to 100 MHz (245 MHz) (0816.2063.02)
- **Model 03:** RF current injection probe 20 Hz to 100 MHz (245 MHz) (0816.2063.03)

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Muehldorfstr. 15, 81671 Muenchen, Germany

Phone: +49 89 41 29 - 0

Email: info@rohde-schwarz.com

Internet: www.rohde-schwarz.com

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Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol, e.g. R&S®EZ-17 is indicated as R&S EZ-17.

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1 Safety and regulatory information

The product documentation helps you to use the product safely and efficiently. Follow the instructions provided here and in [Chapter 1.1, "Safety instructions"](#), on page 5.

Intended use

The product is intended for the development, production and verification of electronic components and devices in industrial, administrative, and laboratory environments. Use the product 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 of potential dangers and gives instructions on how to prevent personal injury or damage caused by dangerous situations. Safety information is provided as follows:

- In [Chapter 1.1, "Safety instructions"](#), on page 5. The same information is provided in many languages as printed "Safety Instructions". The printed "Safety Instructions" are delivered with the product.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

1.1 Safety instructions

Products from the Rohde & Schwarz group of companies are manufactured according to the highest technical standards. To use the products safely, follow the instructions provided here and in the product documentation. Keep the product documentation nearby and offer it to other users.

Use the product only for its intended use and within its performance limits. Intended use and limits are described in the product documentation such as the data sheet, manuals and the printed "Safety Instructions". If you are unsure about the appropriate use, contact Rohde & Schwarz customer service.

Using the product requires specialists or specially trained personnel. These users also need sound knowledge of at least one of the languages in which the user interfaces and the product documentation are available.

Safety instructions

Reconfigure or adjust the product only as described in the product documentation or the data sheet. Any other modifications can affect safety and are not permitted.

Never open the casing of the product. Only service personnel authorized by Rohde & Schwarz are allowed to repair the product. If any part of the product is damaged or broken, stop using the product. Contact Rohde & Schwarz customer service at <https://www.rohde-schwarz.com/support>.

Choosing the operating site

Only use the product indoors. The product casing is not waterproof. Water that enters can electrically connect the casing with live parts, which can lead to electric shock, serious personal injury or death if you touch the casing. If Rohde & Schwarz provides accessories designed for your product, e.g. a carrying bag, you can use the product outdoors.

Unless otherwise specified, you can operate the product up to an altitude of 2000 m above sea level. The product is suitable for pollution degree 2 environments where nonconductive contamination can occur. For more information on environmental conditions such as ambient temperature and humidity, see the data sheet.

Working with current probes

Only connect, set up and use current probes if you are an electrically skilled person. Electrically skilled persons have the relevant education and experience to enable them to perceive risks and to avoid hazards that electricity can cause. Direct contact with high currents can cause serious injuries.

Before applying the current probe, always switch off the test circuit and take the following measures for your safety.

Only use the current probe on insulated conductors.

- Make sure that the insulation of the conductor is sufficient for the voltage that must be insulated.
- Make sure that the insulation of the conductor meets the requirements of current standards (IEC 60664-1:2020 or a similar standard that complies with your local rules and regulations).
- Using the current probe on uninsulated conductors that belong to measurement category II, III or IV can cause serious injury.

Labels on the product

Use the current probe only in environments that contain sufficiently insulated conductors.

- Make sure that there are no devices with hazardous voltages nearby.
- Only connect the current probe to devices that cannot imprint hazardous voltages on the probe. Voltages higher than 30 V RMS, or 42 V peak, or 60 V DC are regarded as hazardous contact voltages.



Observe all voltage and current ratings of the instrument, the probes, and the accessories. Exceeding the allowed limits can lead to an electric shock. Limits and ratings are marked on the products and listed in the data sheets.

In addition, use the current probe only within the specified frequency limits as stated in the data sheet. Using the probe above those limits can cause high temperatures which in turn can cause burns or start a fire.

Cleaning the product

Use a dry, lint-free cloth to clean the product. When cleaning, keep in mind that the casing is not waterproof. Do not use liquid cleaning agents.

Meaning of safety labels

	<p>Potential hazard Read the product documentation to avoid personal injury or product damage.</p>
	<p>Hazardous contact voltages Do not use the current probe at uninsulated live lines. Make sure to measure at sufficiently insulated conductors. This measure protects you against electric shock, electric burn, or arc flash.</p>


1.2 Labels on the product

Labels on the casing inform about:

- Personal safety, see "[Meaning of safety labels](#)" on page 7
- Product and environment safety, see [Table 1-1](#)
- Identification of the product is indicated on a sticker on the current probe. The identifier consists of the order number and serial number (for example: 0816.2063.02-123456).

Warning messages in the documentation

Table 1-1: Labels regarding product and environment safety

	Labeling in line with EN 50419 for disposal of electrical and electronic equipment after the product has come to the end of its service life. For more information, see " Disposing of electrical and electronic equipment " on page 19.
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1.3 Warning messages in the documentation

A warning message points out a risk or danger that you need to be aware of. The signal word indicates the severity of the safety hazard and how likely it will occur if you do not follow the safety precautions.

DANGER

Imminently hazardous situation. Will result in death or serious injury if not avoided.

2 Documentation overview

This section provides an overview of the R&S EZ-17 user documentation.

The documents are available on our website at <https://www.rohde-schwarz.com>.

Safety instructions

Contains information about using the current probe safely. A printed version of the safety instructions in various languages is part of the delivery.

User manual

Contains information about operating the current probe and the measurements you can perform with the current probe. The user manual also provides information on maintaining the probes.

A printed version of the user manual is part of the delivery. It is also available to download from the internet.

Product brochure

Contains an overview of the features of the current probe. The brochure also contains technical specifications.

The product brochure is available to download from the internet.

3 Welcome to the R&S EZ-17

The R&S EZ-17 is a current probe that allows measurements of the RF current in a conductor. During the measurement, the jaws of the probe are clamped around the conductor. The current probe measures a voltage proportional to the primary current at its RF output of the current probe. A measuring instrument connected to the probe displays the results of the measurement.

In addition to measuring the RF current, model 03 of the probe also allows you to inject interference currents on the conductor. Refer to the datasheet for information about maximum current and power consumption.

The two variants of the R&S EZ-17 are suitable for the following applications in the frequency range from 20 Hz to 100 MHz (245 MHz).

- **Model .02** (complies with the norm CISPR 16-1-2)
With its flat frequency response above 1 MHz and an internal resistance of 50 Ω , model .02 is ideal for the following applications.
 - Measuring electromagnetic emissions according to CISPR14-1, CISPR25, CISPR32, MIL-STD-461.
 - Measuring the shielding effectiveness of RF cables.
- **Model .03**
With its small transducer factor in the frequency range from 1 MHz to 200 MHz and its high load capacity, model .03 is ideal for the following applications.
 - Measuring electromagnetic emissions with high sensitivity requirements (for example VG 95373-20 and RTCA/DO-160).
 - Measuring electromagnetic susceptibility (EMS) (bulk current injection tests).

4 Preparing for use

Here, you can find basic information about setting up the product for the first time.

4.1 Unpacking and checking

1. Unpack the product carefully.
2. Retain the original packing material. Use it when transporting or shipping the product later.
3. Using the delivery notes, check the equipment for completeness.
4. Check the equipment for damage.

If the delivery is incomplete or equipment is damaged, contact Rohde & Schwarz.

4.2 Choosing the operating site

Specific operating conditions ensure proper operation and avoid damage to the product and connected devices. For information on environmental conditions such as ambient temperature and humidity, see the data sheet.

See also "[Choosing the operating site](#)" on page 6.

4.3 Considerations for test setup

Permissible current loading

Currents beyond the limits stated in the datasheet impair the result due to saturation of the ferrite core.

When measuring bunched wires, make sure that the vector sum of the currents does not exceed the aforementioned limits.

Considerations for test setup

The permanent permissible current loading is limited for model 02 by the loading of the internal terminations, for model 03 by the thermal loading capacity of the ferrite core.

5 Operating the current probe

The RF current probe is designed as a clamp whose jaws surround the conductor through which the current flows or is to be applied to. The metal frame of the current probe contains two halves of a ferrit core and forms a static shielding.

1. **DANGER!** Risk of physical injury. Follow the measures described in "[Working with current probes](#)" on page 6 before using the current probe to avoid physical injuries like electric shock, burns or injuries resulting from an arc flash.
Turn off the test circuit.
2. Connect the probe to the measuring instrument, for example an EMI receiver.

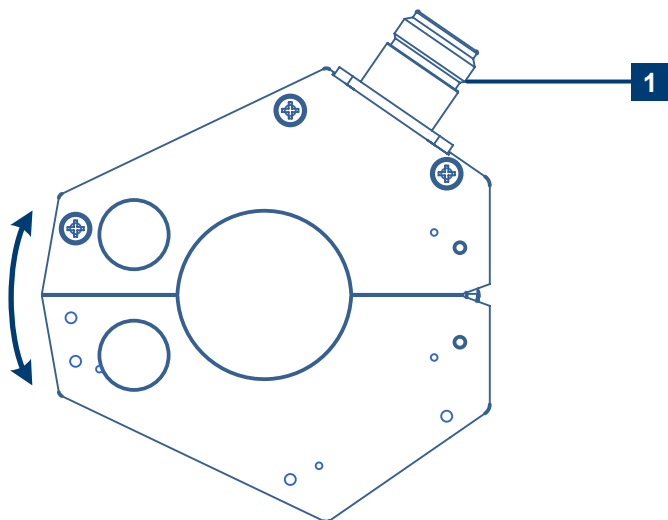


Figure 5-1: Closed current probe without conductor and cable

- 1 = RF connector (output)
- 2 = Jaws
- 3 = Opening / closing mechanism

An appropriate cable is part of the delivery.

- For the cable that is part of the delivery, the frequency-dependent cable loss is already considered while determining the calibration data.
 - For other cables, shield the cable adequately and correct the measurement results for the additional loss. Cables must have an impedance of $Z = 50 \Omega$.
- a) Connect one end of the cable to the RF output of the current probe (N-connector).
 - b) Connect the other end of the cable to the RF input of the measuring instrument (N-connector).

3. Open the jaws of the current probe.

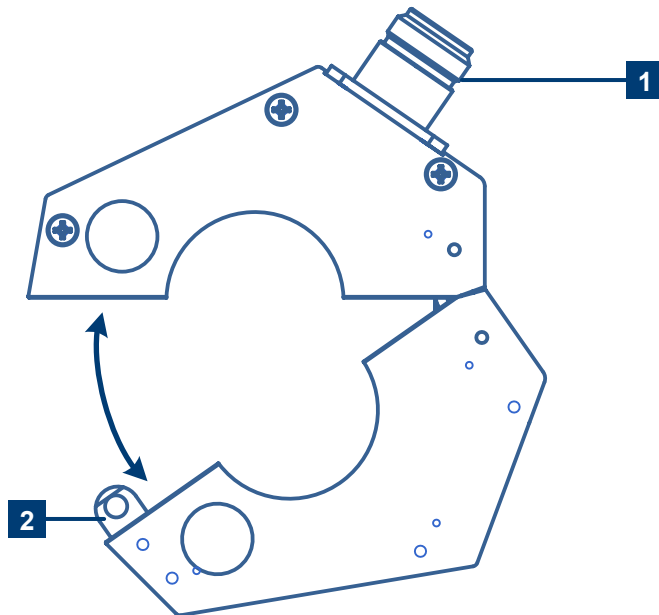


Figure 5-2: Opened current probe with cable

1 = RF connector (output)
2 = Spring catch

4. Place the conductor between the two halves of the current probe.
The outer diameter of the conductor (single-wire or multi-wire cables, bunched wires, coaxial cables) must be less than 30 mm.

Tip: Quality of measurement results. Avoid any contamination that can produce an additional air gap between the two halves and thus invalidate the measurement result.

5. Close the jaws of the RF current probe.
A spring catch holds the two halves of the current probes together and closes its magnetic circuit.

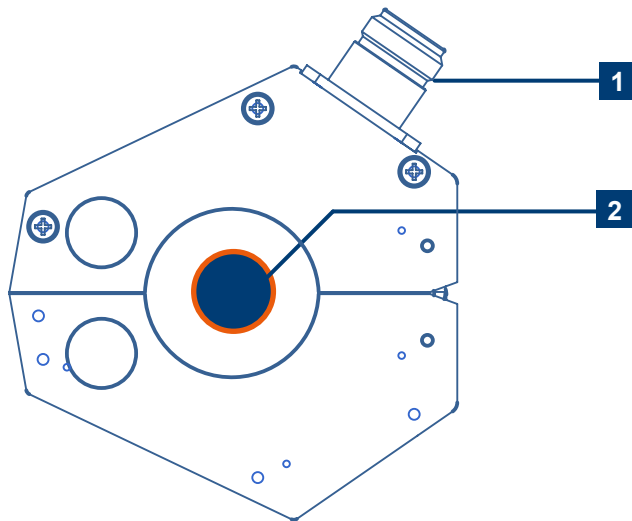


Figure 5-3: Closed current probe with conductor and cable

1 = RF connector (output)

2 = Conductor caught between the jaws

6. Turn on the test circuit.

When you are done with the measurement and disassemble the test setup, follow the steps above in reverse order.

6 Measurements

You can use the R&S EZ-17 for RF current measurements. R&S EZ-17 model .03 also supports electromagnetic susceptibility (EMS) measurements.

6.1 RF current measurement

The current probe works like a transformer.

- The DUT surrounded by the current probe forms the primary winding.
- The two jaws of the current clamp forms the secondary winding.

See [Figure 6-1](#) for an overview.

When closed, a spring catch holds the two jaws of the probe together, providing a defined air gap for a definitely closed magnetic circuit.

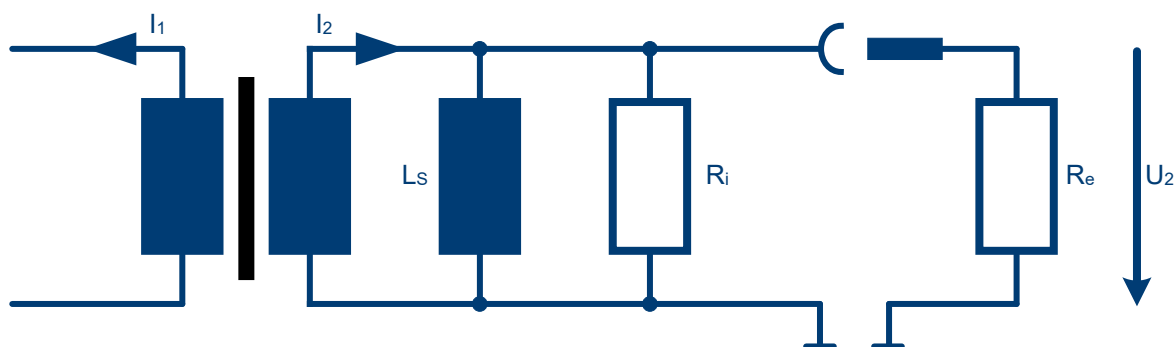


Figure 6-1: Equivalent circuit diagram

To get an even frequency response, the inductive resistance ωL_S of the secondary winding in [Figure 6-1](#) is higher than the receiver input impedance R_e .

For frequencies lower than 1 MHz, the voltage response decreases by 20 dB per frequency decade.

For frequencies higher than 100 MHz voltage response is influenced by an intrinsic resonance of the R&S EZ-17.

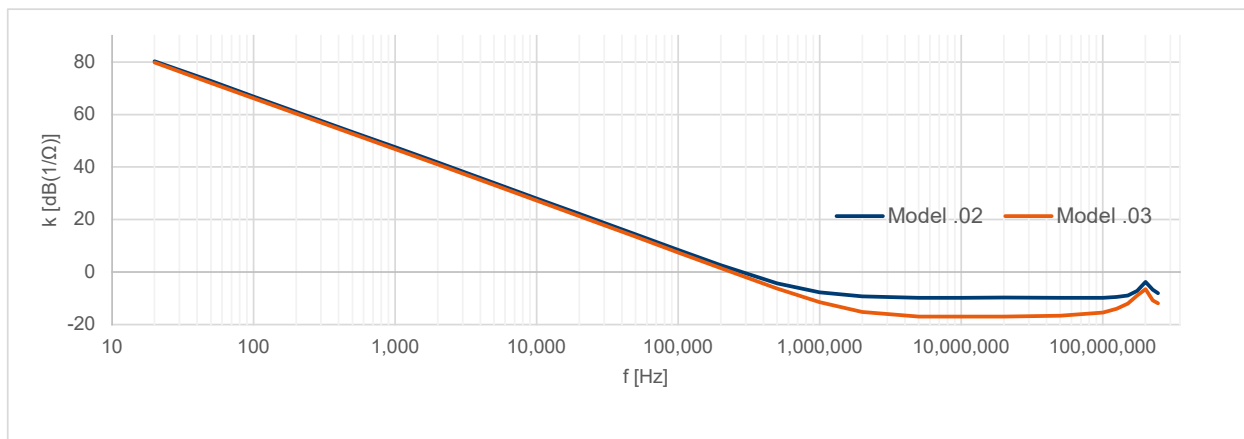


Figure 6-2: Transducer factor k for model 02 and model 03 in the frequency range 20 Hz to 245 MHz

The relation between the current measured in the conductor I_1 and the voltage reading U_1 is given by the transfer admittance.

$$Y_{\ddot{u}} = \frac{I_1}{U_2}$$

Equation 6-1: Calculation of transfer admittance

$$k = 20 \lg \frac{Y_{\ddot{u}}}{1 \text{ S}}$$

Equation 6-2: Calculation of transducer factor

Dimensioning the electrical components correspondingly results in the following transducer factor in the range of the plane frequency response (see [Figure 6-2](#)):

- $k = -10$ dB for model 02
- $k = -17$ dB for model 03

At lower frequencies the transducer factor increases by 20 dB / decade.

An individual transducer factor is part of the standard delivery.

We recommend storing the transducer factor in the measuring receiver connected to the R&S EZ-17. The receiver then automatically provides the corrected result with the correct unit (dB μ A).

To obtain the current level in dB(μ A), it is necessary to add the transducer factor to the voltage level in dB(μ V):

$$I [\text{dB}(\mu\text{A})] = U [\text{dB}(\mu\text{V})] + k [\text{dB}(\frac{\text{V}}{\text{A}})]$$

Example: If $U = 20$ dB(μ V) and $k = -17$ dB(V/A), current $I = + 3$ dB(μ A).

6.2 Electromagnetic susceptibility (EMS) measurement

The RF current probe can be compared to a transformer.

- The conductor surrounded by the probe forms the secondary winding.
- The winding of the two halves of the ferrite core forms the primary winding.

Determine the transducer factor as described in [Chapter 6.1, "RF current measurement"](#), on page 16.

7 Maintenance, storage and disposal

The product does not require regular maintenance. It only requires occasional cleaning. It is however advisable to check the nominal data from time to time.

7.1 Cleaning

How to clean the product is described in "[Cleaning the product](#)" on page 7.

Do not use any liquids for cleaning. Cleaning agents, solvents, acids and bases can damage the front panel labeling, plastic parts and display.

7.2 Storage

Protect the product against dust. Ensure that the environmental conditions, e.g. temperature range and climatic load, meet the values specified in the data sheet.

7.3 Disposal

Rohde & Schwarz is committed to making careful, ecologically sound use of natural resources and minimizing the environmental footprint of our products. Help us by disposing of waste in a way that causes minimum environmental impact.

Disposing of electrical and electronic equipment

A product that is labeled as follows cannot be disposed of in normal household waste after it has come to the end of its life. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.



Figure 7-1: Labeling in line with EU directive WEEE

Disposal

Rohde & Schwarz has developed a disposal concept for the eco-friendly disposal or recycling of waste material. As a manufacturer, Rohde & Schwarz completely fulfills its obligation to take back and dispose of electrical and electronic waste. Contact your local service representative to dispose of the product.

8 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 8-1: QR code to the Rohde & Schwarz support page