

R&S® RT-ZD01

High Voltage Differential Probe

User Manual



1422.0732.02 – 01

This User Manual describes the following R&S®RT-ZD models and options:

- R&S®RT-ZD01 (1422.0703.02)

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The following abbreviations are used throughout this manual: R&S®RT-ZD01 is abbreviated as R&S RT-ZD01. R&S®RTO is abbreviated as R&S RTO.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any purpose other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.









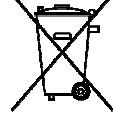

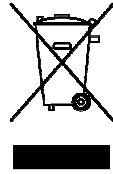

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments,

Basic Safety Instructions

systems and all accessories. For product-specific information, see the data sheet and the product documentation.





Symbols and safety labels

| Symbol | Meaning | Symbol | Meaning |
|---|--|---|--|
|  | Notice, general danger location Observe product documentation | ○ | ON/OFF supply voltage |
|  | Caution when handling heavy equipment | ⏻ | Standby indication |
|  | Danger of electric shock | — — — | Direct current (DC) |
|  | Warning! Hot surface | ~ | Alternating current (AC) |
|  | Protective conductor terminal | ⎓ | Direct/alternating current (DC/AC) |
|  | Ground |  | Device fully protected by double (reinforced) insulation |
|  | Ground terminal |  | EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1. |
|  | Be careful when handling electrostatic sensitive devices |  | EU labeling for separate collection of electrical and electronic devices For additional information, see section "Waste disposal/Environmental protection", item 2. |
|  | Warning! Laser radiation For additional information, see section "Operation", item 7. | | |

Basic Safety Instructions

Signal words and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

| | |
|---|---|
|  | Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. |
|  | Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
|  | Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. |
|  | Indicates the possibility of incorrect operation which can result in damage to the product. In the product documentation, the word ATTENTION is used synonymously. |

These signal words are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products:
predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of $\pm 10\%$ shall apply to the nominal voltage and $\pm 5\%$ to the nominal frequency, overvoltage category 2, pollution severity 2.

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2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If there is no power switch for disconnecting the product from the AC supply network, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the AC supply network. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.

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5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages $V_{\text{rms}} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.

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16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal/Environmental protection", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.

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6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).
8. EMC classes (in line with CISPR 11)
Class A: Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings.
Class B: Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings.

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

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1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
5. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
6. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
7. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.

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3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately. Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

For additional information about environmental protection, visit the Rohde & Schwarz website.

Instrucciones de seguridad elementales

¡Es imprescindible leer y cumplir las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad adjunto de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.









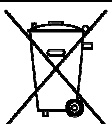
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.


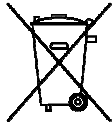


Instrucciones de seguridad elementales

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios. Los datos específicos del producto figuran en la hoja de datos y en la documentación del producto.

Símbolos y definiciones de seguridad

| Símbolo | Significado | Símbolo | Significado |
|---|---|---|---|
|  | Aviso: punto de peligro general Observar la documentación del producto | ○ | Tensión de alimentación de PUESTA EN MARCHA / PARADA |
|  | Atención en el manejo de dispositivos de peso elevado | ⏻ | Indicación de estado de espera (standby) |
|  | Peligro de choque eléctrico | — — — | Corriente continua (DC) |
|  | Advertencia: superficie caliente | ~ | Corriente alterna (AC) |
|  | Conexión a conductor de protección | ⎓ | Corriente continua / Corriente alterna (DC/AC) |
|  | Conexión a tierra |  | El aparato está protegido en su totalidad por un aislamiento doble (reforzado) |
|  | Conexión a masa |  | Distintivo de la UE para baterías y acumuladores Más información en la sección "Eliminación/protección del medio ambiente", punto 1. |

Instrucciones de seguridad elementales

| Símbolo | Significado | Símbolo | Significado |
|---|---|--|---|
|  | Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD) |   | Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2. |
|  | Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7. | | |

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.



PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.



ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.



ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.



AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Instrucciones de seguridad elementales

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue:
como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ sobre la frecuencia nominal. Categoría de sobrecarga eléctrica 2, índice de suciedad 2.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, se pueden causar lesiones o, en determinadas circunstancias, incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.

Instrucciones de seguridad elementales

2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión $U_{\text{eff}} > 30 \text{ V}$ se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).

Instrucciones de seguridad elementales

10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Instrucciones de seguridad elementales

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.
5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.

Instrucciones de seguridad elementales

7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases CEM (según CISPR 11)
Clase A: dispositivo apropiado para el uso en cualquier zona excepto en áreas residenciales y en aquellas zonas que se encuentran conectadas a una red de suministro de baja tensión que alimenta un edificio de viviendas.
Clase B: dispositivo apropiado para el uso en áreas residenciales y en aquellas zonas que se encuentran conectadas a una red de suministro de baja tensión que alimenta un edificio de viviendas.

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

Instrucciones de seguridad elementales

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
6. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
7. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.

Instrucciones de seguridad elementales

3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado. Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (povos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

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 will work 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 take care that you will get the right information.

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ROHDE & SCHWARZ

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1 Product Description

1.1 Key Features and Key Characteristics

The R&S RT-ZD01 high voltage differential probe is designed to safely measure high-voltage floating circuits using a grounded oscilloscope. The probe extends the measurement capability of oscilloscopes in measuring electronic power converters, inverters, motor speed controls, switch mode power supplies and many other applications.

The R&S RT-ZD01 high voltage differential probe conforms to the safety requirements for CAT III measurement instruments and pollution degree 2 according to IEC 61010. The maximum working voltage is 1000 V (RMS) between each input lead and earth ground. This limit applies for all attenuation settings.

1.2 Measurement Categories

To ensure safe operation of measurement instruments, IEC 61010-2-030 defines particular safety requirements for testing and measuring circuits. The standard introduces measurement categories that rate instruments on their ability to resist short transient overvoltages that occur in addition to the working voltage of the instrument and can exceed the working voltage many times over.

Measurement categories are distinguished as follows:

- O - Instruments without rated measurement category
For measurements performed on circuits not directly connected to mains, for example, electronics, circuits powered by batteries, and specially protected secondary circuits. This measurement category is also known as CAT I.
- CAT II:
For measurements performed on circuits directly connected to the low-voltage installation by a standard socket outlet, for example, household appliances and portable tools.
- CAT III:
For measurements performed in the building installation, such as junction boxes, circuit breakers, distribution boards, and equipment with permanent connection to the fixed installation.

- CAT IV:
For measurements performed at the source of the low-voltage installation, such as electricity meters and primary overcurrent protection devices.

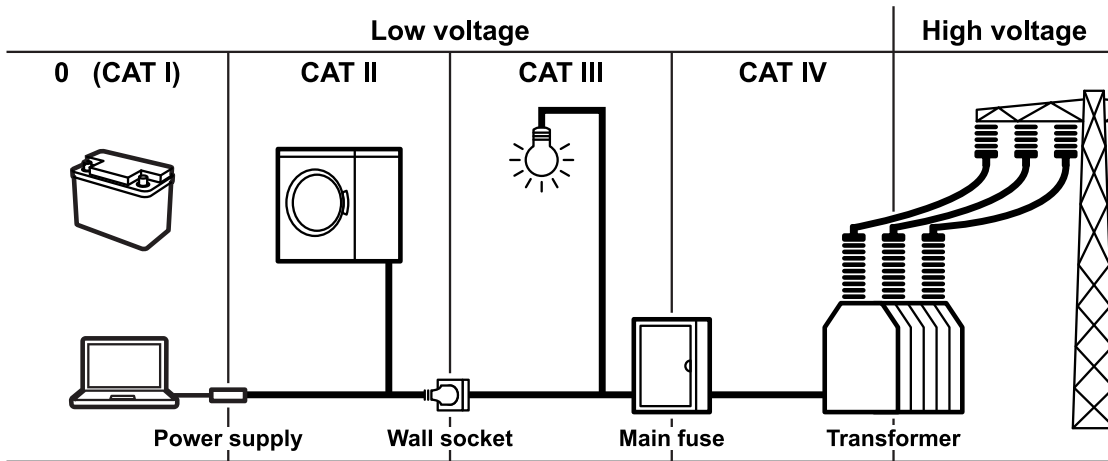


Fig. 1-1: Examples of measurement categories

The higher the category, the higher the expected transient overvoltage. Overvoltages can overload a circuit and cause electrical and physical damage. Therefore, use the measurement instrument only in electrical environments for which the instrument is rated.

The measurement categories correspond to the overvoltage categories of the IEC60664 standards. Working voltages stated in context with measurement categories are always specified as effective voltages V (RMS) against earth ground.

1.3 Pollution Degrees

The pollution degree classifies the amount of dry pollution and condensation that may occur in the environment. Products must be used only in the environment for which they are rated.

- Pollution Degree 1:
No pollution or only dry, nonconductive pollution occurs. The pollution has no effect. Products of this category are generally encapsulated, hermetically sealed, or used only in clean rooms.
- Pollution Degree 2:
Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. Temporary con-

Pollution Degrees

condensation occurs only when the product is out of service. The typical location is an office, laboratory or home environment.

- **Pollution Degree 3:**
Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. The typical environment are sheltered locations where neither temperature nor humidity is controlled, for example, industrial manufacturing areas. The location is usually protected from direct sunshine, rain, and direct wind.
- **Pollution Degree 4:**
The pollution generates persistent conductivity caused by conductive dust, rain, or snow. This is typical for outdoor locations.

1.4 Precautions

⚠ WARNING

Shock hazard caused by high voltages

To avoid electric shock and personal injury, and to prevent damage to the probe or any other products connected to it, observe the following instructions:

- The probe and the measurement instrument must be grounded.
The probe is grounded with the shell of the BNC connector or an auxiliary ground connector through the grounding of the measurement instrument.
- Never use the probe in measurement environments higher than measurement category III.
- Do not apply effective voltages greater than 1000 V (RMS) between either input of the probe and earth ground, or between both inputs.
- Make sure that all accessories comply with measurement category III, 1000 V (RMS).
- Do not operate the probe without covers.
- Do not use the probe in wet, damp or explosive atmospheres.
Make sure that the surface of the probe is completely dry before connecting the inputs.
- Avoid exposed circuitry. Do not touch exposed connections and components when power is on.
Remove jewelry, watches, and other metallic objects.
- Do not operate the probe if any part is damaged, or with suspected failures.
If you detect or suspect any damage to the probe, have it inspected by qualified service personnel.

1.5 Unpacking the Instrument

The following items are included in the delivery:

- R&S RT-ZD01 high voltage differential probe
- Carrying case
- Sprung hooks (black and red)

- USB power cord
- User manual
- R&S RT-Zxx data sheet
- Calibration certificate
- Documentation of calibration values (if ordered)

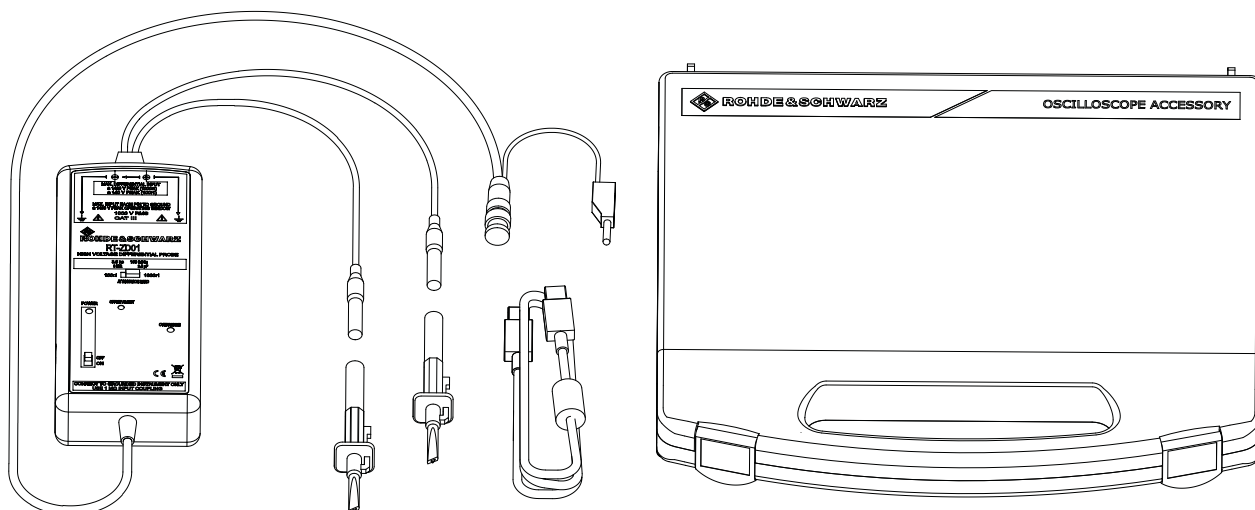


Fig. 1-2: R&S RT-ZD01 probe with accessories

1.5.1 Inspecting the Contents

- Inspect the package for damage.
Keep a damaged package and the cushioning material until the contents have been checked for completeness and the instrument has been tested.
If the packaging material shows any signs of stress, notify the carrier as well as 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-ZD01 high voltage differential 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 instrument are listed in [chapter 1.7, "Accessories and Items"](#), on page 14.

1.6 Description of the Probe

1.6.1 Parts of the probe

The R&S RT-ZD01 consists of the probe amplifier box, an output lead and two input leads.

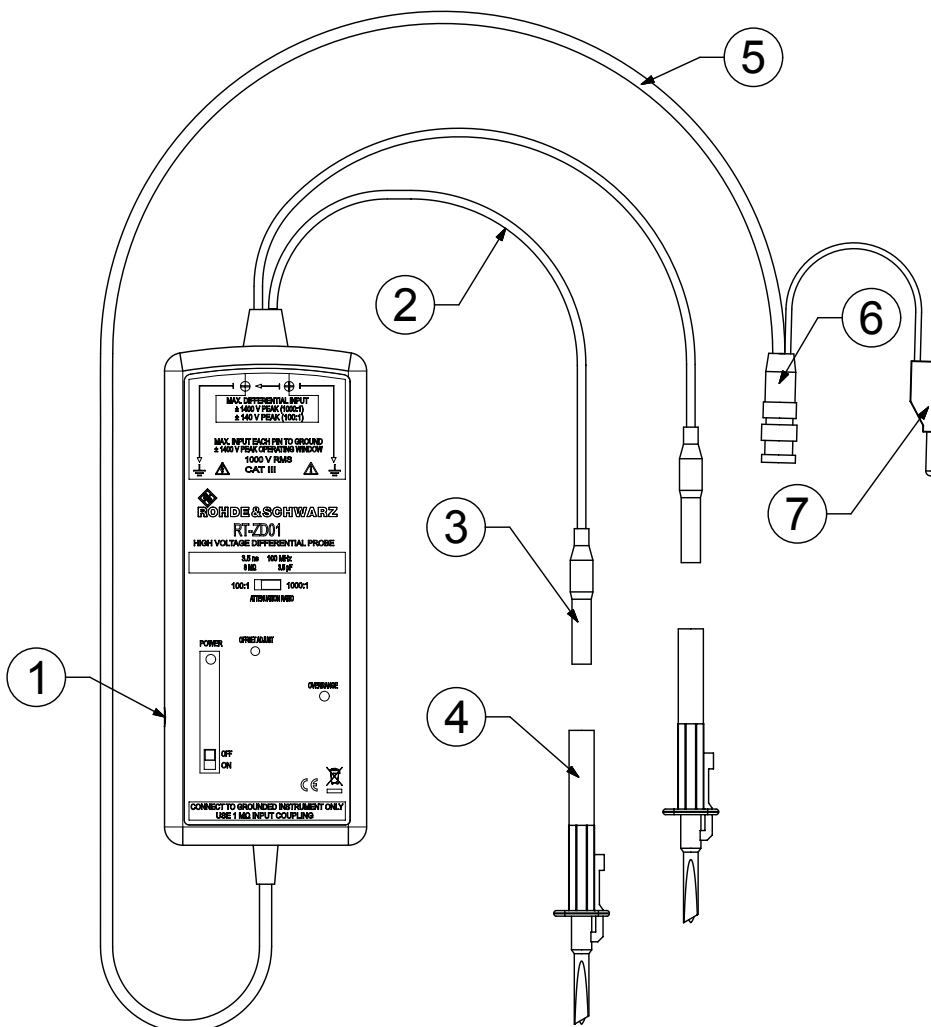


Fig. 1-3: R&S RT-ZD01 probe

- 1 = Probe amplifier box
- 2 = Input leads
- 3 = Safety banana plug (4 mm)
- 4 = Sprung hooks
- 5 = Output lead
- 6 = BNC output connector
- 7 = Auxiliary ground connector

Probe amplifier box

Contains the high voltage divider, the active differential amplifier and other electronic components. All components are designed to ensure safe operation at hazardous contact voltages within the specified working voltage and measurement category. In particular, all air gaps and creeping distances comply with all current safety standards to protect the user, the measurement object, and the probe against any harm or damage.

The active differential amplifier takes the difference between the positive and negative signal input voltages. The probe transfers this difference signal to the oscilloscope. Common mode voltages are rejected.

The controls and indicators of the amplifier box are described in [chapter 1.6.2, "Controls and Indicators"](#), on page 12.

Output lead

Connects the amplifier box to the oscilloscope or other measurement instruments using a BNC connector. Its length of 90 cm allows for a comfortable working distance to the base unit. The output lead is specially qualified for high voltage usage.

Input leads

Provide flexible contact to the DUT even in confined physical conditions. The input leads are each 30 cm long, thus the maximum distance of the measurement points is 60 cm. The 4 mm safety banana plugs can be used to contact the DUT directly, or to connect suitable contact accessories like the sprung hooks delivered with the probe.

See also: [chapter 2.2, "Connecting the Probe to the DUT"](#), on page 20

WARNING

Shock hazard caused by high voltages

The input leads have a jacket wear indicator. If the input lead's jacket is excessively worn, a different jacket color becomes visible. If you see this color indicator, do not use the probe.

1.6.2 Controls and Indicators

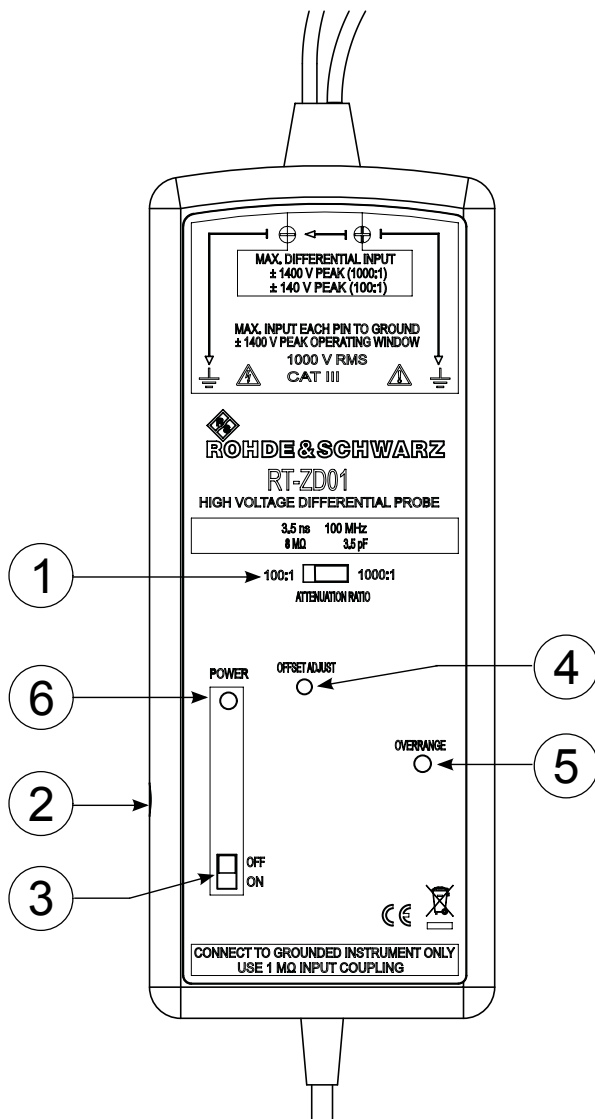


Fig. 1-4: Probe control box

- 1 = Attenuation ratio switch
- 2 = Power input
- 3 = Power switch
- 4 = Offset adjustment
- 5 = Overrange indicator
- 6 = Power indicator

Attenuation ratio switch

Sets the attenuation of the probe to 100:1 or 1000:1. The setting 1000:1 provides a maximum voltage range of up to 1.4 kV (peak). The setting 100:1 works with measurement voltages up to 140 V (peak) and is characterized by less noise.

The selected attenuation does not influence the allowed working voltage, measurement category, and the usable common mode range. Thus, setting the attenuation does neither cause a hazardous situation nor a measurement error due to inadmissible common mode voltages.

Power input

The supplied voltage must be less than 12 V and greater than 4.4 V, otherwise the probe could be damaged or cannot be operated properly. Use the USB power cord to connect the probe to an unused USB port of the oscilloscope or another USB device, e.g. USB hub. Alternatively, batteries can be used to power the probe.

Power switch

Switches the probe on or off.

If you use batteries, make sure to switch the probe off after use to extend the lifetime of the batteries.

Offset adjustment

The rotary knob removes unwanted offset voltages of the probe or the measurement object from the measurement signal.

See also: [chapter 2.1, "Connecting the Probe to R&S Oscilloscopes"](#), on page 16

Overrange indicator

The overrange indicator lights red if the voltage of the differential input signal exceeds the dynamic range limit of the probe. In this case, the signal on the probe output may not accurately represent the signal on the probe input. The overrange indicator does not detect overranges of common-mode voltages at the probe inputs.

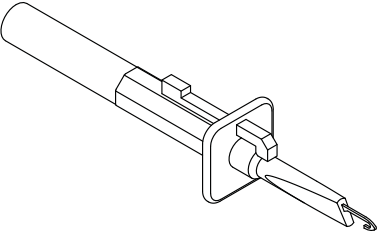
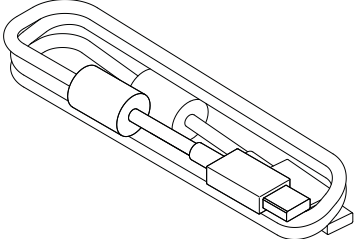
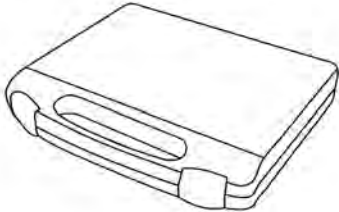
Power indicator

The power indicator lights up continuously if the probe is switched on and powered correctly. If the probe is powered by batteries, the power indicator blinks if the voltage of the cells is too low.

1.7 Accessories and Items

The following tables show the accessories supplied with the R&S RT-ZD01 high voltage differential probe and the optional service accessories.

Table 1-1: Accessories supplied

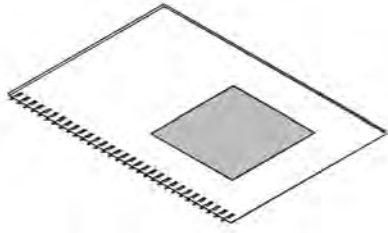
| Item | Quantity | Description |
|---|----------|---|
|  | 2 | Sprung hook Maximum rating: 1000 V (RMS) CAT III |
|  | 1 | USB power cord |
|  | 1 | Carrying case with foam inlay |

⚠ WARNING

Shock hazard caused by high voltages

Always check the working voltage and measurement category of the accessory. If these values are smaller than the values of the R&S RT-ZD01 probe, make sure not to exceed the accessory limits.

Table 1-2: R&S RT-ZD01 service accessories

| | |
|---|---|
|  | <p>Service Manual</p> <p>The Service Manual contains a detailed description of the performance test for verifying the probe specifications. It is delivered on the service kit CD-ROM.</p> |
|---|---|



All service accessories and items can be ordered from your Rohde & Schwarz service center.

2 Putting into Operation

2.1 Connecting the Probe to R&S Oscilloscopes

⚠ WARNING**Shock hazard caused by high voltages**

To avoid electric shock and personal injury, and to prevent damage to the probe or any other products connected to it, make sure that the shell of the BNC output connector is safely connected to earth ground.

Never connect the probe to the DUT before grounding is ensured!

Usually, the outer cable of the measuring instrument is connected to protective ground and ensures the grounding of the instrument and the probe.

If the probe is used together with an ungrounded instrument, the auxiliary ground connector (4 mm banana plug) must be used to ground the probe.

NOTICE**Avoiding measurement errors**

The probe must only be connected to measuring instruments with high-impedance signal input (at least 10 k Ω termination). Do not use instruments that have only 50 Ω terminated inputs.

1. Connect the BNC output connector to an input channel of the oscilloscope. Turn the collar until it clicks, and check that it is locked securely.
2. Make sure that the measuring instrument and the probe are grounded. If you use a measuring instrument without grounded input, use the auxiliary ground connector to ground the probe.

Connecting the Probe to R&S Oscilloscopes

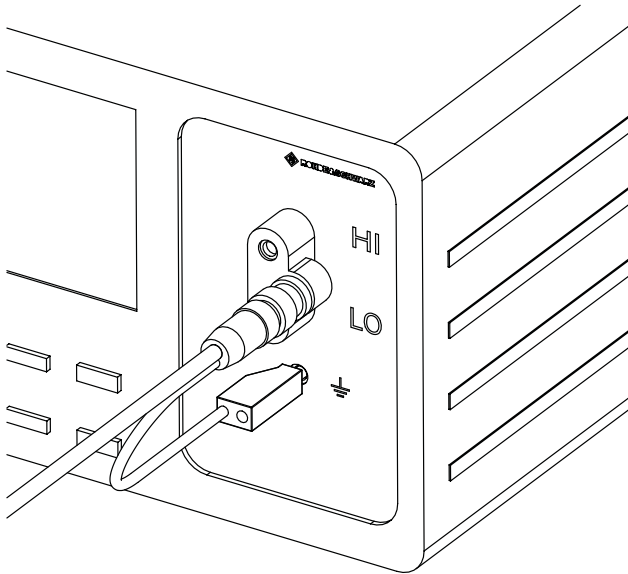


Fig. 2-1: Connecting the BNC output connector and the auxiliary ground connector when using a measurement instrument without grounded inputs

3. Connect the USB power cord to the power input of the probe and to a free USB port of the oscilloscope. You can also use a USB hub. Alternatively, the probe can be powered with batteries, see [chapter 2.3, "Alternative Battery Operation"](#), on page 21.

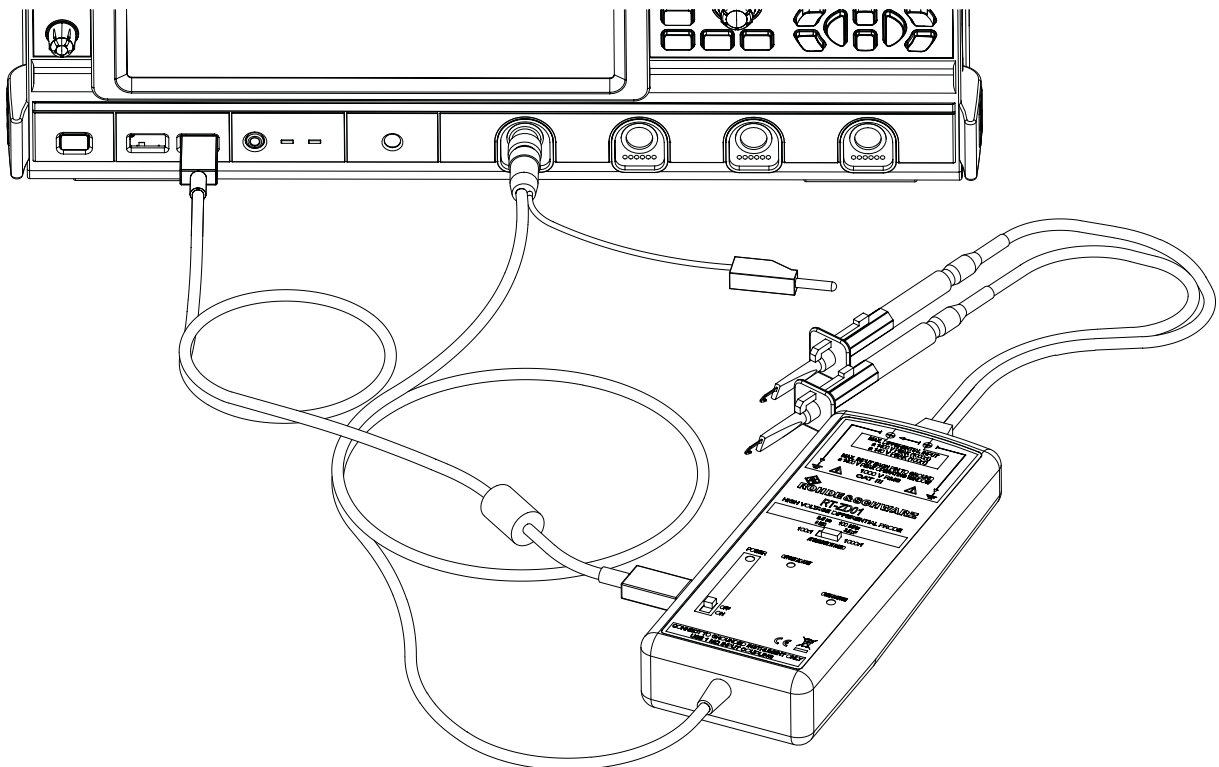


Fig. 2-2: Connecting the probe to the R&S oscilloscope

Connecting the Probe to R&S Oscilloscopes

4. Switch the power switch of the probe to ON.
5. Adjust the attenuation ratio on the probe.
If you measure signals below 140 V (peak), set the attenuation to 100:1 to get higher resolution and less noise. Otherwise, set the attenuation to 1000:1.
6. If you use an R&S RTO, set up the oscilloscope as follows:
 - a) On the "Vertical" menu, select "Probe Setup".

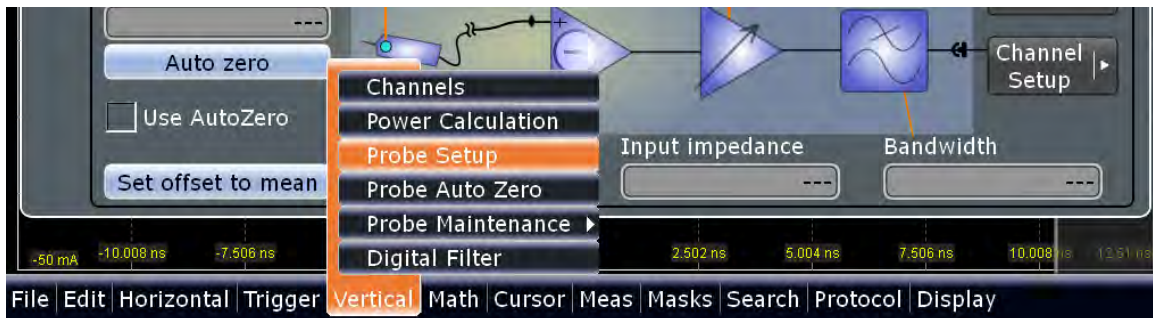


Fig. 2-3: Access to "Probe Setup"

- b) Under "Probe detection", select the "Manual" tab.
Select the "Predefined probe": "RT-ZD01 (100:1)" or "RT-ZD01 (1000:1)" according to the setting on the probe.
7. If you use an R&S RTM, set up the oscilloscope as follows:
 - a) In the VERTICAL section on the front panel, press the appropriate channel key.
 - b) On the first page of the "Channels" menu, set:
 - Coupling: "DC"
 - Termination: "1 MΩ"
 - Press "More".

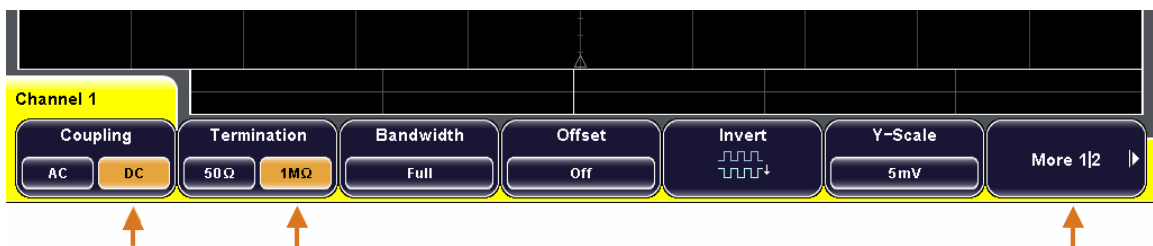


Fig. 2-4: RTM Channel1 menu 1st page

- c) Press "Probe" on the second page of the "Channels" menu.

Connecting the Probe to R&S Oscilloscopes

d) In the "Probe" menu, set:

- Unit: "V - Volt"
- Attenuation: "x100" or "x1000" according to the setting on the probe.

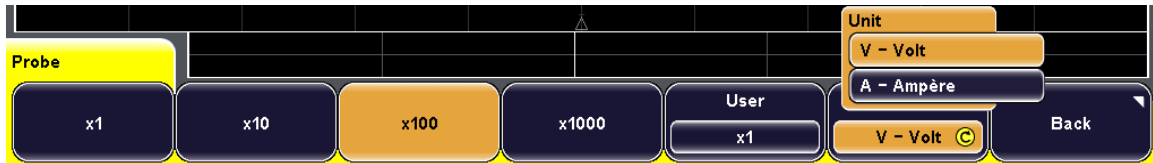


Fig. 2-5: RTM Channel1 Probe menu, attenuation 100:1

8. Adjust the offset level:

- Set the measuring instrument to the smallest vertical resolution (vertical scale).
- Short the two input leads of the probe.
- Using a small screwdriver, turn the "Offset Adjust" screw until the waveform meets exactly the 0 V position in the middle of the display.

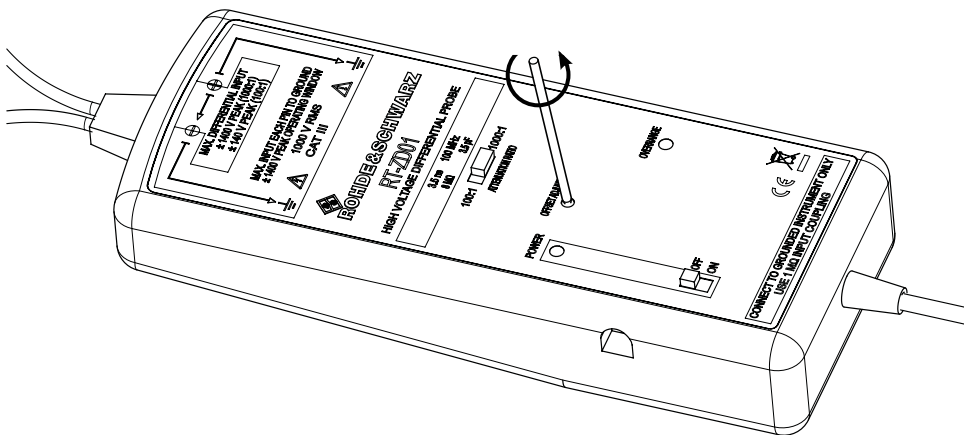


Fig. 2-6: Adjusting the offset

2.2 Connecting the Probe to the DUT

⚠ WARNING

Shock hazard caused by high voltages

Before connecting the probe to the test circuit, make sure that probe is connected to the measuring instrument and the instrument is properly grounded. Use the auxiliary ground connector if necessary.

Ensure a stable connection between the output leads and the sprung hooks. Switch off the test circuit while connecting and disconnecting the sprung hooks.

Always use the slider to open the sprung hook. The finger guard provides protection. Keep your fingers behind the finger guard.

1. Connect the sprung hooks to the output leads.
2. Using the slider, connect the sprung hooks to the circuit: Connect the red cable to the more positive voltage level than the black probe cable.

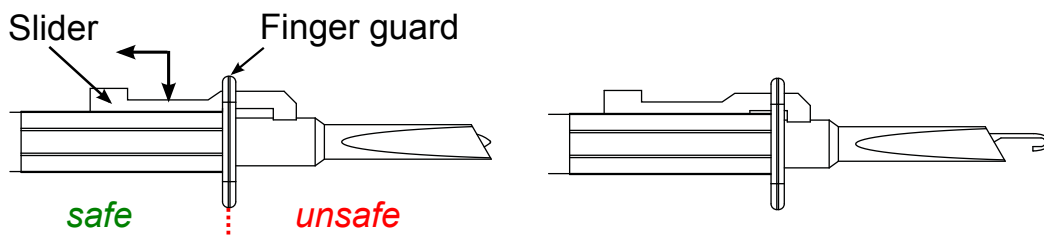


Fig. 2-7: Opening the sprung hook

⚠ WARNING

Shock hazard caused by high voltages

Disconnect the sprung hooks from the DUT before disconnecting the probe from the measuring instrument.

Keep the probe amplifier box and the output lead away from the circuit being measured.

2.2.1 Reducing noise induction

Twist the input leads to cancel noise that is induced into the input leads.

Input leads that form a large loop area pick up any radiated electromagnetic field that passes through the loop. The fields induce noise in the input leads that appears as a differential mode signal. Twisting the leads minimizes the loop area.

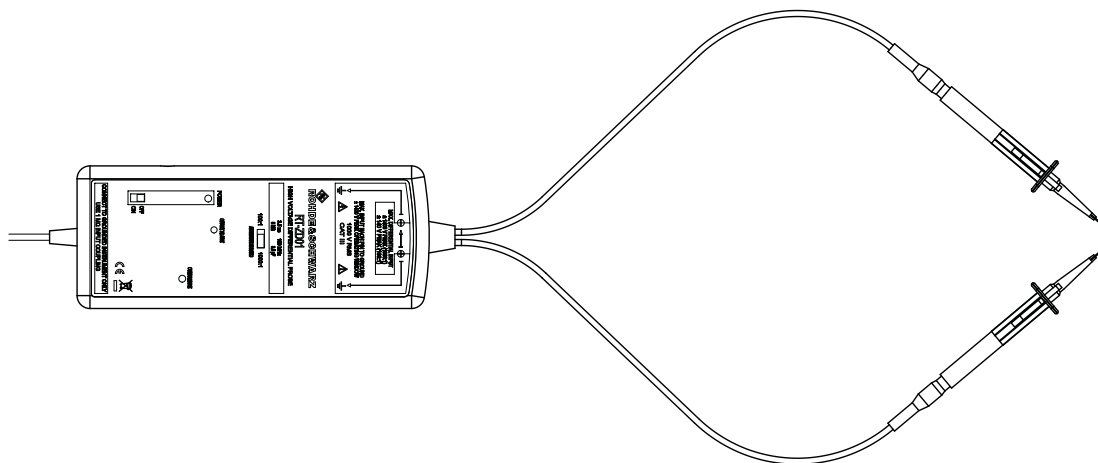


Fig. 2-8: Leads, untwisted

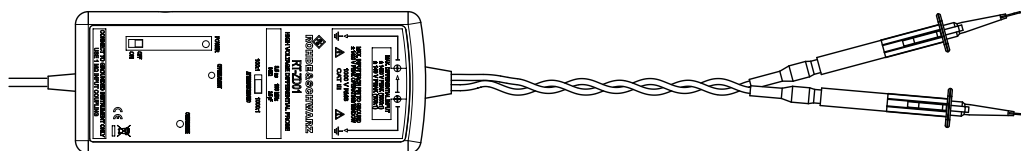


Fig. 2-9: Leads, twisted

2.3 Alternative Battery Operation

Usually, the probe is powered by the USB power cord that is connected to a USB connector of the oscilloscope.

See also: "[Power input](#)" on page 13

Alternatively, you can use four AA batteries:

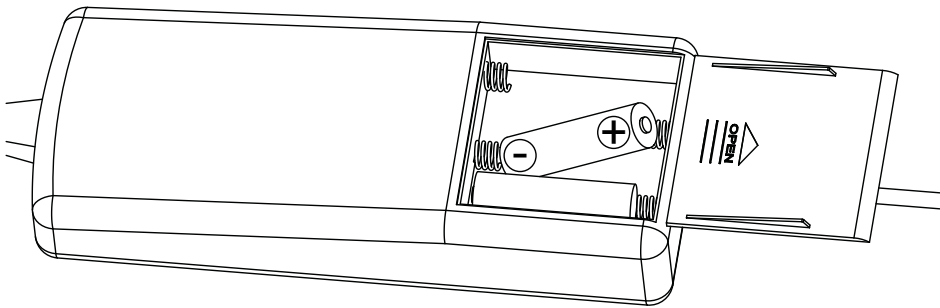


Fig. 2-10: Inserting batteries

Note: Batteries are not included in the delivery of the probe, you have to purchase them separately.

If the voltage of the cells is too low, the power indicator on the probe control box blinks.

3 Characteristics of Differential Probes

A differential probe has three sockets: the positive signal socket (+), the negative signal socket (-), and the ground socket.

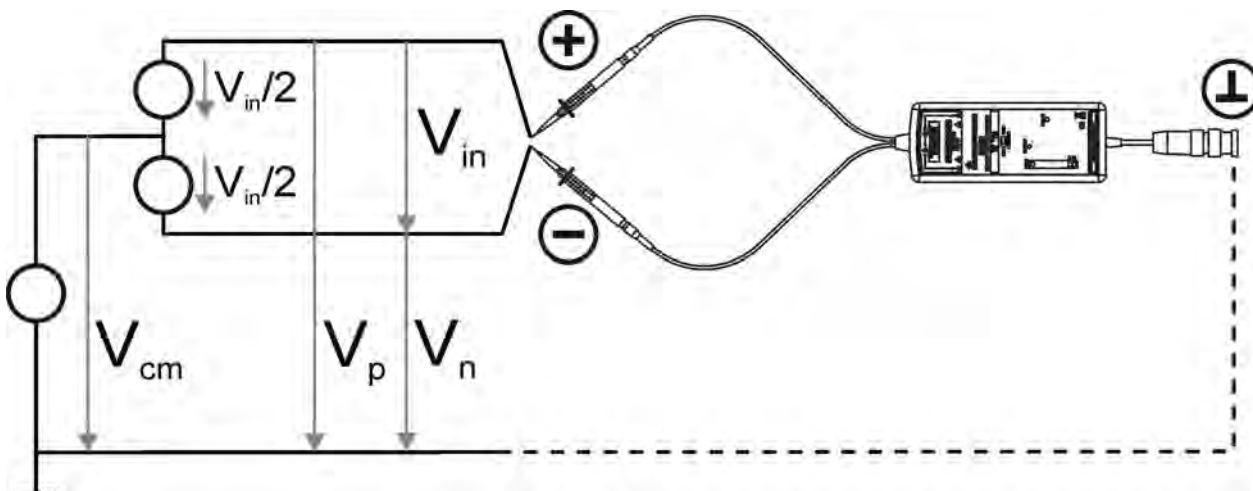


Fig. 3-1: Input voltages on a differential probe

Differential probes provide multiple input voltages:

- Differential mode input voltage (V_{in})
Voltage between the positive and negative signal sockets
- Positive single-ended input voltage (V_p)
Voltage between the positive signal socket and the ground socket
- Negative single-ended input voltage (V_n)
Voltage between the negative signal socket and the ground socket
- Common mode input voltage (V_{cm})
Mean voltage of positive and negative signal sockets referred to the ground socket, respectively

Two of these voltages are independent values, the other two can be calculated:

$$V_{in} = V_p - V_n$$

$$V_{cm} = \frac{V_p + V_n}{2}$$

Typically, the differential and the common mode input voltages are used to describe the behavior of a differential probe.

Common Mode Rejection Ratio (CMRR)

The output voltage V_{out} , which is displayed on the base unit, is generally obtained by superimposing the voltages generated from the differential mode input voltage and from the common mode input voltage:

$$V_{out} = A_{vdm}V_{in} + A_{vcm}V_{cm}$$

In this equation, A_{vdm} is the amplification of the differential mode input voltage and A_{vcm} is the amplification of the common mode input voltage.

An ideal differential probe is expressed as $A_{vdm} = 1$ and $A_{vcm} = 0$. In this case, the displayed voltage exactly corresponds to the differential input voltage V_{in} between the two signal sockets, and the common mode input voltage is totally suppressed.

3.1 Common Mode Rejection Ratio (CMRR)

An *ideal* differential probe outputs a voltage that depends only on the differential input voltage V_{in} between positive and negative input, and suppresses the common mode voltages. This is equivalent to an infinite common mode rejection ratio (CMRR).

In contrast, real probes have a finite CMRR, resulting in a small part of the common mode voltage visible in the output signal. The CMRR is defined as the ratio of the amplifications of differential and common mode input signals:

$$CMRR = \frac{A_{vdm}}{A_{vcm}}$$

Example:

If a differential input voltage of 1 V yields an output voltage of 10 mV ($A_{vdm} = 0.01$) and a common mode input voltage of 1 V an output voltage of 0.1 mV ($A_{vcm} = 0.0001$), the CMRR is 100 or 40 dB.

A high CMRR is important if significant common mode signals are encountered at the probe input, for example:

- DC voltages for setting the operating points of active DUTs
- Different ground levels of probe and DUT, e.g. floating DUTs
- An interference that couples equally to both conductors of a differential transmission line

Dynamic Range and Operating Voltage Window

- Probing on ground-referenced signals. In this case, the common mode component is always equal to half of the input voltage.

3.2 Dynamic Range and Operating Voltage Window

Two separate specifications are necessary in order to characterize the permissible input voltage range of a differential voltage probe:

- The dynamic range (or "differential mode range") designates the maximum differential voltage V_{in} that may occur between the positive and negative signal pin.
- At the same time, the two voltage values at each of the two signal pins V_p and V_n referenced to the common ground must not exceed a specific limit value. This limitation is referred to as the operating voltage window (some manufacturers also use the less precise term "common mode range" for the same parameter).

If one of these ranges is exceeded, an unwanted signal clipping may occur.

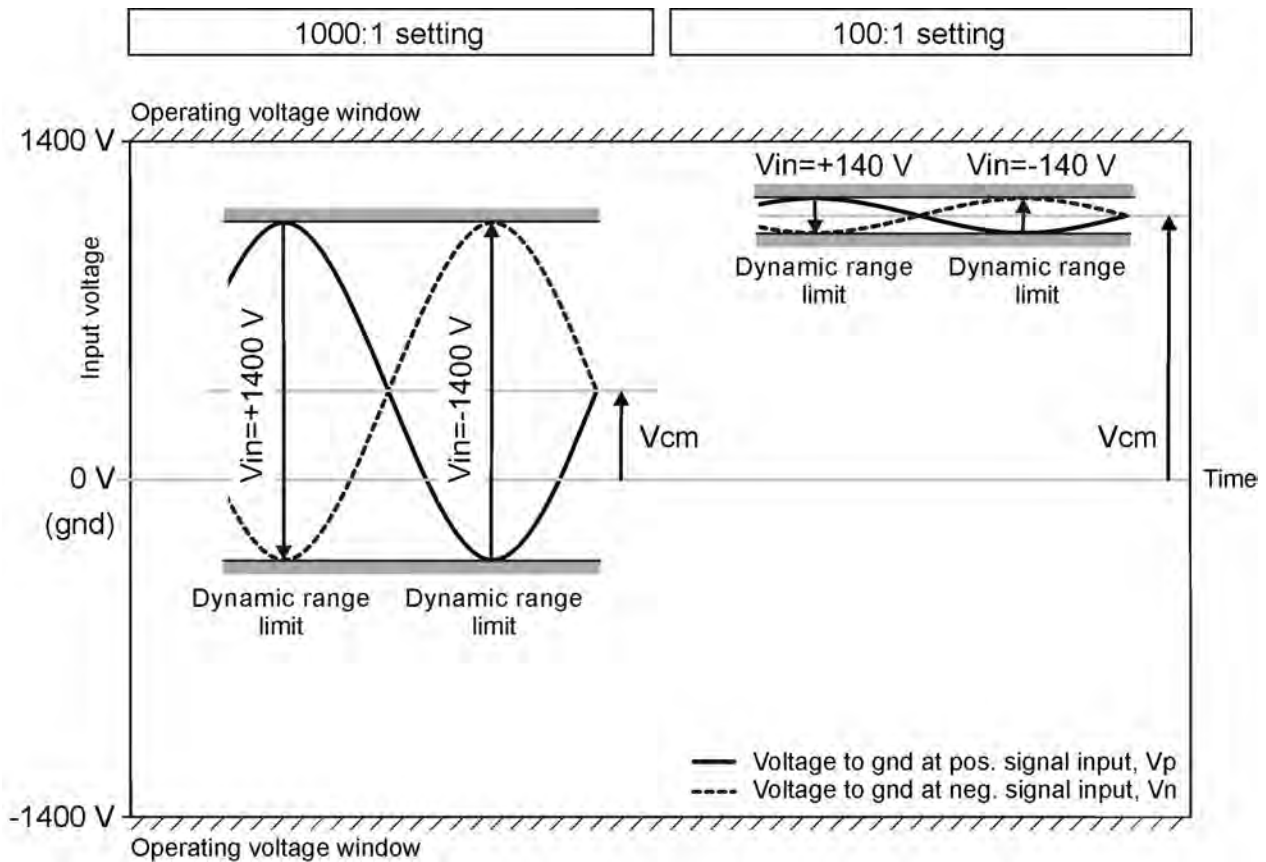


Fig. 3-2: Dynamic range and operating voltage window for both attenuation ratios 100:1 and 1000:1

Dynamic Range and Operating Voltage Window

The dependencies of dynamic range, operating voltage window and attenuation ratio are shown in figure 3-2. The dynamic range between the positive and negative signal pins depends on the selected attenuation, but the operating voltage window between each of the signal pins and common ground is not affected by the attenuation.

The figure 3-3 shows several examples for permissible and impermissible inputs.

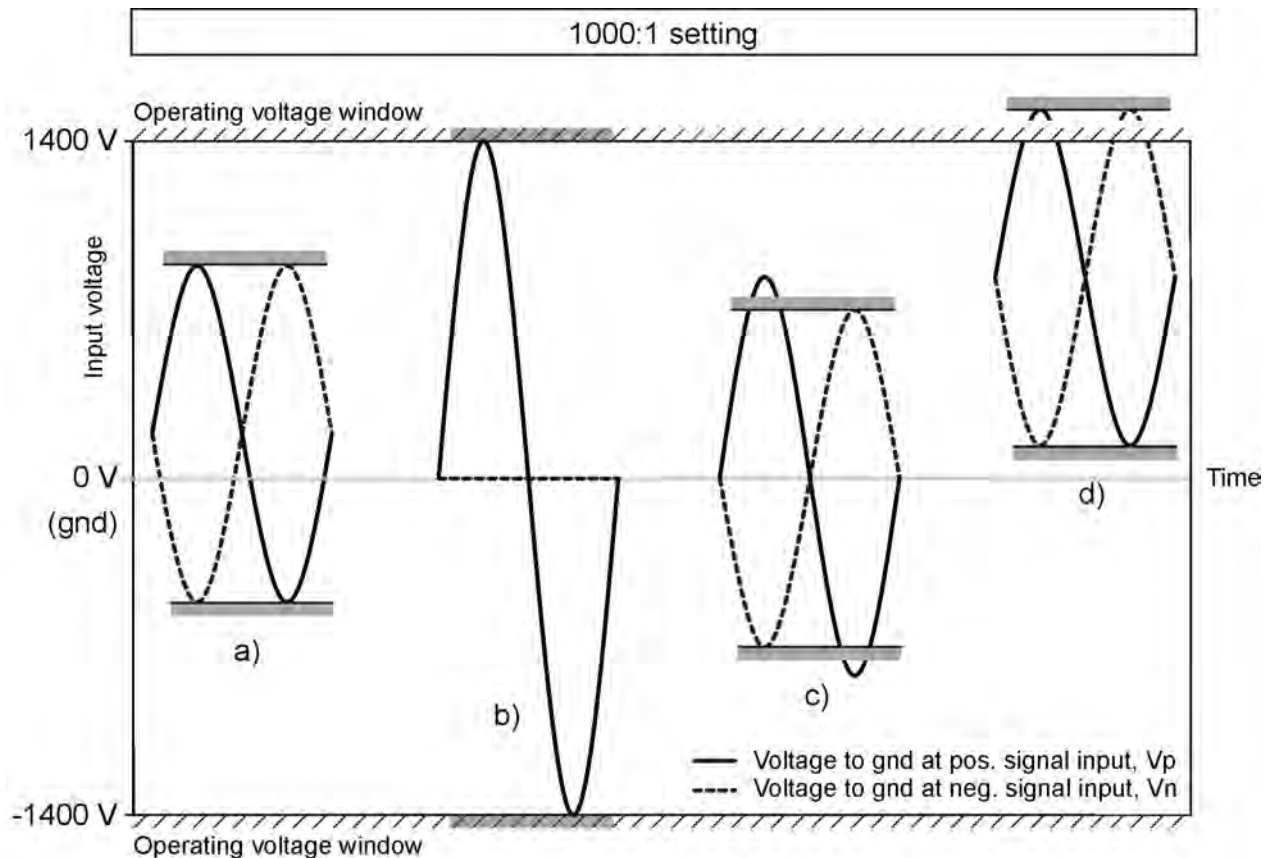


Fig. 3-3: Signal curves

- a) = Two signals of ± 700 V and opposing phase are applied to positive and negative inputs. At the peaks, the probe is driven with an input voltage of ± 1400 V between the positive and negative signal pin. The dynamic range limit is reached.
- b) = The negative signal pin is connected to ground, the positive pin is driven with an input voltage of ± 1400 V. Dynamic range and operating voltage window are used completely. Note that the oscilloscope displays the same waveform as with example a).
- c) = Dynamic range limit is exceeded. The oscilloscope displays a clipped signal.
- d) = Operating voltage window is exceeded. The oscilloscope displays a clipped signal.

NOTICE**Signal clipping**

Only differential input signals are detected by the probe and displayed by the base unit. Common mode signals are suppressed by the probe. Therefore, the user does not initially recognize that the operating voltage window is exceeded owing to inadmissible common mode voltages. If unexpected clipping occurs, check the positive or negative input voltage relative to ground.

3.3 Maximum Voltage Input

The R&S RT-ZD01 high voltage differential probe is rated for CAT III environments with a maximum working voltage of 1000 V (RMS) between each input lead and earth ground. Thus, it can be used to measure electrical devices or installations of categories 0 (I), II, or III if the effective value of the measured voltage against earth ground does not exceed 1000 V (RMS).

See also: [chapter 1.2, "Measurement Categories"](#), on page 5

The rating ensures that the probe is protected against short transient overvoltages as long as the maximum working voltage limit is observed.

⚠ WARNING**Shock hazard caused by high transient overvoltages**

Never use the R&S RT-ZD01 probe for measurements in a higher category or at higher effective working voltages!

Do not use the probe to measure effective working voltages higher than 1000 V (RMS) between each input lead and earth ground even if the effective differential voltage is lower than 1000 V (RMS).

The maximum working voltage is derated for higher frequencies. Refer to the R&S RT-Zxx data sheet for the specification of voltage derating over frequency.

4 Maintenance and Service

4.1 Service Strategy

The R&S RT-ZD01 high voltage differential probe is a high-precision, high-performance instrument that extends the limits of today's technological possibilities. Like all Rohde & Schwarz instruments, the R&S RT-ZD01 high voltage differential probe is of high quality and requires only minimum service and repair. However, if the probe needs to be serviced, contact your Rohde & Schwarz service center. Return a defective probe to the Rohde & Schwarz service center for diagnosis and exchange.

You can return the R&S RT-ZD01 high voltage differential probe for calibration. The service personnel will then perform the required tests.

4.2 Returning the Probe for Servicing

Use the original packaging to return the R&S RT-ZD01 high voltage differential probe to your Rohde & Schwarz service center.

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

1. Use a sufficiently sized box.
2. Protect the probe from damage and moisture (e.g. with bubble wrap).
3. Use some kind of protective material (e.g. crumpled newspaper) to stabilize the probe inside the box.
4. Seal the box with tape.
5. Address the package to your nearest Rohde & Schwarz service center.

4.3 Cleaning

To clean the exterior of the probe, use a soft cloth moistened with either distilled water or isopropyl alcohol. Before using the probe again, make sure to dry it completely.

NOTICE**Instrument damage caused by cleaning agents**

Cleaning agents contain substances that may damage the instrument; for example, solvent may damage the labeling or plastic parts.

Never use cleaning agents such as solvents (thinners, acetone, etc.), acids, bases or other substances

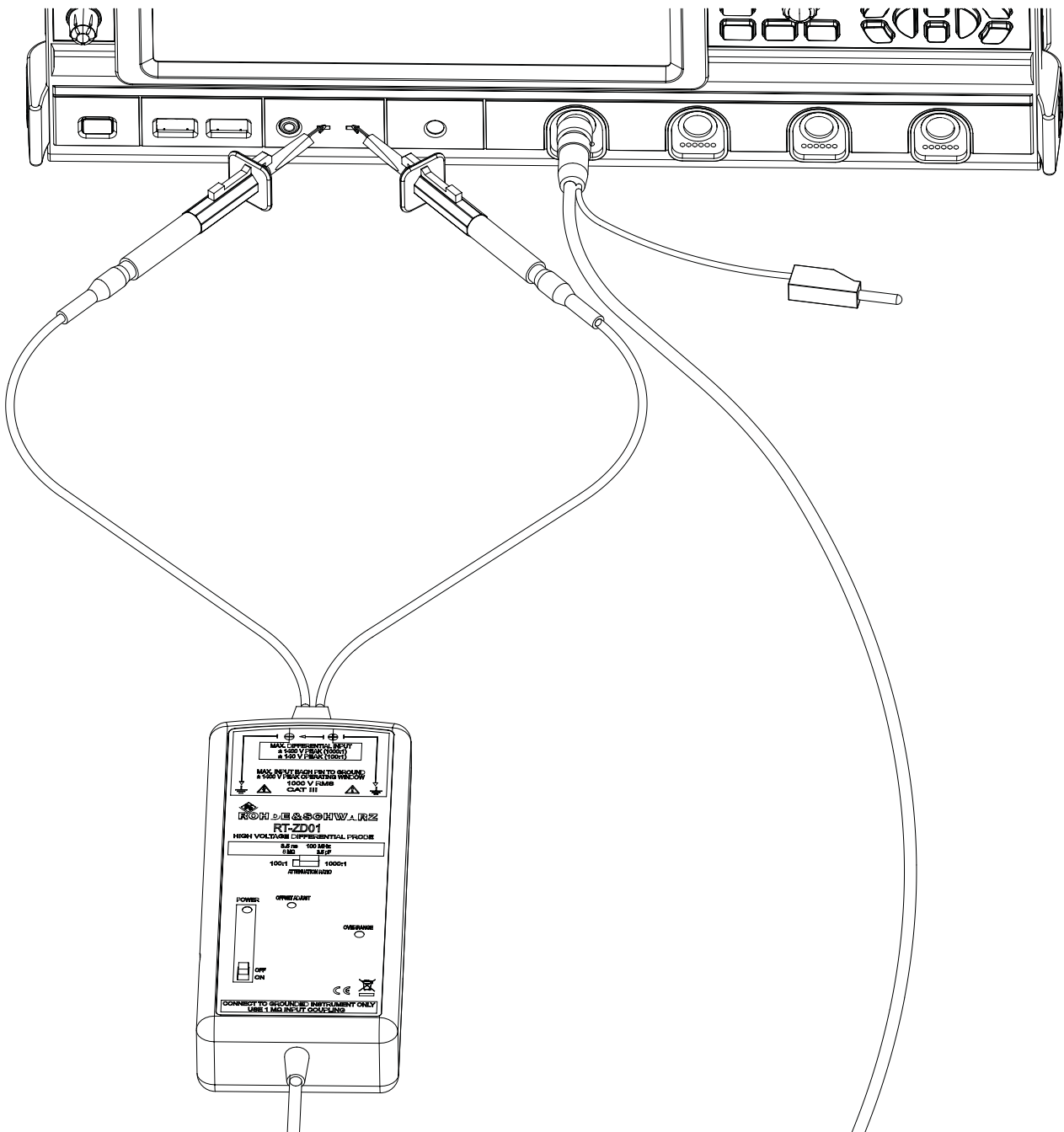
4.4 Calibration Interval



The recommended calibration interval is two years. For servicing, send the probe to your nearest Rohde & Schwarz service center (see [chapter 4.2, "Returning the Probe for Servicing"](#), on page 28).

5 Functional Check

The functional check is used to confirm the basic operation of the R&S RT-ZD01 high voltage differential probe using simple measurement equipment.

The functional check is not suitable for verifying compliance with the probe specifications, since the test results are influenced by the oscilloscope used.



1. Set the attenuation ratio on the probe to 100:1.
2. Connect the R&S RT-ZD01 probe to an R&S oscilloscope as described in [chapter 2.1, "Connecting the Probe to R&S Oscilloscopes"](#), on page 16.
3. Connect the red sprung hook to the square wave output  of the oscilloscope.
4. Connect the black sprung hook to the probe ground connector  of the oscilloscope.
5. Press the AUTOSET key on the oscilloscope.

A square wave with 1 V (pp) between 0 V and 1 V is displayed on the display.

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