R&S®RTO
Digital Oscilloscope
Getting Started

1316.0833.02 ─ 10

ROHDE&SCHWARZ

Test & Measurement

Getting Started

This manual describes the following R&S®RTO models with firmware version 2.70 and higher:

- R&S®RTO1002 (1316.1000K02)
- R&S®RTO1004 (1316.1000K04)
- R&S®RTO1012 (1316.1000K12)
- R&S®RTO1014 (1316.1000K14)
- R&S®RTO1022 (1316.1000K22)
- R&S®RTO1024 (1316.1000K24)
- R&S®RTO1044 (1316.1000K44)

The software contained in this product makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual: 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 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.

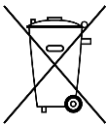
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. 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, systems and all accessories. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

The following safety labels are used on products to warn against risks and dangers.

Symbol	Meaning	Symbol	Meaning
	Notice, general danger location Observe product documentation		ON/OFF Power
	Caution when handling heavy equipment		Standby indication
	Danger of electric shock		Direct current (DC)

Symbol	Meaning	Symbol	Meaning
	Caution ! Hot surface		Alternating current (AC)
	Protective conductor terminal To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth		Direct/alternating current (DC/AC)
	Earth (Ground)		Class II Equipment to identify equipment meeting the safety requirements specified for Class II equipment (device protected by double or reinforced insulation)
	Frame or chassis 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.		

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.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, e.g. messages relating to property damage.
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 ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency, overvoltage category 2, pollution degree 2.
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 mains-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 mains, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the mains. 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.
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_{rms} > 30 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 IEC 60950-1 / EN 60950-1 or IEC 61010-1 / 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.
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.
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 EN 55011/CISPR 11, and analogously with EN 55022/CISPR 22, EN 55032/CISPR 32)
   - Class A equipment:
     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
     Note: Class A equipment is intended for use in an industrial environment. This equipment may cause radio disturbances in residential environments, due to possible conducted as well as radiated disturbances. In this case, the operator may be required to take appropriate measures to eliminate these disturbances.
   - Class B equipment:
     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.

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.
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 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.

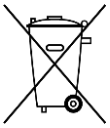
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa 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.

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.

Señalización de seguridad de los productos

Las siguientes señales de seguridad se utilizan en los productos para advertir sobre riesgos y peligros.

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.

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.

Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.

Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.

Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.

Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales.
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.

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 ±10 % sobre el voltaje nominal y de ±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.
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_{eff} > 30 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.).
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.

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 señalizar 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.
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 de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

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.

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.
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 (polvos 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.

Grundlegende Sicherheitshinweise

Lesen und beachten Sie unbedingt die nachfolgenden Anweisungen und Sicherheitshinweise!

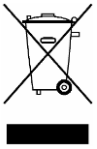
Alle Werke und Standorte der Rohde & Schwarz Firmengruppe sind ständig bemüht, den Sicherheitsstandard unserer Produkte auf dem aktuellsten Stand zu halten und unseren Kunden ein höchstmögliches Maß an Sicherheit zu bieten. Unsere Produkte und die dafür erforderlichen Zusatzgeräte werden entsprechend der jeweils gültigen Sicherheitsvorschriften gebaut und geprüft. Die Einhaltung dieser Bestimmungen wird durch unser Qualitätssicherungssystem laufend überwacht. Das vorliegende Produkt ist gemäß beiliegender EU-Konformitätsbescheinigung gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen. Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muss der Benutzer alle Hinweise, Warnhinweise und Warnvermerke beachten. Bei allen Fragen bezüglich vorliegender Sicherheitshinweise steht Ihnen die Rohde & Schwarz Firmengruppe jederzeit gerne zur Verfügung.

Darüber hinaus liegt es in der Verantwortung des Benutzers, das Produkt in geeigneter Weise zu verwenden. Das Produkt ist ausschließlich für den Betrieb in Industrie und Labor bzw., wenn ausdrücklich zugelassen, auch für den Feldeinsatz bestimmt und darf in keiner Weise so verwendet werden, dass einer Person/Sache Schaden zugefügt werden kann. Die Benutzung des Produkts außerhalb des bestimmungsgemäßen Gebrauchs oder unter Missachtung der Anweisungen des Herstellers liegt in der Verantwortung des Benutzers. Der Hersteller übernimmt keine Verantwortung für die Zweckentfremdung des Produkts.

Die bestimmungsgemäße Verwendung des Produkts wird angenommen, wenn das Produkt nach den Vorgaben der zugehörigen Produktdokumentation innerhalb seiner Leistungsgrenzen verwendet wird (siehe Datenblatt, Dokumentation, nachfolgende Sicherheitshinweise). Die Benutzung des Produkts erfordert Fachkenntnisse und zum Teil englische Sprachkenntnisse. Es ist daher zu beachten, dass das Produkt ausschließlich von Fachkräften oder sorgfältig eingewiesenen Personen mit entsprechenden Fähigkeiten bedient werden darf. Sollte für die Verwendung von Rohde & Schwarz-Produkten persönliche Schutzausrüstung erforderlich sein, wird in der Produktdokumentation an entsprechender Stelle darauf hingewiesen. Bewahren Sie die grundlegenden Sicherheitshinweise und die Produktdokumentation gut auf und geben Sie diese an weitere Benutzer des Produkts weiter.

Die Einhaltung der Sicherheitshinweise dient dazu, Verletzungen oder Schäden durch Gefahren aller Art auszuschließen. Hierzu ist es erforderlich, dass die nachstehenden Sicherheitshinweise vor der Benutzung des Produkts sorgfältig gelesen und verstanden sowie bei der Benutzung des Produkts beachtet werden. Sämtliche weitere Sicherheitshinweise wie z.B. zum Personenschutz, die an entsprechender Stelle der Produktdokumentation stehen, sind ebenfalls unbedingt zu beachten. In den vorliegenden Sicherheitshinweisen sind sämtliche von der Rohde & Schwarz Firmengruppe vertriebenen Waren unter dem Begriff „Produkt“ zusammengefasst, hierzu zählen u. a. Geräte, Anlagen sowie sämtliches Zubehör.

Symbole und Sicherheitskennzeichnungen

Symbol	Bedeutung	Symbol	Bedeutung
	Achtung, allgemeine Gefahrenstelle Produktdokumentation beachten		EIN-/AUS (Versorgung)
	Vorsicht beim Umgang mit Geräten mit hohem Gewicht		Stand-by-Anzeige
	Gefahr vor elektrischem Schlag		Gleichstrom (DC)
	Warnung vor heißer Oberfläche		Wechselstrom (AC)
	Schutzleiteranschluss		Gleichstrom/Wechselstrom (DC/AC)
	Erdungsanschluss		Gerät entspricht den Sicherheits-anforderungen an die Schutzklasse II (Gerät durchgehend durch doppelte / verstärkte Isolierung geschützt.
	Masseanschluss des Gestells oder Gehäuses		EU - Kennzeichnung für Batterien und Akkumulatoren. Das Gerät enthält eine Batterie bzw. einen Akkumulator. Diese dürfen nicht über unsortierten Siedlungsabfall entsorgt werden, sondern sollten getrennt gesammelt werden. Weitere Informationen siehe Seite 7.
	Achtung beim Umgang mit elektrostatisch gefährdeten Bauelementen		EU - Kennzeichnung für die getrennte Sammlung von Elektro- und Elektronikgeräten. Elektroaltgeräte dürfen nicht über unsortierten Siedlungsabfall entsorgt werden, sondern müssen getrennt gesammelt werden. Weitere Informationen siehe Seite 7.
	Warnung vor Laserstrahl Produkte mit Laser sind je nach ihrer Laser-Klasse mit genormten Warnhinweisen versehen. Laser können aufgrund der Eigenschaften ihrer Strahlung und aufgrund ihrer extrem konzentrierten elektromagnetischen Leistung biologische Schäden verursachen. Für zusätzliche Informationen siehe Kapitel „Betrieb“ Punkt 7.		

Signalworte und ihre Bedeutung

Die folgenden Signalworte werden in der Produktdokumentation verwendet, um vor Risiken und Gefahren zu warnen.

kennzeichnet eine unmittelbare Gefährdung mit hohem Risiko, die Tod oder schwere Körperverletzung zur Folge haben wird, wenn sie nicht vermieden wird.

kennzeichnet eine mögliche Gefährdung mit mittlerem Risiko, die Tod oder (schwere) Körperverletzung zur Folge haben kann, wenn sie nicht vermieden wird.

kennzeichnet eine Gefährdung mit geringem Risiko, die leichte oder mittlere Körperverletzungen zur Folge haben könnte, wenn sie nicht vermieden wird.

weist auf die Möglichkeit einer Fehlbedienung hin, bei der das Produkt Schaden nehmen kann.

Diese Signalworte entsprechen der im europäischen Wirtschaftsraum üblichen Definition für zivile Anwendungen. Neben dieser Definition können in anderen Wirtschaftsräumen oder bei militärischen Anwendungen abweichende Definitionen existieren. Es ist daher darauf zu achten, dass die hier beschriebenen Signalworte stets nur in Verbindung mit der zugehörigen Produktdokumentation und nur in Verbindung mit dem zugehörigen Produkt verwendet werden. Die Verwendung von Signalworten in Zusammenhang mit nicht zugehörigen Produkten oder nicht zugehörigen Dokumentationen kann zu Fehlinterpretationen führen und damit zu Personen- oder Sachschäden führen.

Betriebszustände und Betriebslagen

Das Produkt darf nur in den vom Hersteller angegebenen Betriebszuständen und Betriebslagen ohne Behinderung der Belüftung betrieben werden. Werden die Herstellerangaben nicht eingehalten, kann dies elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen. Bei allen Arbeiten sind die örtlichen bzw. landesspezifischen Sicherheits- und Unfallverhütungsvorschriften zu beachten.

1. Sofern nicht anders vereinbart, gilt für R&S-Produkte folgendes:
   als vorgeschriebene Betriebslage grundsätzlich Gehäuseboden unten, IP-Schutzart 2X, Verschmutzungsgrad 2, Überspannungskategorie 2, nur in Innenräumen verwenden, Betrieb bis 2000 m ü. NN, Transport bis 4500 m ü. NN, für die Nennspannung gilt eine Toleranz von ±10%, für die Nennfrequenz eine Toleranz von ±5%.
2. Stellen Sie das Produkt nicht auf Oberflächen, Fahrzeuge, Ablagen oder Tische, die aus Gewichts- oder Stabilitätsgründen nicht dafür geeignet sind. Folgen Sie bei Aufbau und Befestigung des Produkts an Gegenständen oder Strukturen (z.B. Wände und Regale) immer den Installationshinweisen des Herstellers. Bei Installation abweichend von der Produktdokumentation können Personen verletzt, unter Umständen sogar getötet werden.
3. Stellen Sie das Produkt nicht auf hitzeerzeugende Gerätschaften (z.B. Radiatoren und Heizlüfter). Die Umgebungstemperatur darf nicht die in der Produktdokumentation oder im Datenblatt spezifizierte Maximaltemperatur überschreiten. Eine Überhitzung des Produkts kann elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen.

Elektrische Sicherheit

Werden die Hinweise zur elektrischen Sicherheit nicht oder unzureichend beachtet, kann dies elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen.

1. Vor jedem Einschalten des Produkts ist sicherzustellen, dass die am Produkt eingestellte Nennspannung und die Netznennspannung des Versorgungsnetzes übereinstimmen. Ist es erforderlich, die Spannungseinstellung zu ändern, so muss ggf. auch die dazu gehörige Netzsicherung des Produkts geändert werden.
2. Bei Produkten der Schutzklasse I mit beweglicher Netzzuleitung und Gerätesteckvorrichtung ist der Betrieb nur an Steckdosen mit Schutzkontakt und angeschlossenem Schutzleiter zulässig.
3. Jegliche absichtliche Unterbrechung des Schutzleiters, sowohl in der Zuleitung als auch am Produkt selbst, ist unzulässig. Es kann dazu führen, dass von dem Produkt die Gefahr eines elektrischen Schlags ausgeht. Bei Verwendung von Verlängerungsleitungen oder Steckdosenleisten ist sicherzustellen, dass diese regelmäßig auf ihren sicherheitstechnischen Zustand überprüft werden.
4. Sofern das Produkt nicht mit einem Netzschalter zur Netztrennung ausgerüstet ist, beziehungsweise der vorhandene Netzschalter zu Netztrennung nicht geeignet ist, so ist der Stecker des Anschlusskabels als Trennvorrichtung anzusehen.
   Die Trennvorrichtung muss jederzeit leicht erreichbar und gut zugänglich sein. Ist z.B. der Netzstecker die Trennvorrichtung, darf die Länge des Anschlusskabels 3 m nicht überschreiten.
   Funktionsschalter oder elektronische Schalter sind zur Netztrennung nicht geeignet. Werden Produkte ohne Netzschalter in Gestelle oder Anlagen integriert, so ist die Trennvorrichtung auf Anlagenebene zu verlagern.
5. Benutzen Sie das Produkt niemals, wenn das Netzkabel beschädigt ist. Überprüfen Sie regelmäßig den einwandfreien Zustand der Netzkabel. Stellen Sie durch geeignete Schutzmaßnahmen und Verlegearten sicher, dass das Netzkabel nicht beschädigt werden kann und niemand z.B. durch Stolperfallen oder elektrischen Schlag zu Schaden kommen kann.
6. Der Betrieb ist nur an TN/TT Versorgungsnetzen gestattet, die mit höchstens 16 A abgesichert sind (höhere Absicherung nur nach Rücksprache mit der Rohde & Schwarz Firmengruppe).
7. Stecken Sie den Stecker nicht in verstaubte oder verschmutzte Steckdosen/-buchsen. Stecken Sie die Steckverbindung/-vorrichtung fest und vollständig in die dafür vorgesehenen Steckdosen/-buchsen. Missachtung dieser Maßnahmen kann zu Funken, Feuer und/oder Verletzungen führen.
8. Überlasten Sie keine Steckdosen, Verlängerungskabel oder Steckdosenleisten, dies kann Feuer oder elektrische Schläge verursachen.
9. Bei Messungen in Stromkreisen mit Spannungen U_{eff} > 30 V ist mit geeigneten Maßnahmen Vorsorge zu treffen, dass jegliche Gefährdung ausgeschlossen wird (z.B. geeignete Messmittel, Absicherung, Strombegrenzung, Schutztrennung, Isolierung usw.).
10. Bei Verbindungen mit informationstechnischen Geräten, z.B. PC oder Industrierechner, ist darauf zu achten, dass diese der jeweils gültigen IEC 60950-1 / EN 60950-1 oder IEC 61010-1 / EN 61010-1 entsprechen.
11. Sofern nicht ausdrücklich erlaubt, darf der Deckel oder ein Teil des Gehäuses niemals entfernt werden, wenn das Produkt betrieben wird. Dies macht elektrische Leitungen und Komponenten zugänglich und kann zu Verletzungen, Feuer oder Schaden am Produkt führen.

12. Wird ein Produkt ortsfest angeschlossen, ist die Verbindung zwischen dem Schutzleiteranschluss vor Ort und dem Geräteschutzleiter vor jeglicher anderer Verbindung herzustellen. Aufstellung und Anschluss darf nur durch eine Elektrofachkraft erfolgen.
13. Bei ortsfesten Geräten ohne eingebaute Sicherung, Selbstschalter oder ähnliche Schutzeinrichtung muss der Versorgungskreis so abgesichert sein, dass alle Personen, die Zugang zum Produkt haben, sowie das Produkt selbst ausreichend vor Schäden geschützt sind.
14. Jedes Produkt muss durch geeigneten Überspannungsschutz vor Überspannung (z.B. durch Blitzschlag) geschützt werden. Andernfalls ist das bedienende Personal durch elektrischen Schlag gefährdet.
15. Gegenstände, die nicht dafür vorgesehen sind, dürfen nicht in die Öffnungen des Gehäuses eingebracht werden. Dies kann Kurzschlüsse im Produkt und/oder elektrische Schläge, Feuer oder Verletzungen verursachen.
16. Sofern nicht anders spezifiziert, sind Produkte nicht gegen das Eindringen von Flüssigkeiten geschützt, siehe auch Abschnitt "Betriebszustände und Betriebslagen", Punkt 1. Daher müssen die Geräte vor Eindringen von Flüssigkeiten geschützt werden. Wird dies nicht beachtet, besteht Gefahr durch elektrischen Schlag für den Benutzer oder Beschädigung des Produkts, was ebenfalls zur Gefährdung von Personen führen kann.
17. Benutzen Sie das Produkt nicht unter Bedingungen, bei denen Kondensation in oder am Produkt stattfinden könnte oder ggf. bereits stattgefunden hat, z.B. wenn das Produkt von kalter in warme Umgebung bewegt wurde. Das Eindringen von Wasser erhöht das Risiko eines elektrischen Schlages.
18. Trennen Sie das Produkt vor der Reinigung komplett von der Energieversorgung (z.B. speisendes Netz oder Batterie). Nehmen Sie bei Geräten die Reinigung mit einem weichen, nicht fasernden Staublappen vor. Verwenden Sie keinesfalls chemische Reinigungsmittel wie z.B. Alkohol, Aceton, Nitroverdünnung.

Betrieb

1. Die Benutzung des Produkts erfordert spezielle Einweisung und hohe Konzentration während der Benutzung. Es muss sichergestellt sein, dass Personen, die das Produkt bedienen, bezüglich ihrer körperlichen, geistigen und seelischen Verfassung den Anforderungen gewachsen sind, da andernfalls Verletzungen oder Sachschäden nicht auszuschließen sind. Es liegt in der Verantwortung des Arbeitsgebers/Betreibers, geeignetes Personal für die Benutzung des Produkts auszuwählen.
2. Bevor Sie das Produkt bewegen oder transportieren, lesen und beachten Sie den Abschnitt "Transport".
3. Wie bei allen industriell gefertigten Gütern kann die Verwendung von Stoffen, die Allergien hervorrufen - so genannte Allergene (z.B. Nickel) - nicht generell ausgeschlossen werden. Sollten beim Umgang mit R&S-Produkten allergische Reaktionen, z.B. Hautausschlag, häufiges Niesen, Bindehautrötung oder Atembeschwerden auftreten, ist umgehend ein Arzt aufzusuchen, um die Ursachen zu klären und Gesundheitsschäden bzw. -belastungen zu vermeiden.
4. Vor der mechanischen und/oder thermischen Bearbeitung oder Zerlegung des Produkts beachten Sie unbedingt Abschnitt "Entsorgung", Punkt 1.

5. Bei bestimmten Produkten, z.B. HF-Funkanlagen, können funktionsbedingt erhöhte elektromagnetische Strahlungen auftreten. Unter Berücksichtigung der erhöhten Schutzwürdigkeit des ungeborenen Lebens müssen Schwangere durch geeignete Maßnahmen geschützt werden. Auch Träger von Herzschrittmachern können durch elektromagnetische Strahlungen gefährdet sein. Der Arbeitgeber/Betreiber ist verpflichtet, Arbeitsstätten, bei denen ein besonderes Risiko einer Strahlenexposition besteht, zu beurteilen und zu kennzeichnen und mögliche Gefahren abzuwenden.
6. Im Falle eines Brandes entweichen ggf. giftige Stoffe (Gase, Flüssigkeiten etc.) aus dem Produkt, die Gesundheitsschäden verursachen können. Daher sind im Brandfall geeignete Maßnahmen wie z.B. Atemschutzmasken und Schutzkleidung zu verwenden.
7. Falls ein Laser-Produkt in ein R&S-Produkt integriert ist (z.B. CD/DVD-Laufwerk), dürfen keine anderen Einstellungen oder Funktionen verwendet werden, als in der Produktdokumentation beschrieben, um Personenschäden zu vermeiden (z.B. durch Laserstrahl).
8. EMV Klassen (nach EN 55011 / CISPR 11; sinngemäß EN 55022 / CISPR 22, EN 55032 / CISPR 32)

   Gerät der Klasse A:
   Ein Gerät, das sich für den Gebrauch in allen anderen Bereichen außer dem Wohnbereich und solchen Bereichen eignet, die direkt an ein Niederspannungs-Versorgungsnetz angeschlossen sind, das Wohngebäude versorgt.
   Hinweis: Diese Einrichtung kann wegen möglicher auftretender leitungsgebundener als auch gestrahlten Störgrößen im Wohnbereich Funkstörungen verursachen. In diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen durchzuführen.
   Gerät der Klasse B:
   Ein Gerät, das sich für den Betrieb im Wohnbereich sowie in solchen Bereichen eignet, die direkt an ein Niederspannungs-Versorgungsnetz angeschlossen sind, das Wohngebäude versorgt.

Reparatur und Service

1. Das Produkt darf nur von dafür autorisiertem Fachpersonal geöffnet werden. Vor Arbeiten am Produkt oder Öffnen des Produkts ist dieses von der Versorgungsspannung zu trennen, sonst besteht das Risiko eines elektrischen Schlages.
2. Abgleich, Auswechseln von Teilen, Wartung und Reparatur darf nur von R&S-autorisierten Elektrofachkräften ausgeführt werden. Werden sicherheitsrelevante Teile (z.B. Netzschalter, Netztrafos oder Sicherungen) ausgewechselt, so dürfen diese nur durch Originalteile ersetzt werden. Nach jedem Austausch von sicherheitsrelevanten Teilen ist eine Sicherheitsprüfung durchzuführen (Sichtprüfung, Schutzleitertest, Isolationswiderstand-, Ableitstrommessung, Funktionstest). Damit wird sichergestellt, dass die Sicherheit des Produkts erhalten bleibt.

Batterien und Akkumulatoren/Zellen

Werden die Hinweise zu Batterien und Akkumulatoren/Zellen nicht oder unzureichend beachtet, kann dies Explosion, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen. Die Handhabung von Batterien und Akkumulatoren mit alkalischen Elektrolyten (z.B. Lithiumzellen) muss der EN 62133 entsprechen.

1. Zellen dürfen nicht zerlegt, geöffnet oder zerkleinert werden.
2. Zellen oder Batterien dürfen weder Hitze noch Feuer ausgesetzt werden. Die Lagerung im direkten Sonnenlicht ist zu vermeiden. Zellen und Batterien sauber und trocken halten. Verschmutzte Anschlüsse mit einem trockenen, sauberen Tuch reinigen.

3. Zellen oder Batterien dürfen nicht kurzgeschlossen werden. Zellen oder Batterien dürfen nicht gefahrbringend in einer Schachtel oder in einem Schubfach gelagert werden, wo sie sich gegenseitig kurzschließen oder durch andere leitende Werkstoffe kurzgeschlossen werden können. Eine Zelle oder Batterie darf erst aus ihrer Originalverpackung entnommen werden, wenn sie verwendet werden soll.
4. Zellen oder Batterien dürfen keinen unzulässig starken, mechanischen Stößen ausgesetzt werden.
5. Bei Undichtheit einer Zelle darf die Flüssigkeit nicht mit der Haut in Berührung kommen oder in die Augen gelangen. Falls es zu einer Berührung gekommen ist, den betroffenen Bereich mit reichlich Wasser waschen und ärztliche Hilfe in Anspruch nehmen.
6. Werden Zellen oder Batterien, die alkalische Elektrolyte enthalten (z.B. Lithiumzellen), unsachgemäß ausgewechselt oder geladen, besteht Explosionsgefahr. Zellen oder Batterien nur durch den entsprechenden R&S-Typ ersetzen (siehe Ersatzteilliste), um die Sicherheit des Produkts zu erhalten.
7. Zellen oder Batterien müssen wiederverwertet werden und dürfen nicht in den Restmüll gelangen. Akkumulatoren oder Batterien, die Blei, Quecksilber oder Cadmium enthalten, sind Sonderabfall. Beachten Sie hierzu die landesspezifischen Entsorgungs- und Recycling-Bestimmungen.

Transport

1. Das Produkt kann ein hohes Gewicht aufweisen. Daher muss es vorsichtig und ggf. unter Verwendung eines geeigneten Hebemittels (z.B. Hubwagen) bewegt bzw. transportiert werden, um Rückenschäden oder Verletzungen zu vermeiden.
2. Griffe an den Produkten sind eine Handhabungshilfe, die ausschließlich für den Transport des Produkts durch Personen vorgesehen ist. Es ist daher nicht zulässig, Griffe zur Befestigung an bzw. auf Transportmitteln, z.B. Kränen, Gabelstaplern, Karren etc. zu verwenden. Es liegt in Ihrer Verantwortung, die Produkte sicher an bzw. auf geeigneten Transport- oder Hebemitteln zu befestigen. Beachten Sie die Sicherheitsvorschriften des jeweiligen Herstellers eingesetzter Transport- oder Hebemittel, um Personenschäden und Schäden am Produkt zu vermeiden.
3. Falls Sie das Produkt in einem Fahrzeug benutzen, liegt es in der alleinigen Verantwortung des Fahrers, das Fahrzeug in sicherer und angemessener Weise zu führen. Der Hersteller übernimmt keine Verantwortung für Unfälle oder Kollisionen. Verwenden Sie das Produkt niemals in einem sich bewegenden Fahrzeug, sofern dies den Fahrzeugführer ablenken könnte. Sichern Sie das Produkt im Fahrzeug ausreichend ab, um im Falle eines Unfalls Verletzungen oder Schäden anderer Art zu verhindern.

Entsorgung

1. Batterien bzw. Akkumulatoren, die nicht mit dem Hausmüll entsorgt werden dürfen, darf nach Ende der Lebensdauer nur über eine geeignete Sammelstelle oder eine Rohde & Schwarz-Kundendienststelle entsorgt werden.
2. Am Ende der Lebensdauer des Produktes darf dieses Produkt nicht über den normalen Hausmüll entsorgt werden, sondern muss getrennt gesammelt werden.
   Rohde & Schwarz GmbH & Co.KG ein Entsorgungskonzept entwickelt und übernimmt die Pflichten der Rücknahme- und Entsorgung für Hersteller innerhalb der EU in vollem Umfang. Wenden Sie sich bitte an Ihre Rohde & Schwarz-Kundendienststelle, um das Produkt umweltgerecht zu entsorgen.

3. Werden Produkte oder ihre Bestandteile über den bestimmungsgemäßen Betrieb hinaus mechanisch und/oder thermisch bearbeitet, können ggf. gefährliche Stoffe (schwermetallhaltiger Staub wie z.B. Blei, Beryllium, Nickel) freigesetzt werden. Die Zerlegung des Produkts darf daher nur von speziell geschultem Fachpersonal erfolgen. Unsachgemäßes Zerlegen kann Gesundheitsschäden hervorrufen. Die nationalen Vorschriften zur Entsorgung sind zu beachten.
4. Falls beim Umgang mit dem Produkt Gefahren- oder Betriebsstoffe entstehen, die speziell zu entsorgen sind, z.B. regelmäßig zu wechselnde Kühlmittel oder Motorenöle, sind die Sicherheitshinweise des Herstellers dieser Gefahren- oder Betriebsstoffe und die regional gültigen Entsorgungsvorschriften einzuhalten. Beachten Sie ggf. auch die zugehörigen speziellen Sicherheitshinweise in der Produktdokumentation. Die unsachgemäße Entsorgung von Gefahren- oder Betriebsstoffen kann zu Gesundheitsschäden von Personen und Umweltschäden führen.

Weitere Informationen zu Umweltschutz finden Sie auf der Rohde & Schwarz Home Page.

Consignes de sécurité fondamentales

Lisez et respectez impérativement les instructions et consignes de sécurité suivantes

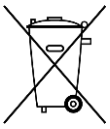
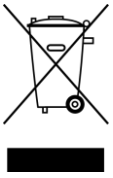
Les usines et sites du groupe Rohde & Schwarz veillent à la conformité des produits du groupe avec les normes de sécurité en vigueur dans un souci constant de garantir aux clients le plus haut niveau de sécurité possible. Nos produits ainsi que les accessoires nécessaires sont fabriqués et testés conformément aux règles de sécurité en vigueur. Le respect de ces règles est vérifié régulièrement par notre système d'assurance qualité. Le présent produit a été fabriqué et contrôlé conformément au certificat de conformité CE ci-joint et a quitté l'usine dans un parfait état de sécurité. Pour le maintenir dans cet état et en garantir une utilisation sans danger, l'utilisateur doit respecter l'ensemble des consignes, remarques de sécurité et avertissements qui se trouvent dans ce manuel. Le groupe Rohde & Schwarz se tient à votre disposition pour toutes questions relatives aux présentes consignes de sécurité.

Il incombe à l'utilisateur d'employer ce produit de manière appropriée. Le produit est exclusivement destiné à l'utilisation en industrie et en laboratoire et/ou, si cela a été expressément autorisé, également aux travaux extérieurs ; il ne peut en aucun cas être utilisé à des fins pouvant causer des dommages corporels ou matériels. L'exploitation du produit en dehors de son utilisation prévue ou le non-respect des consignes du fabricant se font sous la responsabilité de l'utilisateur. Le fabricant décline toute responsabilité en cas d'utilisation non conforme du produit.

Le produit est présumé faire l'objet d'une utilisation conforme lorsqu'il est utilisé conformément aux consignes de la documentation produit correspondante et dans la limite de ses performances (voir fiche technique, documentation, consignes de sécurité ci-après). L'utilisation du produit exige des compétences en la matière et des connaissances de base de l'anglais. Par conséquent, le produit ne devra être utilisé que par un personnel qualifié ou des personnes formées de manière approfondie et possédant les compétences requises. Si, pour l'utilisation des produits Rohde & Schwarz, l'emploi d'un équipement personnel de protection s'avère nécessaire, il en est fait mention dans la documentation produit à l'emplacement correspondant. Conservez les consignes de sécurité fondamentales et la documentation produit dans un lieu sûr et transmettez ces documents aux autres utilisateurs du produit.

La stricte observation des consignes de sécurité a pour but d'exclure des blessures ou dommages causés par des dangers de toutes sortes. A cet effet, il est nécessaire de lire avec soin et de bien comprendre les consignes de sécurité ci-dessous avant l'utilisation du produit et de les respecter lors de l'utilisation du produit. Toutes les autres consignes de sécurité présentées à l'emplacement correspondant de la documentation produit, par exemple, celles concernant la protection des personnes, doivent également être impérativement respectées. Dans les présentes consignes de sécurité, toutes les marchandises commercialisées par le groupe Rohde & Schwarz, notamment les appareils, les systèmes ainsi que les accessoires, sont dénommés « produit ».

Symboles et marquages de sécurité

Symbole	Signification	Symbole	Signification
	Avis, source générale de danger Se référer à la documentation produit		MARCHE / ARRET (tension d'alimentation)
	Attention lors de la manipulation d'appareils ayant un poids élevé		Indicateur de veille
	Risque de choc électrique		Courant continu (CC)
	Avertissement, surface chaude		Courant alternatif (CA)
	Borne de conducteur de protection		Courant continu/alternatif (CC/CA)
	Borne de mise à la terre		L'appareil est conforme aux exigences de sécurité du degré de protection II (appareil entièrement protégé par isolation double/renforcée).
	Borne de mise à la masse du bâti ou du boîtier		Marquage UE pour batteries et accumulateurs. L'appareil contient une batterie ou un accumulateur. Ces pièces ne peuvent pas être éliminées avec les déchets urbains non triés, mais doivent faire l'objet d'une collecte séparée. Pour plus d'informations, voir la page 7.
	Avis : prudence lors de la manipulation de composants sensibles aux décharges électrostatiques		Marquage UE pour la collecte séparée d'équipements électriques et électroniques. Les déchets d'équipements électriques et électroniques ne peuvent pas être éliminés avec les déchets urbains non triés, mais doivent faire l'objet d'une collecte séparée. Pour plus d'informations, voir la page 7.
	Avertissement, rayon laser Les produits laser sont munis d'avertissements normalisés d'après leur catégorie laser. En raison des caractéristiques de leur rayonnement ainsi que de leur puissance électromagnétique extrêmement concentrée, les lasers peuvent causer des dommages biologiques. Pour plus d'informations, voir le chapitre « Fonctionnement »", point 7.		

Mots d'alerte et significations

Les mots d'alerte suivants sont utilisés dans la documentation produit pour avertir des risques et dangers.

DANGER	Indique une situation dangereuse immédiate qui, si elle n'est pas évitée, comporte un risque élevé de blessures graves ou mortelles.
AVERTISSEMENT	Indique une situation dangereuse possible qui, si elle n'est pas évitée, comporte un risque modéré de blessures (graves) ou mortelles.
ATTENTION	Indique une situation dangereuse qui, si elle n'est pas évitée, comporte un risque faible de blessures mineures ou modérées.
AVIS	Indique la possibilité d'une fausse manœuvre susceptible d'endommager le produit.

Ces mots d'alerte correspondent à la définition habituelle utilisée pour des applications civiles dans l'espace économique européen. Des définitions divergentes peuvent cependant exister dans d'autres espaces économiques ou dans le cadre d'applications militaires. Il faut donc veiller à ce que les mots d'alerte décrits ici ne soient utilisés qu'en relation avec la documentation produit correspondante et seulement avec le produit correspondant. L'utilisation des mots d'alerte en relation avec des produits ou des documentations non correspondants peut conduire à des erreurs d'interprétation et par conséquent à des dommages corporels ou matériels.

États et positions de fonctionnement

L'appareil ne doit être utilisé que dans les états et positions de fonctionnement indiqués par le fabricant. Tout obstacle à la ventilation doit être empêché. Le non-respect des indications du fabricant peut provoquer des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort. Pour tous les travaux, les règles locales et/ou nationales de sécurité et de prévention des accidents doivent être respectées.

1. Sauf stipulations contraires, les produits Rohde & Schwarz répondent aux exigences ci-après : faire fonctionner le produit avec le fond du boîtier toujours en bas, degré de protection IP 2X, degré de pollution 2, catégorie de surtension 2, utilisation uniquement à l'intérieur, fonctionnement à une altitude max. de 2000 m au-dessus du niveau de la mer, transport à une altitude max. de 4500 m au-dessus du niveau de la mer, tolérance de ±10 % pour la tension nominale et de ±5 % pour la fréquence nominale.
2. Ne jamais placer le produit sur des surfaces, véhicules, dépôts ou tables non appropriés pour raisons de stabilité ou de poids. Suivre toujours strictement les indications d'installation du fabricant pour le montage et la fixation du produit sur des objets ou des structures (par exemple parois et étagères). En cas d'installation non conforme à la documentation produit, il y a risque de blessures, voire de mort.
3. Ne jamais placer le produit sur des dispositifs générant de la chaleur (par exemple radiateurs et appareils de chauffage soufflants). La température ambiante ne doit pas dépasser la température maximale spécifiée dans la documentation produit ou dans la fiche technique. Une surchauffe du produit peut provoquer des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort.

Sécurité électrique

Si les consignes relatives à la sécurité électrique ne sont pas ou sont insuffisamment respectées, il peut s'ensuivre des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort.

1. Avant chaque mise sous tension du produit, il faut s'assurer que la tension nominale réglée sur le produit correspond à la tension nominale du réseau électrique. S'il est nécessaire de modifier le réglage de la tension, il faut remplacer le fusible du produit, le cas échéant.
2. L'utilisation des produits du degré de protection I pourvus d'un câble d'alimentation mobile et d'un connecteur n'est autorisée qu'avec des prises munies d'un contact de protection et d'un conducteur de protection raccordé.
3. Toute déconnexion intentionnelle du conducteur de protection, dans le câble ou dans le produit lui-même, est interdite. Elle entraîne un risque de choc électrique au niveau du produit. En cas d'utilisation de câbles prolongateurs ou de multiprises, ceux-ci doivent être examinés régulièrement quant à leur état de sécurité technique.
4. Si le produit n'est pas doté d'un interrupteur d'alimentation pour le couper du réseau électrique ou si l'interrupteur d'alimentation disponible n'est pas approprié pour couper le produit du réseau électrique, le connecteur mâle du câble de raccordement est à considérer comme dispositif de séparation.
   Le dispositif de séparation doit être à tout moment facilement accessible. Si, par exemple, le connecteur d'alimentation sert de dispositif de séparation, la longueur du câble de raccordement ne doit pas dépasser 3 m.
   Les commutateurs fonctionnels ou électroniques ne sont pas appropriés pour couper l'appareil du réseau électrique. Si des produits sans interrupteur d'alimentation sont intégrés dans des bâtis ou systèmes, le dispositif de séparation doit être reporté au niveau du système.
5. Ne jamais utiliser le produit si le câble d'alimentation est endommagé. Vérifier régulièrement le parfait état du câble d'alimentation. Prendre les mesures préventives appropriées et opter pour des types de pose tels que le câble d'alimentation ne puisse pas être endommagé et que personne ne puisse subir de préjudice, par exemple en trébuchant sur le câble ou par des chocs électriques.
6. L'utilisation des produits est uniquement autorisée sur des réseaux d'alimentation de type TN/TT protégés par des fusibles d'une intensité max. de 16 A (pour toute intensité supérieure, consulter le groupe Rohde & Schwarz).
7. Ne pas brancher le connecteur dans des prises d'alimentation sales ou poussiéreuses. Enfoncer fermement le connecteur jusqu'au bout de la prise. Le non-respect de cette mesure peut provoquer des étincelles, incendies et/ou blessures.
8. Ne pas surcharger les prises, les câbles prolongateurs ou les multiprises, cela pouvant provoquer des incendies ou chocs électriques.
9. En cas de mesures sur les circuits électriques d'une tension efficace > 30 V, prendre les précautions nécessaires pour éviter tout risque (par exemple équipement de mesure approprié, fusibles, limitation de courant, coupe-circuit, isolation, etc.).
10. En cas d'interconnexion avec des équipements informatiques comme par exemple un PC ou un ordinateur industriel, veiller à ce que ces derniers soient conformes aux normes IEC 60950-1 / EN 60950-1 ou IEC 61010-1 / EN 61010-1 en vigueur.
11. Sauf autorisation expresse, il est interdit de retirer le couvercle ou toute autre pièce du boîtier lorsque le produit est en cours de service. Les câbles et composants électriques seraient ainsi accessibles, ce qui peut entraîner des blessures, des incendies ou des dégâts sur le produit.

12. Si un produit est connecté de façon stationnaire, établir avant toute autre connexion le raccordement du conducteur de protection local et du conducteur de protection du produit. L'installation et le raccordement ne peuvent être effectués que par un électricien ou électronicien qualifié.
13. Sur les appareils stationnaires sans fusible ni disjoncteur automatique ou dispositif de protection similaire intégrés, le circuit d'alimentation doit être sécurisé de sorte que toutes les personnes ayant accès au produit et le produit lui-même soient suffisamment protégés contre tout dommage.
14. Chaque produit doit être protégé de manière appropriée contre les éventuelles surtensions (par exemple dues à un coup de foudre). Sinon, les utilisateurs sont exposés à des risques de choc électrique.
15. Ne jamais introduire d'objets non prévus à cet effet dans les ouvertures du boîtier, étant donné que cela peut entraîner des courts-circuits dans le produit et/ou des chocs électriques, incendies ou blessures.
16. Sauf spécification contraire, les produits ne sont pas protégés contre l'infiltration de liquides, voir aussi la section « États et positions de fonctionnement », point 1. Il faut donc protéger les produits contre l'infiltration de liquides. La non-observation de cette consigne entraîne le risque de choc électrique pour l'utilisateur ou d'endommagement du produit, ce qui peut également mettre les personnes en danger.
17. Ne pas utiliser le produit dans des conditions pouvant occasionner ou ayant déjà occasionné, le cas échéant, des condensations dans ou sur le produit, par exemple lorsque celui-ci est déplacé d'un environnement froid dans un environnement chaud. L'infiltration d'eau augmente le risque de choc électrique.
18. Avant le nettoyage, débrancher le produit de l'alimentation (par exemple réseau électrique ou batterie). Pour le nettoyage des appareils, utiliser un chiffon doux non pelucheux. N'utiliser en aucun cas de produit de nettoyage chimique, tel que de l'alcool, de l'acétone ou un diluant nitrocellulosique.

Fonctionnement

1. L'utilisation du produit exige une formation spécifique ainsi qu'une grande concentration. Il est impératif que les personnes qui utilisent le produit présent les aptitudes physiques, mentales et psychiques requises, vu qu'autrement des dommages corporels ou matériels ne peuvent pas être exclus. Le choix du personnel qualifié pour l'utilisation du produit est sous la responsabilité de l'employeur/l'exploitant.
2. Avant de déplacer ou de transporter le produit, lire et respecter la section « Transport ».
3. Comme pour tous les biens produits de façon industrielle, l'utilisation de matériaux pouvant causer des allergies (allergènes, comme par exemple le nickel) ne peut être totalement exclue. Si, lors de l'utilisation de produits Rohde & Schwarz, des réactions allergiques surviennent, telles qu'éruption cutanée, éternuements fréquents, rougeur de la conjonctive ou difficultés respiratoires, il faut immédiatement consulter un médecin pour en clarifier la cause et éviter toute atteinte à la santé.
4. Avant le traitement mécanique et/ou thermique ou le démontage du produit, il faut impérativement observer la section « Élimination des déchets », point 1.

5. Selon les fonctions, certains produits, tels que des systèmes de radiocommunication RF, peuvent produire des niveaux élevés de rayonnement électromagnétique. Étant donné la vulnérabilité de l'enfant à naître, les femmes enceintes doivent être protégées par des mesures appropriées. Les porteurs de stimulateurs cardiaques peuvent également être menacés par les rayonnements électromagnétiques. L'employeur/l'exploitant est tenu d'évaluer et de repérer les lieux de travail soumis à un risque particulier d'exposition aux rayonnements et de prévenir les dangers éventuels.
6. En cas d'incendie, il se peut que le produit dégage des matières toxiques (gaz, liquides, etc.) susceptibles de nuire à la santé. Il faut donc, en cas d'incendie, prendre des mesures adéquates comme par exemple le port de masques respiratoires et de vêtements de protection.
7. Si un produit laser est intégré dans un produit Rohde & Schwarz (par exemple lecteur CD/DVD), il ne faut pas utiliser de réglages ou fonctions autres que ceux décrits dans la documentation produit pour éviter tout dommage corporel (par exemple causé par rayon laser).
8. Classes CEM (selon EN 55011 / CISPR 11 ; selon EN 55022 / CISPR 22, EN 55032 / CISPR 32 par analogie)
   - Appareil de la classe A :
     Appareil approprié à un usage dans tous les environnements autres que l'environnement résidentiel et les environnements raccordés directement à un réseau d'alimentation basse tension qui alimente des bâtiments résidentiels.
     Remarque : ces appareils peuvent provoquer des perturbations radioélectriques dans l'environnement résidentiel en raison de perturbations conduites ou rayonnées. Dans ce cas, on peut exiger que l'exploitant mette en œuvre de mesures appropriées pour éliminer ces perturbations.
   - Appareil de la classe B :
     Appareil approprié à un usage dans l'environnement résidentiel ainsi que dans les environnements raccordés directement à un réseau d'alimentation basse tension qui alimente des bâtiments résidentiels.

Réparation et service après-vente

1. Le produit ne doit être ouvert que par un personnel qualifié et autorisé. Avant de travailler sur le produit ou de l'ouvrir, il faut le couper de la tension d'alimentation ; sinon il y a risque de choc électrique.
2. Les travaux d'ajustement, le remplacement des pièces, la maintenance et la réparation ne doivent être effectués que par des électroniciens qualifiés et autorisés par Rohde & Schwarz. En cas de remplacement de pièces concernant la sécurité (notamment interrupteur d'alimentation, transformateur d'alimentation réseau ou fusibles), celles-ci ne doivent être remplacées que par des pièces d'origine. Après chaque remplacement de pièces concernant la sécurité, une vérification de sécurité doit être effectuée (contrôle visuel, vérification du conducteur de protection, mesure de la résistance d'isolement et du courant de fuite, essai de fonctionnement). Cela permet d'assurer le maintien de la sécurité du produit.

Batteries et accumulateurs/cellules

Si les instructions concernant les batteries et accumulateurs/cellules ne sont pas ou sont insuffisamment respectées, cela peut provoquer des explosions, des incendies et/ou des blessures graves pouvant entraîner la mort. La manipulation de batteries et accumulateurs contenant des électrolytes alcalins (par exemple cellules de lithium) doit être conforme à la norme EN 62133.

1. Les cellules ne doivent être ni démontées, ni ouvertes, ni réduites en morceaux.
2. Ne jamais exposer les cellules ou batteries à la chaleur ou au feu. Ne pas les stocker dans un endroit où elles sont exposées au rayonnement direct du soleil. Tenir les cellules et batteries au sec. Nettoyer les raccords sales avec un chiffon sec et propre.
3. Ne jamais court-circuiter les cellules ou batteries. Les cellules ou batteries ne doivent pas être gardées dans une boîte ou un tiroir où elles peuvent se court-circuiter mutuellement ou être court-circuitées par d'autres matériaux conducteurs. Une cellule ou batterie ne doit être retirée de son emballage d'origine que lorsqu'on l'utilise.
4. Les cellules ou batteries ne doivent pas être exposées à des chocs mécaniques de force non admissible.
5. En cas de manque d'étanchéité d'une cellule, le liquide ne doit pas entrer en contact avec la peau ou les yeux. S'il y a contact, rincer abondamment à l'eau l'endroit concerné et consulter un médecin.
6. Il y a danger d'explosion en cas de remplacement ou chargement incorrect des cellules ou batteries qui contiennent des électrolytes alcalins (par exemple cellules de lithium). Remplacer les cellules ou batteries uniquement par le type Rohde & Schwarz correspondant (voir la liste des pièces de rechange) pour maintenir la sécurité du produit.
7. Il faut recycler les cellules ou batteries et il est interdit de les éliminer comme déchets normaux. Les accumulateurs ou batteries qui contiennent du plomb, du mercure ou du cadmium sont des déchets spéciaux. Observer les règles nationales d'élimination et de recyclage.

Transport

1. Le produit peut avoir un poids élevé. Il faut donc le déplacer ou le transporter avec précaution et en utilisant le cas échéant un moyen de levage approprié (par exemple, chariot élévateur) pour éviter des dommages au dos ou des blessures.
2. Les poignées des produits sont une aide de manipulation exclusivement réservée au transport du produit par des personnes. Il est donc proscrit d'utiliser ces poignées pour attacher le produit à ou sur des moyens de transport, tels que grues, chariots et chariots élévateurs, etc. Vous êtes responsable de la fixation sûre des produits à ou sur des moyens de transport et de levage appropriés. Observer les consignes de sécurité du fabricant des moyens de transport ou de levage utilisés pour éviter des dommages corporels et des dégâts sur le produit.
3. L'utilisation du produit dans un véhicule se fait sous l'unique responsabilité du conducteur qui doit piloter le véhicule de manière sûre et appropriée. Le fabricant décline toute responsabilité en cas d'accidents ou de collisions. Ne jamais utiliser le produit dans un véhicule en mouvement si cela pouvait détourner l'attention du conducteur. Sécuriser suffisamment le produit dans le véhicule pour empêcher des blessures ou dommages de tout type en cas d'accident.

Élimination des déchets

1. Au terme de leur durée de vie, les batteries ou accumulateurs qui ne peuvent pas être éliminés avec les déchets ménagers peuvent uniquement être éliminés par des points de collecte appropriés ou par un centre de service après-vente Rohde & Schwarz.

2. Au terme de sa durée de vie, un produit ne peut pas être éliminé avec les déchets ménagers normaux, mais doit être collecté séparément.
   Rohde & Schwarz GmbH & Co. KG a développé un concept d'élimination des déchets et assume toutes les obligations en matière de reprise et d'élimination, valables pour les fabricants au sein de l'UE. Veuillez vous adresser à votre centre de service après-vente Rohde & Schwarz pour éliminer le produit de manière écologique.
3. Si les produits ou leurs composants sont travaillés mécaniquement et/ou thermiquement au-delà de l'utilisation prévue, ils peuvent, le cas échéant, libérer des substances dangereuses (poussières contenant des métaux lourds comme par exemple du plomb, du béryllium ou du nickel). Le démontage du produit ne doit donc être effectué que par un personnel qualifié et spécialement formé. Le démontage inadéquat peut nuire à la santé. Les règles nationales concernant l'élimination des déchets doivent être observées.
4. Si, lors de l'utilisation du produit, des substances dangereuses ou combustibles exigeant une élimination spéciale sont dégagées, comme par exemple liquides de refroidissement ou huiles moteurs qui sont à changer régulièrement, les consignes de sécurité du fabricant de ces substances dangereuses ou combustibles ainsi que les règles sur l'élimination en vigueur au niveau régional doivent être respectées. Les consignes de sécurité spéciales correspondantes dans la documentation produit doivent également être respectées, le cas échéant. L'élimination non conforme des substances dangereuses ou combustibles peut provoquer des atteintes à la santé et des dommages écologiques.

Pour plus d'informations concernant la protection de l'environnement, voir la page d'accueil 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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Contents

1 Preface

1.1 Key Features

The R&S RTO Digital Oscilloscope provides fast signal acquisition and analysis. Outstanding key features are:

- 1 million waveforms per second waveform acquisition rate
- Memory depth of up to 80 MSa per channel, depending on the instrument type
- Highly accurate digital trigger system
- Very low noise floor
- Precise measurements due to single-core A/D converter
- High measurement speed, even for complex analysis functions
- Easy and intuitive to operate
- High-quality line of probes

For a detailed specification refer to the data sheet.

The R&S RTO Digital Oscilloscope brings various benefits in your daily work:

- Find rare signal faults quickly with no trade-offs for measurement and analysis due to highest acquisition rate and shortest blind time.
- Access and analyze prior waveforms in the memory using the history function
- Get fastest results even with maximum data with hardware-accelerated processing: mathematical operations, mask tests, histograms, automatic and cursor measurements, and spectrum display.
- Capture closest successive events with the real-time digital trigger system. It works with high trigger sensitivity at full bandwidth and very low trigger jitter.
- Get key measurement results at the push of a button with Quick Measurement
- Easy to use:
  - Smart and straightforward user guidance
  - Color-coded control elements for clear identification
  - Signal icons with drag & drop functionality
  - Toolbar with frequently used functionality
- Verify and debug embedded systems using the options for triggering and decoding of serial protocols such as I²C, SPI, UART, CAN, LIN and FlexRay
- Turn the R&S RTO into a mixed signal oscilloscope using the MSO option and analyze up to 16 additional digital channels

1.2 Documentation Overview

The user documentation for the R&S RTO consists of the following parts:

- Online Help system on the instrument
- "Getting Started" printed manual in English
- Documentation CD-ROM with:
  - Getting Started
  - User Manual
  - Service Manual
  - Data sheet and product brochure
  - Links to useful sites on the Rohde & Schwarz internet

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming.

Getting Started

The English edition of this manual is delivered with the instrument in printed form. The manual is available also in other languages in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument, and describes basic operations and typical measurement examples. The manual includes also safety information.

User Manual

The user manual is available in PDF format on the Documentation CD-ROM. This manual describes all instrument functions in detail. It provides an introduction to remote control and a complete description of the remote control commands with programming examples.

Web Help

The web help provides online access to all instructions on how to operate the R&S RTO: No need to download first. Web help content corresponds to the user manual for the latest product version.

The web help is available from the R&S RTO product page at www.scope-of-the-art.com/product/rto.html >"Downloads > Web Help".

Service Manual

The Service Manual is available in PDF format on the Documentation CD-ROM. It describes how to check compliance with rated specifications, instrument function, repair, troubleshooting, and fault elimination. It contains all information required for repairing the instrument by replacing modules.

Documentation updates

You can download the newest version of the "Getting Started" and "User Manual" from the "Downloads > Manuals" section on the Rohde & Schwarz "Scope of the Art" website: www.scope-of-the-art.com/product/rto.html.

The current online help is part of the instrument firmware, and it is installed together with the firmware. Firmware updates are available in the "Downloads > Firmware" section on the Rohde & Schwarz "Scope of the Art" product website.

1.3 Conventions Used in the Documentation

1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.3.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

1.3.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 Preparing for Use

This section describes the basic steps to be taken when setting up the R&S RTO for the first time.

NOTICE

Risk of instrument damage

Note that the general safety instructions also contain information on operating conditions that will prevent damage to the instrument. The instrument's data sheet may contain additional operating conditions.

2.1 Unpacking and Checking the Instrument

To remove the instrument from its packaging and check the equipment for completeness, proceed as follows:

1. Pull off the polyethylene protection pads from the instrument's rear feet and then carefully remove the pads from the instrument handles at the front.
2. Pull off the corrugated cardboard cover that protects the rear of the instrument.
3. Carefully unthread the corrugated cardboard cover at the front that protects the instrument handles and remove it.
4. Check the equipment for completeness using the delivery note and the accessory lists for the various items.
5. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. Make sure not to discard the box and packing material.

Packing material

Retain the original packing material. If the instrument needs to be transported or shipped at a later date, you can use the material to protect the control elements and connectors.

2.2 Positioning the Instrument

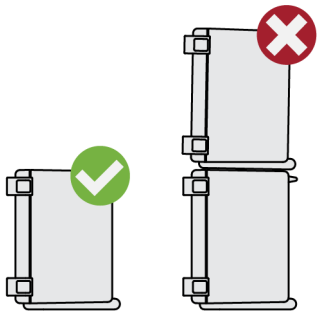
The instrument is designed for use under laboratory conditions. It can be used in standalone operation on a bench top or can be installed in a rack.

CAUTION

Risk of injury and instrument damage if stacking instruments

A stack of instruments may tilt over and cause injury and material damage because the instrument's top surface area is too small.

Never stack instruments on top of each other. If you need to stack instruments, install them in a rack.



2.2.1 Standalone Operation

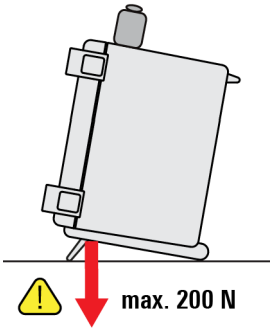
For standalone operation, place the instrument on a horizontal bench with even, flat surface. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

CAUTION

Risk of injury if feet are folded out

The feet may fold in if they are not folded out completely or if the instrument is shifted. This may cause damage or injury.

- Fold the feet completely in or completely out to ensure stability of the instrument. Never shift the instrument when the feet are folded out.
- When the feet are folded out, do not work under the instrument or place anything underneath.
- The feet can break if they are overloaded. The overall load on the folded-out feet must not exceed 200 N.



2.2.2 Rackmounting

The instrument can be installed in a 19" rack mount using a rack adapter kit. The order No. is given in the data sheet. The installation instructions are part of the adapter kit.

NOTICE

Risk of instrument damage in a rack

An insufficient airflow can cause the instrument to overheat, which may disturb the operation and even cause damage.

Make sure that all fan openings are unobstructed, that the airflow perforations are unimpeded, and that the minimum distance from the wall is 10 cm.

2.3 Starting the Instrument

NOTICE

Risk of instrument damage during operation

An unsuitable operating site or test setup can cause damage to the instrument and to connected devices. Ensure the following operating conditions before you switch on the instrument:

- All fan openings are unobstructed and the airflow perforations are unimpeded. The minimum distance from the wall is 10 cm.
- The instrument is dry and shows no sign of condensation.
- The instrument is positioned as described in the following sections.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are correctly connected and are not overloaded.

2.3.1 Powering On

The AC power connector and the main power switch are located on the rear panel of the instrument.

⚠ WARNING

Risk of injury and instrument damage

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury, or damage.

- Do not use an isolating transformer to connect the instrument to the AC power supply.
- Do not open the instrument casing.
- Read and observe the "Basic Safety Instructions" delivered as a printed brochure with the instrument or in electronic format on the documentation CD-ROM.
  In addition, read and observe the safety instructions in the following sections.
  Notice that the data sheet may specify additional operating conditions.

1. Connect the instrument to the AC power supply using the AC power cable delivered with the instrument.
   If grounding is *not* ensured by the mains system, ground the instrument using the protective earth conductor on the front panel and an appropriate cable.
2. Switch the main power switch at the rear of the instrument to position I.

When you power up the instrument, be sure to comply with the warm-up phase specified in the data sheet before you start measurements.

You can leave on the AC power permanently. Powering off is only required if the instrument must be completely disconnected from all power supplies.

2.3.2 Starting Up and Shutting Down

The POWER switch is located in the bottom left corner of the front panel.

To start up the instrument

1. Make sure that the R&S RTO is connected to the AC power supply and the main power switch on the rear panel is in position I.
2. Press the POWER key on the front panel.

   The instrument performs a system check, boots the Windows operating system, and then starts the R&S RTO firmware.
   The illuminated keys on the front panel light up. If the previous session was terminated regularly, the oscilloscope uses the last settings.

To shut down the instrument

► Press the POWER key again.
Alternatively, tap "Exit" on the "File" menu.

All current settings are saved, and the software shuts down. The standby power only supplies the power switch circuits and the optional oven quartz (OCXO, option R&S RTO-B4).
Now it is safe to power off the instrument.

2.3.3 Powering Off

Powering off is required only if the instrument must be completely disconnected from all power supplies.

It also interrupts the power supply of the OCXO (option OCXO Reference Frequency, R&S RTO-B4).

When you power on the instrument again, be sure to comply with the extended warm-up phase specified in the data sheet.

1. If the instrument is running, press the POWER key on the front panel to shut down the instrument.
2. Switch the main power switch at the rear of the instrument to position 0.
3. Disconnect the AC power cable from the AC power supply.

NOTICE

Risk of losing data

If you switch off the running instrument using the rear panel switch or by disconnecting the power cord, the instrument loses its current settings. Furthermore, program data may be lost.

Press the POWER key first to shut down the application properly.

2.3.4 EMI Suppression

Electromagnetic Interference (EMI) may affect the measurement results.

To suppress generated Electromagnetic Interference:

- Use suitable shielded cables of high quality. For example use double-shielded RF and LAN cables.
- Always terminate open cable ends.
- Note the EMC classification in the data sheet.

2.4 Connecting External Devices

The following interfaces for external devices are provided:

- USB connectors, see also "USB" on page 31
- Monitor connector, see also "MONITOR (DVI-D)" on page 33

2.4.1 Connecting USB Devices

The USB interfaces on the front and rear panels of the R&S RTO allow you to connect USB devices directly to the instrument. This number can be increased as necessary by using USB hubs. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S RTO.

The following list shows various USB devices that can be useful:

- Flash drive for easy transfer of data to/from a computer (e.g. firmware updates)
- CD-ROM drives for easy installation of firmware applications
- Keyboard and/or to simplify the operation and the entry of data, comments, file names, etc.
- Printer for printing out measurement results

All USB devices can be connected to or disconnected from the instrument during operation.

Installing USB devices on R&S RTO is easy under the Windows operating system, because all USB devices are plug&play. After a device is connected to the USB interface, Windows automatically searches for a suitable device driver.

If the operating system does not find a suitable driver, it prompts you to specify a directory that contains the driver software. If the driver software is on a CD, connect a USB CD-ROM drive to the instrument before proceeding.

When a USB device is disconnected from the R&S RTO, Windows immediately detects the change in hardware configuration and deactivates the corresponding driver.

The properties of external USB devices are configured in the operating system, not in the R&S RTO software. It is recommended that you use mouse and keyboard to access and modify the settings of the Windows operating system. To access Windows, press the Windows key on the external keyboard, or select "File > Minimize" on the R&S RTO menu.

Connecting a USB flash drive or CD-ROM drive

If installation of a USB flash driver or CD-ROM drive is successful, Windows informs you that the device is ready to use. The device is made available as a new drive ("D:") and is displayed under Windows Explorer. The name of the drive depends on the manufacturer.

Connecting a keyboard

The keyboard is detected automatically when it is connected. The default input language is English – US.

Use the Windows' "Start" menu > "Control Panel > Change keyboards or other input methods" to configure the keyboard properties.

Connecting a mouse

The mouse is detected automatically when it is connected.

Use the Windows' "Start" menu > "Devices and Printers > Mouse" to configure the mouse properties.

Connecting a printer

When printing a file, the instrument checks whether a printer is connected and turned on and whether the appropriate printer driver is installed. If necessary, printer driver installation is initiated using the Windows' "Add a Printer" wizard. A printer driver needs to be installed only once.

You can load updated and improved driver versions or new drivers from an installation disk, USB flash drive, or another external storage medium. If the instrument is integrated in a network, you can also install driver data stored in a network directory.

Use the Windows' "Start" menu > "Devices and Printers > Add a printer" to install the driver.

2.4.2 Connecting an External Monitor

You can connect an external monitor or projector to the DVI-D connector on the instrument's rear panel. See also: "MONITOR (DVI-D)" on page 33.

Before connecting an external monitor to the DVI connector, ensure that the monitor and the R&S RTO are connected to a ground contact. Otherwise the instrument may be damaged.

After connecting an additional monitor or projector to the instrument, configure it for usage. The relevant settings are Windows settings but you can configure the displays directly in the instrument setup.

1. Check the input type of the monitor or projector and make sure to select the correct cable. To use a VGA monitor, an active DVI-D to VGA adapter is required.
2. Press the SETUP key.
3. Select the "System" tab.
4. Tap "Display / Monitors".
5. To show the instrument's display content only on the external monitor, select "Projector only".
   To show the instrument's display content on both the oscilloscope and the external monitor, select "Duplicate".

The touchscreen of the R&S RTO has a screen resolution of 1024x768 pixel. Most external monitors have a higher screen resolution. If the screen resolution of the monitor is set higher than the instrument's resolution, the application window uses a 1024x768 area of the monitor display. For full screen display, adjust the monitor's screen resolution using "Additional display settings".

3 Instrument Tour

This chapter describes the front and rear panels of the instrument including all function keys and connectors, and also the touchscreen with its control elements.

3.1 Front Panel

The front panel of the R&S RTO is shown in figure 3-1. The function keys are grouped in functional blocks to the left and the right of the touchscreen. Below, various connectors are located.

Fig. 3-1: Front panel of R&S RTO1024 with 4 input channels

1 = Touchscreen
2 = SETUP controls
3 = HORIZONTAL controls
4 = TRIGGER controls
5 = ANALYSIS controls
6 = VERTICAL controls
7 = NAVIGATION controls
8 = POWER key
9 = Connectors for USB and probe compensation
10 = Input channels

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument. For example, cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

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

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

3.1.1 Touchscreen Display

The touchscreen shows not only the captured waveforms, it also provides everything you need to control the instrument, to analyze waveforms, and to get measurement results. Figure 3-2 shows the touchscreen display on a glance.

Fig. 3-2: Touchscreen display

1 = Toolbar
2 = Diagram area
3 = Signal bar with horizontal and trigger label (3a), signal icon with signal label (3b) and signal icon with minimized live waveform (3c)
4 = Menu bar
5 = Dialog box
6 = Result box
7 = Input box

Toolbar
The icons on the toolbar provide quick and easy access to the most important functionality. For a detailed description, refer to chapter 5.3, "Toolbar", on page 76.

Diagram area
The diagram area shows the diagrams with waveforms. For a detailed description, refer to chapter 5.2, "Information on the Display", on page 72.

Signal bar
The signal bar is the control center for all enabled waveforms. On the top, the horizontal and trigger labels show the main time base and trigger settings.

Below, each waveform is represented by a signal icon. For an active waveform, that is shown in a diagram, the signal icon displays the signal label with the main vertical and acquisition settings for the waveform. If you tap the "Minimize" icon on the signal label, the waveform switches from the diagram area to the signal icon: the icon shows the real-time preview of the waveform. If you touch and hold a signal label, the dialog box with vertical settings for this waveform opens. See chapter 5.4, "Working with Waveforms", on page 82 for a detailed description.

You can also adjust the behavior of the signal bar in various ways, see chapter 5.6, "Using the Signal bar", on page 87.

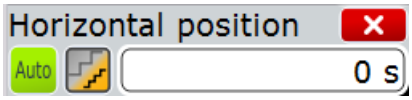
Menu bar
The menus provide access to the complete functionality of R&S RTO.

Dialog box
The tabs of the dialog boxes contain all task-oriented settings and operations, and black buttons for calling related tabs. The usage of dialog boxes is described in chapter 5.7, "Accessing the Functionality", on page 89.

Result box
If you perform manual or automatic measurements, mask testing, or a search, the result box shows the results of the action. Similar to waveform diagrams, you can minimize the result box to a result icon on the signal bar, and display results in a separate diagram on the screen. The  icon opens the corresponding dialog box to adjust the settings.

For details, see chapter 5.5, "Displaying Results", on page 86.

Input box
The input box appears if you adjust a value using one of the rotary knobs, or if you drag an element on the screen, for example, a cursor line. The input box shows the current value of the modified parameter. You can enter the exact numerical value, change the step size, and - if available - autoset the value directly in the input box. The box title shows the name of the currently adjusted parameter. The input box is helpful when using the multi-function rotary knobs - POSITION knobs, INTENSITY, and RESOLUTION/RECORD LENGTH.



See also: chapter 5.8, "Entering Data", on page 90.

3.1.2 SETUP Controls

SETUP keys set the instrument to a defined state, change basic settings, and provide print and help functions. The intensity rotary knob adjusts the display contrast for several display elements.

AUTOSET
The instrument analyzes the enabled channel signals, and adjusts appropriate horizontal, vertical, and trigger settings to display stable waveforms.

PRESET
Resets the instrument to a default state. All measurements, mask tests, zoom, and most individual settings are deleted, all channels except for channel 1 are disabled. You can define preset configurations and save them to a file. The PRESET key can be configured to set either factory defaults or a user-defined preset configuration.

FILE
Opens and closes the "File" dialog box, where you can:
- Save settings
- Load settings which were saved before
- Manage the data: browse, copy, delete, create folders
- Define a naming pattern for waveform data files

SETUP
Opens and closes the "Setup" dialog box, where you can:
- Access MS Windows configuration and install firmware updates
- Configure the touchscreen
- Check and install option keys for software options
- Check availability of hardware options
- Configure LXI and GPIB (if installed)

PRINT
Saves a schreenshot according to the settings in "File" menu > "Print Setup".

HELP
Opens the appropriate help topic for the active tab. If no dialog box is open, the contents page of the online help appears.

MODE
Opens and closes a dialog box where you can change the instrument mode:

- Enable the IQ mode (requires option R&S RTO-K11).
- Enable High Definition mode (requires option R&S RTO-K17).
- Enable functionality in beta state.

T-SCREEN LOCK
Locks the touchscreen to prevent unintended use. When the touchscreen is off, the key is illuminated. Press again to unlock the touchscreen.

DISPLAY
Opens and closes the "Display" dialog box to configure the appearance of the waveforms, the diagram layout, color tables, and also the XY-diagram.

INTENSITY
Adjusts the intensity of the waveforms on the screen, or the background transparency of dialog boxes, or the transparency of result boxes. If a dialog box is open, turning the knob changes the transparency of dialog boxes. If a result box is open, the transparency of result boxes is changed. Otherwise the waveform intensity is adjusted. Press the knob to toggle between the three settings. The controlled parameter and its value are shown in the input box in the upper left corner of the screen.

3.1.3 HORIZONTAL Controls

The keys and rotary knobs in the HORIZONTAL functional block adjust the acquisition basic settings and the horizontal parameters. These settings are effective for all channel waveforms.

RES / REC LEN
Opens and closes the "Resolution" tab in the "Horizontal" dialog box, where you can set the resolution and the record length.

HORIZONTAL
Opens and closes the "Time Base" tab in the "Horizontal" dialog box, where you can:
- Adjust the time scale, and acquisition time
- Adjust the horizontal position, and reference point
- Enable the roll mode

ACQUISITION
Opens and closes the "Acquisition" tab in the "Horizontal" dialog box, where you can define the acquisition processing (decimation and arithmetic).

RESOLUTION / RECORD LENGTH
The rotary knob changes the resolution or the record length. Press the knob to toggle the setting. The controlled parameter and its value are shown in the input box in the upper left corner of the screen.

For resolution, turn clockwise to increase the resolution: the time between two acquisition points gets shorter; and record length and sample rate increase while the acquisition time remains constant.

For record length, turn clockwise to increase the record length, and the resolution increases - the time between to acquisition points gets shorter.

POSITION / REF POINT
The rotary knob changes the horizontal position of the waveform or the screen position of the reference point. Press the knob to toggle the setting. The controlled parameter and its value are shown in the input box in the upper left corner of the screen.

The reference point marks the rescaling center of the time scale. It is indicated by a gray triangle outline at the top of the diagram. If you modify the time scale, the reference point remains fixed on the screen, and the scale is stretched or compressed to both sides of the reference point.

"Horizontal position" defines the time distance of the reference point from the zero point of the diagram. Turn clockwise to move the waveform to the right.

"Reference point" defines the position of the reference point on the screen. Turn clockwise to move it to the right.

SCALE
The rotary knob adjusts the time scale for all signals. The time scale is also known as time base.

Turn clockwise to stretch the waveforms. Doing so, the scale value *time/div* decreases.

3.1.4 TRIGGER Controls

The keys and knob in the TRIGGER functional block adjust the trigger and start or stop acquisition.

TRIGGER
Opens and closes the "Trigger" dialog box, where you can:
- Select a trigger type and configure it
- Set general trigger parameters and control the acquisition run
- Qualify the trigger event with logic patterns
- Configure a sequence of three trigger events

LEVEL
The rotary knob sets the trigger level for all trigger types. Turn clockwise to move the trigger level up. If the selected trigger type requires two trigger levels - upper and lower level - press the knob to toggle between the two levels.

SOURCE
Opens a dialog box where you can select the trigger source. Press the key again to switch the source. The key lights up in the color of the selected trigger source.

SLOPE
Toggles the trigger slope or trigger polarity, dependent on the trigger type. The current setting is shown on the trigger label, which is the upper part of the signal bar on the touchscreen.

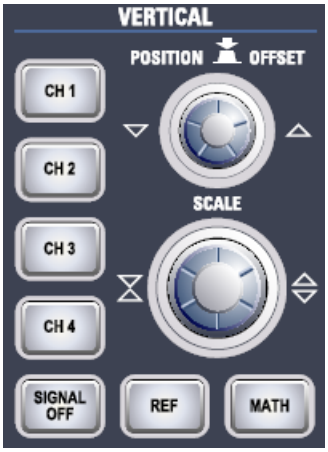
MODE
Toggles the trigger mode between Auto and Normal. The current setting is shown on the trigger label.

RUN CONT
Starts and stops the continuous acquisition. A green light indicates a running acquisition. A red light shows that acquisition is stopped.

RUN N× SINGLE
Starts a defined number of acquisition cycles. A green light indicates running acquisition. A red light shows that acquisition is stopped. To set the number of acquisitions, press the TRIGGER key, select the "Control" tab, and set "Average count (N-single count)". Press the key again to stop running acquisitions.

3.1.5 VERTICAL Controls

The keys and knobs in the VERTICAL functional block select a signal and adjust the vertical scale and position of the parameters of the selected signal.



CH <N>
Turns on, selects, and configures a channel. The key is illuminated with the corresponding channel color, if the channel is active.

The effect of the keypress depends on state of the channel:
- If channel is off: Pressing the key turns on the channel and selects it.
- If the channel is on, but not selected: Pressing the key selects the channel waveform.
- If the waveform is selected: Pressing the key opens the "Vertical" dialog box for the appropriate channel.

The vertical rotary knobs are focused on the selected waveform and they are illuminated in the color of the selected waveform.

REF
Opens the "Reference" dialog box, where you can configure and display reference waveforms. Press the button repeatedly to switch to the reference waveform to be configured.

The vertical rotary knobs are focused on the selected reference waveform and they are illuminated in the color of the selected waveform.

MATH
Opens the "Math" dialog box, where you can configure the calculation of new waveforms with various mathematic operations from other waveforms. Press the button repeatedly to switch to the math waveform to be configured.

The vertical rotary knobs are focused on the selected math waveform and they are illuminated in the color of the selected waveform.

POSITION / OFFSET
The rotary knob changes the vertical position or the offset of the selected waveform. The horizontal axis and the selected waveform are moved vertically. Press the knob to toggle the setting, and turn clockwise to move the waveform up. The controlled parameter and its value are shown in the input box in the upper left corner of the screen.

- Position indicates the vertical location in divisions.
- Offset moves the vertical center of the selected channel to the offset value.

The knob lights up in the color of the selected waveform.

SCALE
This rotary knob adjusts the vertical scale for the selected waveform. The knob lights up in the color of the selected waveform.

Turn clockwise to stretch the waveform. Doing so, the scale value V/div decreases.

SIGNAL OFF
Turns off the selected signal and selects the next channel, math, or reference waveform.

The key is illuminated in the color of the selected signal and changes the color according to the new selection.

3.1.6 ANALYSIS Keys

The keys in the ANALYSIS functional block provide direct access to measurement and analyzing functions. For CURSOR, ZOOM and MEAS, the operation is started on first keypress, and a second keypress opens the corresponding dialog box. For all other functions, pressing the key opens the dialog box.

CURSOR
Displays vertical and horizontal cursors in the active diagram and displays the "Cursor Results" box.

Cursors are markers which are placed at points of interest on a waveform. The instrument measures the cursor positions and delta values between parallel cursors.

If you press the key while a cursor measurement is enabled, the "Cursors" dialog box opens.

In "Cursors" dialog box, you can:
- Configure up to 4 cursor sets
- Define style and labels of the cursors
- Connect the cursor to the waveform and couple the cursors

MEAS
Starts the default automatic measurement for the active waveform and displays the "Measurement" result box.

If you press the MEAS key while a measurement is enabled, the "Measurements" dialog box is displayed, where you can:
- Configure amplitude and time measurements, eye, spectrum, and histogram measurements
- Configure gated measurement
- Configure long term and statistic measurements
- Configure actions to be executed if specified limits are exceeded

MASKS
Opens and closes the "Masks" dialog box. Masks are used for error detection and compliance tests of digital signals.

You can:
- Configure masks and masks segments
- Define mask test parameters
- Configure actions triggered by mask violation
- Configure the mask display

SEARCH
Opens and closes the "Search" dialog box, where you can:
- Configure trigger or measurement events to be searched for
- Limit the search by gating
- Configure the presentation of search results

ZOOM
Displays a zoom diagram for the active diagram. The key is illuminated if at least one zoom is active. If you press the key while the zoom function is on, the "Zoom" dialog box opens, where you can configure several zoom areas for detailed signal observation.

PROTOCOL
Opens the "Protocol" dialog box which contains the configuration of serial buses and the settings for decoding the signals.

USER
Intended for future applications.

HISTORY
The sample memory contains a number of stored acquisitions before the current one which is shown in the display. Press the button to open the quick access "History" dialog box, where you can view the stored acquisitions and use them for further analysis. Press the button again to open the main "History" dialog box with more settings and information.

The button is illuminated as long as a history acquisition or replay is displayed.

3.1.7 NAVIGATION Controls

The rotary knob and the navigation keys provide an alternative way to navigate in dialog boxes and to enter numeric data.

See also: chapter 5.7, "Accessing the Functionality", on page 89

Navigation rotary knob

The navigation knob has various functions:

- In numeric entry fields: turn to increase or decrease the value.
- In tables: press to activate the edit mode, turn clockwise to increase the value or turn counter-clockwise to decrease it, and press to enter the value and move to the next line.
- In input boxes to set cursor positions, histogram areas, mask points: press to toggle the parameter, turn clockwise to increase the value or turn counter-clockwise to decrease it.
- In diagrams: to move the element that has the focus: zoom area, cursor line, or gate.

UNDO
Reverses the last setting actions step by step. The "Undo" is not possible after Preset, load and recall actions, and creating a reference waveform.

REDO
Recovers the undo steps in reverse order.

ESC
Closes a dialog box or input box.

ENTER
The ENTER key has various functions:

- In usual dialog box: if the focus is on a selection list, the key opens the list and applies the selected value.
- In tables: the key activates the edit mode. If the table cell is in edit mode, the key confirms the value, quits the edit mode and moves to the next line.

FIELD LEFT, FIELD RIGHT
In dialog boxes and tables, the keys move the focus.

In diagrams, the keys switch the focus between zoom areas, cursor lines, and gates.

CHECKMARK
The CHECKMARK key has different functions depending on the focus:
- In usual dialog box: if the focus is on a selection list, the key opens the list and applies the selected value.
- In tables: activates the edit mode.

TAB
In a dialog box with horizontal tabs only, the key switches the horizontal tabs.

In a dialog box with horizontal and vertical tabs, the key switches the vertical tabs preferably. If the focus is on a horizontal tab, it switches the horizontal tabs.

In a table or diagram, the key moves the focus in the same way as the FIELD RIGHT key.

UP ARROW, DOWN ARROW
- In numeric edit fields: increase or decrease the parameter value.
- In tables: scroll vertically through the rows.
- In dialog boxes, for option buttons in a column: select an option. In an open selection list, the keys scroll the list.

LEFT ARROW, RIGHT ARROW
- In edit fields: move the cursor.
- In tables: scroll horizontally through the columns.
- In dialog boxes, for option buttons in a row: select an option.

3.1.8 POWER key

The POWER key is located on the lower left corner of the front panel. It starts up and shuts down the instrument's software.

See also: chapter 2.3, "Starting the Instrument", on page 14.

3.1.9 Input Connectors

The R&S RTO has two or four channel inputs to connect the input signals using active and passive probes.

The input connectors are provided with a special Rohde & Schwarz active probe interface, and they are BNC compatible. Thus, the instrument can automatically detect passive probes with standard BNC connector and active Rohde & Schwarz probes having the Rohde & Schwarz probe interface.

The input impedance is selectable, the values are 50 Ω and 1 MΩ.

⚠ WARNING

Risk of electrical shock or fire

Voltages higher than 30 V RMS or 42 V peak or 60 V DC are regarded as hazardous contact voltages. When working with hazardous contact voltages, use appropriate protective measures to preclude direct contact with the measurement setup:

- Use only insulated voltage probes, test leads and adapters.
- Do not touch voltages higher than 30 V RMS or 42 V peak or 60 V DC.

⚠ CAUTION

Risk of injury and instrument damage

The instrument is not rated for any measurement category.

Make sure that the input voltage on *channel inputs* does not exceed 200 V peak, 150 V RMS at 1 MΩ input impedance and 5 V RMS at 50 Ω input impedance.

Transient overvoltages must not exceed 200 V peak.

When performing measurements in circuits with transient overvoltages of category II, III or IV circuits, make sure that no such overvoltages reach the R&S RTO input. Therefore, use only probes that comply with DIN EN 61010-031. When performing measurements in category II, III or IV circuits, it is mandatory to insert a probe that appropriately reduces the voltage so that no transient overvoltages higher than 200 V peak are applied to the instrument. For detailed information, refer to the documentation and safety information of the probe manufacturer.

Explanation: According to section AA.2.4 of EN 61010-2-030, measuring circuits without any measurement category are intended for measurements on circuits which are not connected to the mains system.

3.1.10 Other Font Panel Connectors

Besides the input connectors, the instrument has USB connectors and probe compensation connectors at the front panel.

USB
Two USB type A connectors that comply with standard USB 2.0. They are used to connect devices like keyboard, mouse, printer and flash device to store and reload instrument settings and measurement data. Also environment sensors can be connected to measure and display temperature and other environment conditions.

Note: Electromagnetic interference (EMI) can affect the measurement results. To avoid any impact, do not use USB connecting cables exceeding 1 m in length.

PROBE COMPENSATION
Probe compensation terminal to support adjustment of passive probes to the oscilloscope channel.

⏚ Protective earth conductor for grounding the instrument.

⎍ Square wave signal for probe compensation with 1 kHz and 1 V_{pp}.

⊥ Ground connector for probes.

AUX OUT
Output of the internal calibration signal, if the signal is configured to external destination.

3.2 Rear Panel

Figure 3-3 shows the rear panel of the R&S RTO with its connectors.

Fig. 3-3: Rear panel view of R&S RTO

1 = AC power supply connector and main power switch
2 = LAN connector
3 = USB connectors
4 = DVI-D connector for external monitor
5 = External trigger input
6 = External trigger output
7a = Optional GPIB connector (option R&S RTO-B10, shown in figure)
7b = Optional connector for digital probe (Mixed Signal Option R&S RTO-B1, not shown in figure)
8 = Optional OCXO with input and output of the reference signal (option R&S RTOR&S RTO-B4)
9 = Optional exchangeable hard disk: solid state disk, option R&S RTO-B18 or standard hard disk drive, option R&S RTO-B19
10 = Lugs to attach the accessory bag
11 = Kensington lock slot to secure the instrument against theft

AC power supply connector and main power switch
Connection to the AC power line. The R&S RTO can be used with different AC power voltages and adapts itself automatically to it. The nominal voltage and frequencies ranges are displayed on the rear panel and quoted in the data sheet.

If grounding is *not* ensured by the mains system, ground the instrument using the protective earth conductor on the front panel and an appropriate cable.

The AC main power switch also interrupts the power supply of the OCXO (option OCXO Reference Frequency, R&S RTO-B4).

When you power up the instrument, be sure to comply with the warm-up phase specified in the data sheet before you start measurements.

See also: chapter 2.3, "Starting the Instrument", on page 14

USB
Two USB type A connectors that comply with standard USB 2.0. They are used to connect devices like keyboard, mouse, printer and flash drive to store and reload instrument settings and measurement data. Also environment sensors can be connected to measure and display temperature and other environment conditions.

Note: Electromagnetic interference (EMI) can affect the measurement results. To avoid any impact, do not use USB connecting cables exceeding 1 m in length.

LAN
8-pin RJ-45 connector used to connect the instrument to a Local Area Network (LAN). It supports up to 1000 Mbit/s (10/100/1000BASE-T Ethernet).

MONITOR (DVI-D)
Digital connector for an external monitor or projector. The monitor shows the complete content of the instrument's screen.

See also: chapter 2.4.2, "Connecting an External Monitor", on page 17.

EXT TRIGGER INPUT
The BNC connector for external trigger input is used to control the measurement by means of an external signal. The input impedance can be selected in the trigger configuration, the values are 50 Ω and 1 MΩ. The trigger level can be set from -5 V to 5 V. The maximum input voltage is 30 V RMS at 1 MΩ input impedance and 7 V RMS at 50 Ω input impedance.

EXT TRIGGER OUTPUT
The BNC connector for external trigger output is used to provide the internal trigger signal of the oscilloscope to trigger other instruments for synchronized measurements.

When a trigger occurs, the R&S RTO creates a pulse of 5 V with a source impedance of 50 Ω and delivers it to the external trigger output. The instrument can also send the pulse on mask test violation or violation of measurement limits and margins.

If the connector is terminated with 50 Ω, the signal level is 2.5 V (50 mA), and with 1 MΩ termination the level is 5 V. A short-circuit of the connector to ground creates current of 100 mA.

To enable the trigger out signal, select "Trigger" menu > "Trigger Control". Here you also adjust polarity, delay, and length of the pulse. The default is a positive pulse of 100 ns. The minimum delay is 800 ns.

RTO-B1 (MSO)
Mixed Signal Option, input for digital signals (parallel buses). The hardware module and digital probe come with option R&S RTO-B1. The module provides connectors for two logical probes with 8 digital channels each (D0 to D7 and D8 to D15).

The maximum input voltage is 40 V peak at 100 kΩ input impedance. The maximum input frequency for a signal with the minimum input voltage swing of 500 mV (V_{pp}) is 400 MHz. For detailed specifications refer to the Data Sheet.

RTO-B10 (GBIP)
Optional GBIP connector coming with option R&S RTO-B10 GBIP Interface. For detailed specifications refer to the Data Sheet.

RTO-B4 (OCXO), REF IN AND REF OUT
Optional REF IN (left) and REF OUT (right) connectors coming with option R&S RTOB4 OCXO 10 MHz.

The input frequency ranges from 1 MHz to 20 MHz in 1 MHz steps. The input impedance is 50 Ω.

The output frequency of the OCXO is 10 MHz, the impedance is 50 Ω. For detailed specifications refer to the Data Sheet.

4 Trying Out the Instrument

This chapter introduces the most important functions and settings of the R&S RTO step by step. The complete description of the functionality and its usage is given in the "User Manual". Basic instrument operation is described in chapter 5, "Operating the Instrument", on page 71.

Prerequisites

- The instrument is set up, connected to the mains system, and started up as described in chapter 2, "Preparing for Use", on page 11.
- A probe is available.

For these first measurements, you use the internal calibration signal, so you do not need any additional signal source or instruments. Try out the following:

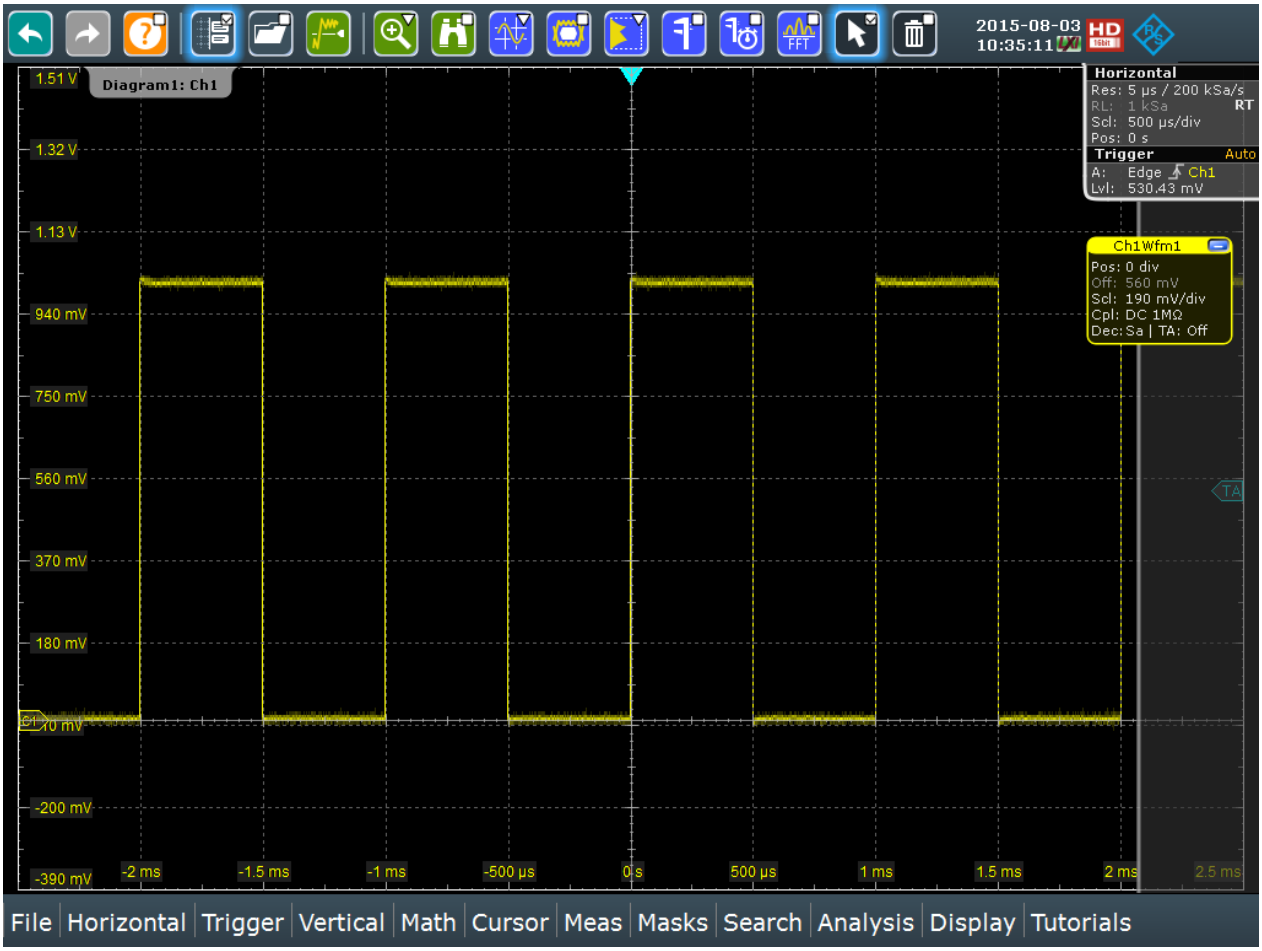
4.1 Displaying a Basic Signal

Displaying the input from a signal channel is very simple and straightforward. Furthermore, you get to know some basic trigger functions. The R&S RTO provides wide-ranging trigger functions to find various signal anomalies, which are described in the "User Manual".

1. Press the PRESET key on the front panel (in the SETUP area on the left).
2. Connect the probe to the input connector CH 1.
   Connect the probe's ground connector to the right compensation pin, and the tip with the left pin.

   The instrument recognizes the probe, and a signal is displayed in the diagram.
3. Press the AUTOSET key on the front panel (in the SETUP area on the left).

   Autoset finds appropriate horizontal and vertical scales and trigger conditions to present a stable square waveform. The trigger is set to edge trigger on rising edge with auto trigger mode.



4. If necessary, compensate the passive probe as described in chapter 6.4, "Adjusting Passive Probes", on page 97.

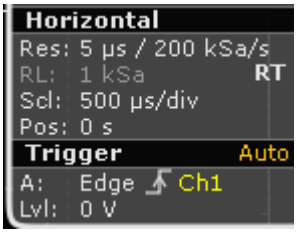
5. Press the SOURCE key in the TRIGGER area of the front panel and press the key again to switch the trigger source to "C2".

   An unstable waveform is displayed. In auto mode, the instrument triggers repeatedly after a time interval if no real trigger occurs.

6. Press the MODE key in the TRIGGER area and check the "Trigger" settings in the upper right corner of the screen.

   The trigger mode has changed to *Normal*. The waveform is no longer refreshed, and the "Wait for trigger" message box appears. The instrument cannot find a real trigger event because there is no signal on channel 2.

7. Tap the "Undo" icon on the toolbar repeatedly until the trigger mode is reset to *Auto* and the trigger source is reset to *CH1*.

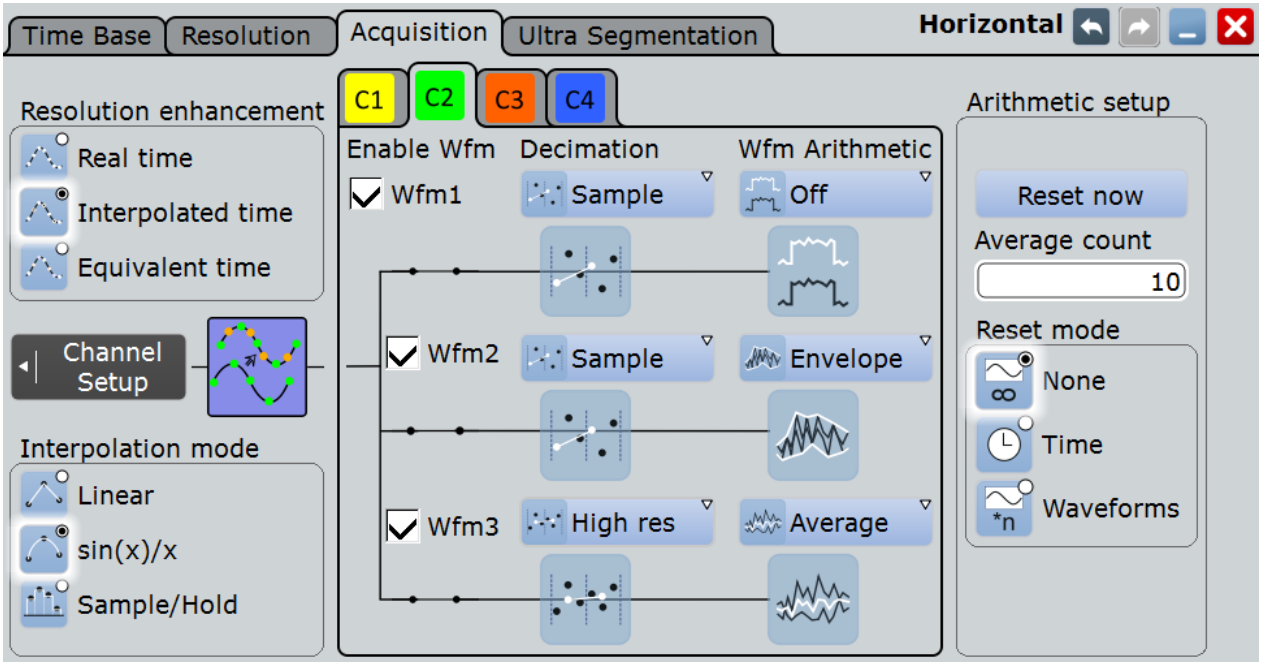


8. Press the SLOPE key to toggle the trigger slope and watch the waveform and the "Trigger" settings.

4.2 Acquiring Data

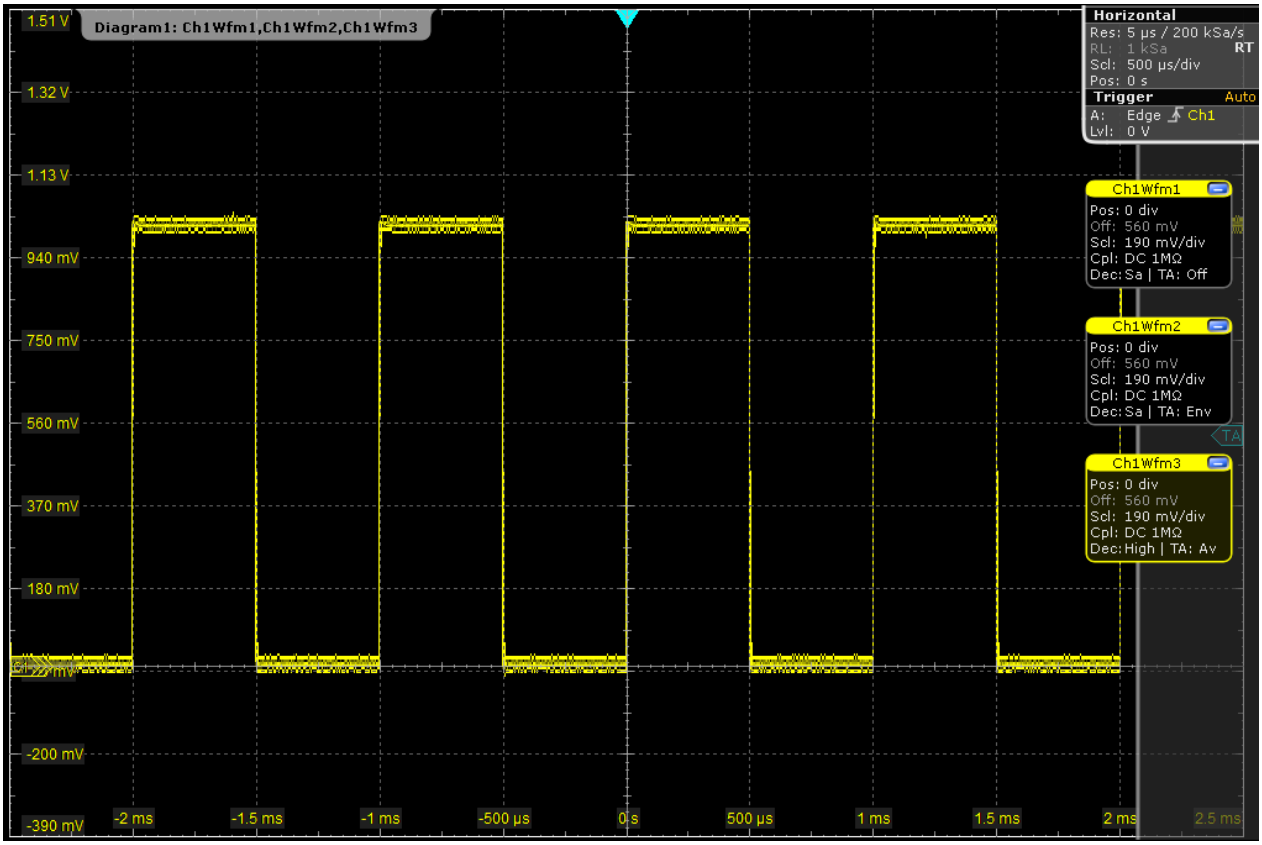
Although you are using only one input channel, you can acquire the calibration data using three different arithmetic methods and display the results in separate waveforms.

1. Press the ACQUISITION key on the front panel (in the HORIZONTAL area).
2. In the "Acquisition" tab of the "Horizontal" dialog box, enable all three waveforms ("Wfm1", "Wfm2", "Wfm3").
3. For Wfm1, select the "Decimation" type *Sample* and the "Wfm Arithmetic" *Off*.
4. For Wfm2, select the "Wfm Arithmetic" *Envelope*. The "Decimation" type is automatically set to *Peak detect* to display the correct envelope waveform.
5. For Wfm3, select the "Decimation" type *High Res* and the "Wfm Arithmetic" *Average*.



6. Close the "Horizontal" dialog box.

The three waveforms are displayed in one diagram. The corresponding signal icons are displayed in the signal bar.



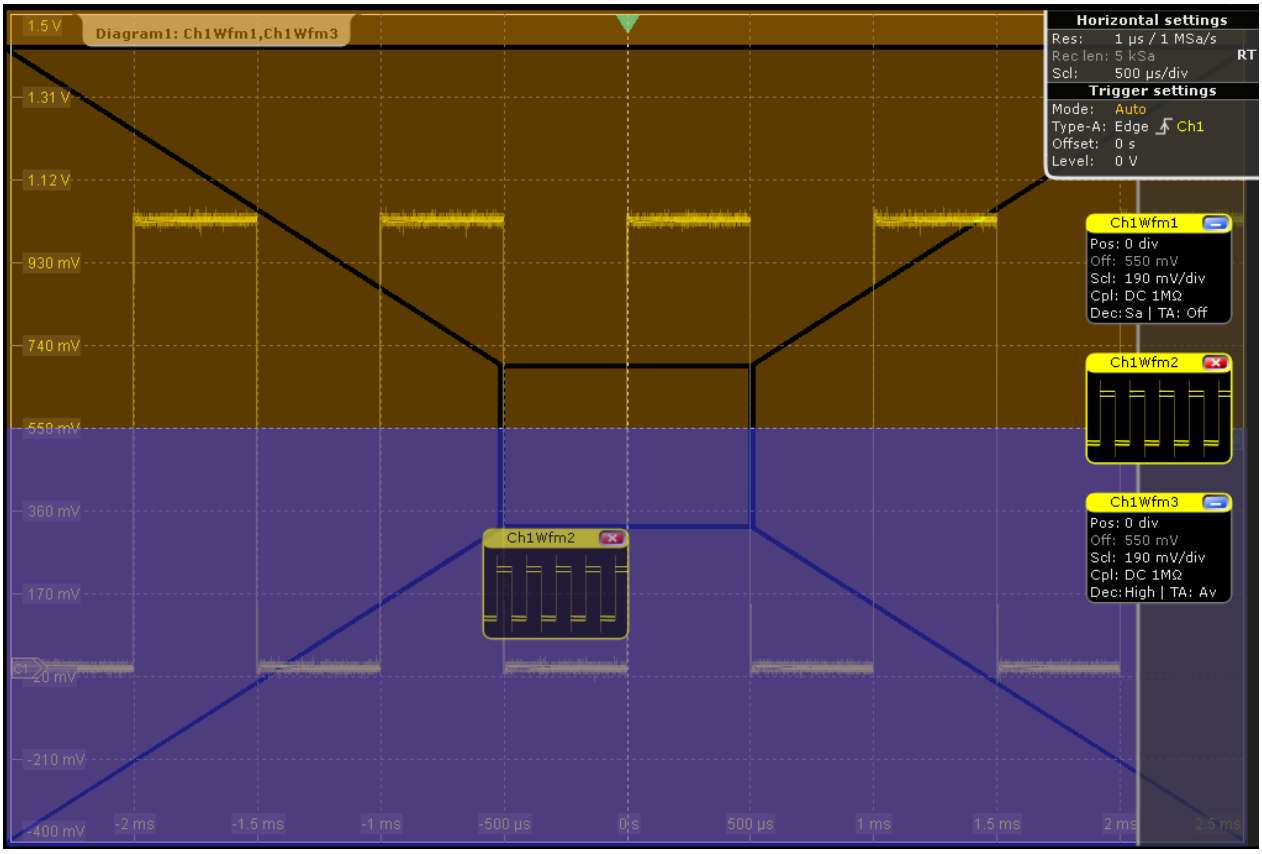
4.3 Organizing the Display

Meanwhile, the display has become confusing with so many waveforms in one diagram. You can display each waveform in a separate diagram and then define a useful label for each diagram. You can also hide diagrams you do not currently need, and display them again later.

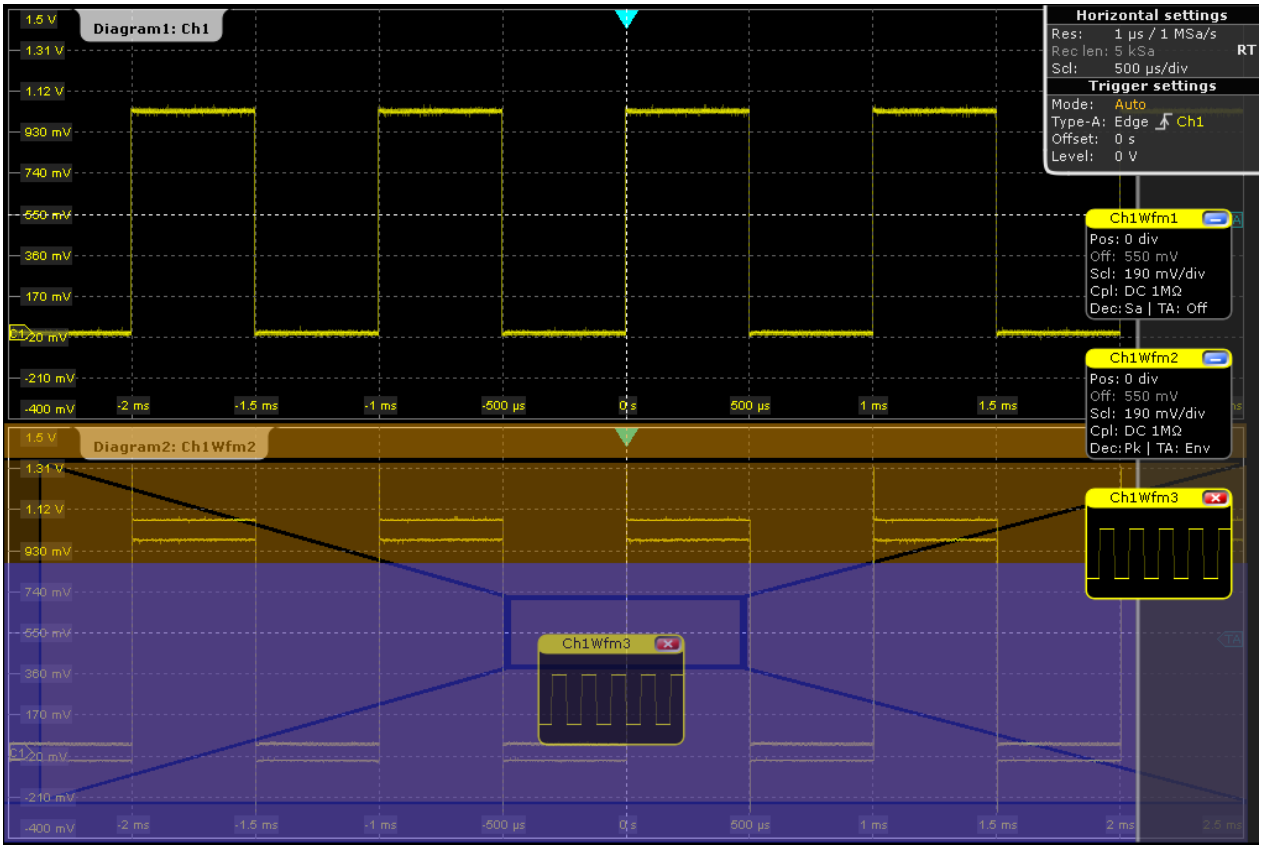
To manage several diagrams

1. Drag the signal icon for "Ch1Wfm2" from the signal bar to the bottom half of the diagram area.

   The SmartGrid appears and a blue area shows where the waveform will be placed.



2. Drag the signal icon for "Ch1Wfm3" to the bottom half of the diagram so it covers an area beneath "Ch1Wfm2" and drop it there.



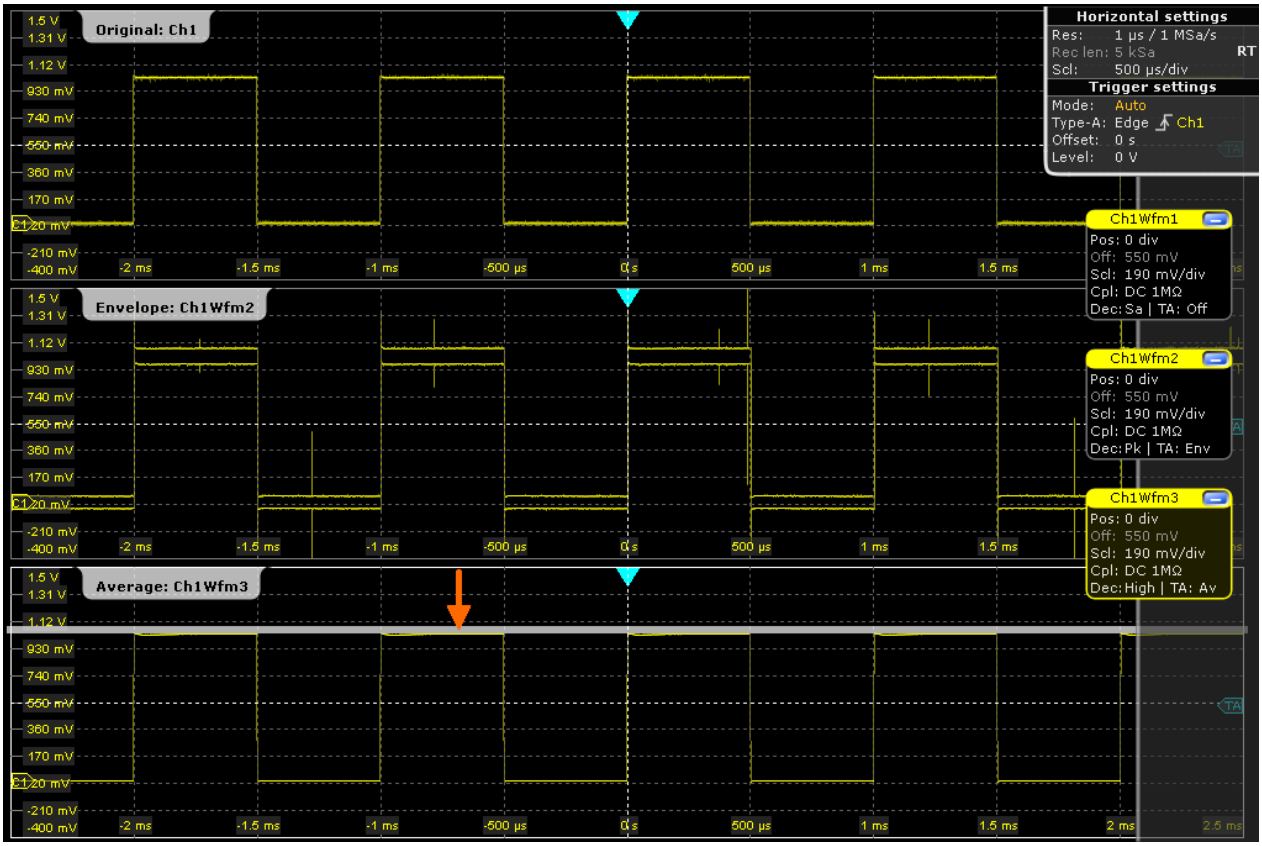
The three waveforms are now displayed in separate diagrams.

3. Rename the diagrams so the label indicates what is displayed:

   a) Double-tap the label for "Diagram 1: Ch1".
   b) On the on-screen keyboard, enter *Original*.
   c) Tap ENTER.
   d) Repeat these steps to rename "Diagram 2: Ch1Wfm2" to *Envelope*.
   e) Rename "Diagram 3: Ch1Wfm3" to *Average*.

   The diagram titles are shown together with the waveform number that is displayed in the diagram.

4. To change the size of a diagram, drag its horizontal edge to the required position.



To delete waveform diagrams

For the procedures in the following chapters we will only need the original waveform diagram, so we close the other two.

1. Minimize the waveform in diagram "Envelope: Ch1Wfm2": tap the "Minimize" icon of the "Ch1Wfm2" signal icon.

   The diagram is removed and the signal icon in the signal bar displays a live view of the signal.

2. Tap the red "Close" button of the signal icon for "Ch1Wfm2".

   The signal icon is removed from the signal bar, the waveform is switched off.

3. Switch off the "Average:Ch1Wfm3" waveform using the toolbar function:

   a) Tap the "Delete" icon on the toolbar.

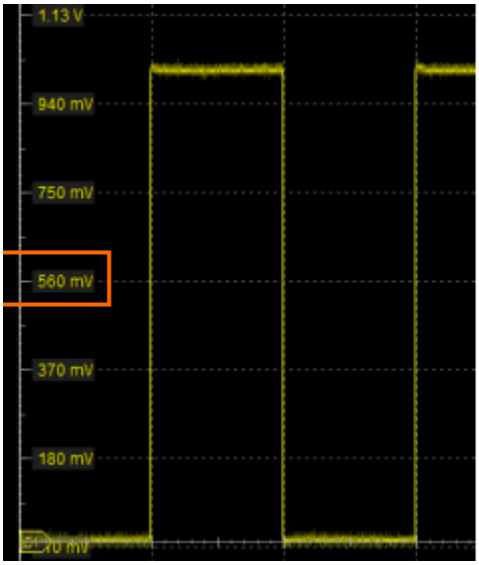
   

   b) Tap the waveform in the "Average:Ch1Wfm3" diagram.

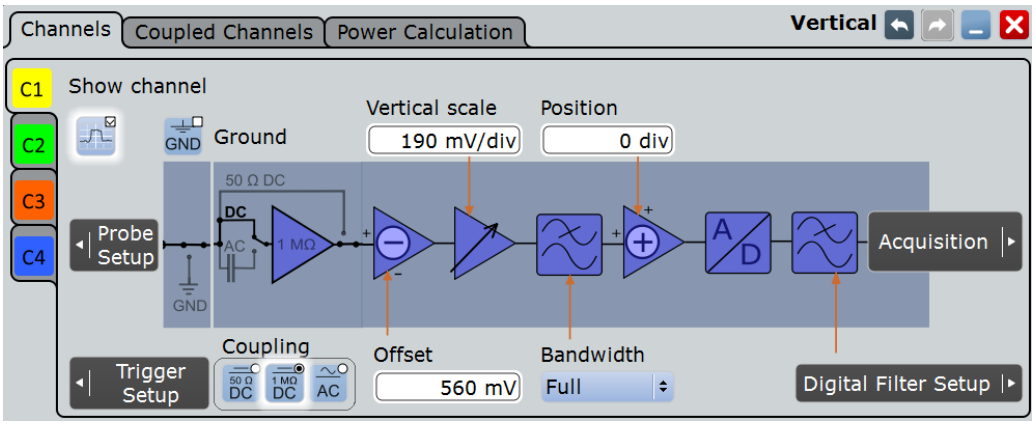
   The waveform is switched off, its signal icon and the empty diagram are removed.

4.4 Changing the Waveform Scaling and Position

As you can see on the y-axis of the display, the calibration signal has a vertical offset of about 550 mV. The value can differ.



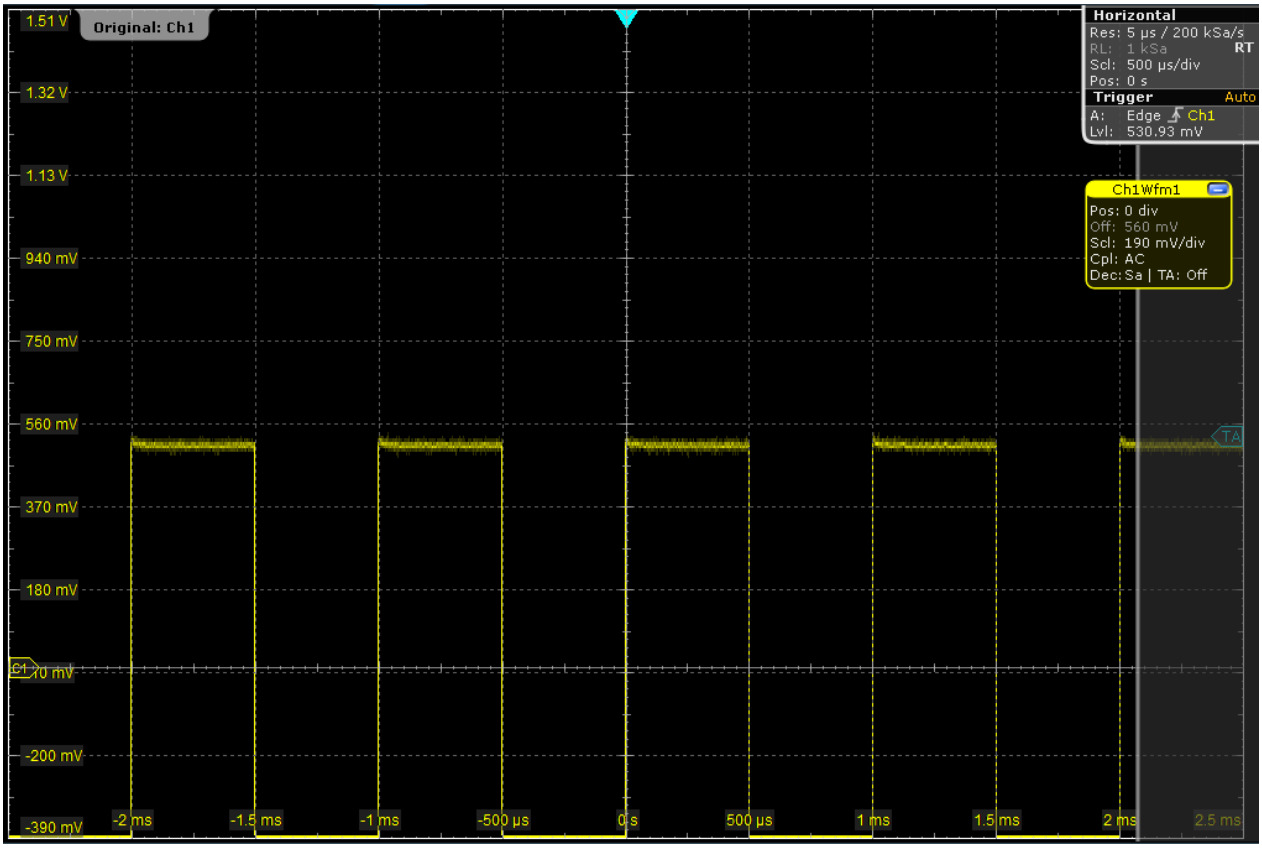
This value is also indicated in the signal icon for channel1 (2nd row). If you press the CH1 key, the "Vertical" settings dialog box also displays the "Offset" value. The offset is the DC component of the signal.



If you use a passive probe, you can filter the DC component by using the AC Coupling function, then quickly find the new trigger level, and try out the scaling functions:

1. Press the CH1 key on the front panel (in the VERTICAL area) to display the "Vertical" dialog box.
2. Change the "Coupling" to *AC*, and close the dialog box.

   The DC component of the signal is eliminated; the waveform position moves down vertically and is now centered around 0 V.



3. To move the waveform back to the center of the screen, eliminate the offset in the vertical settings:

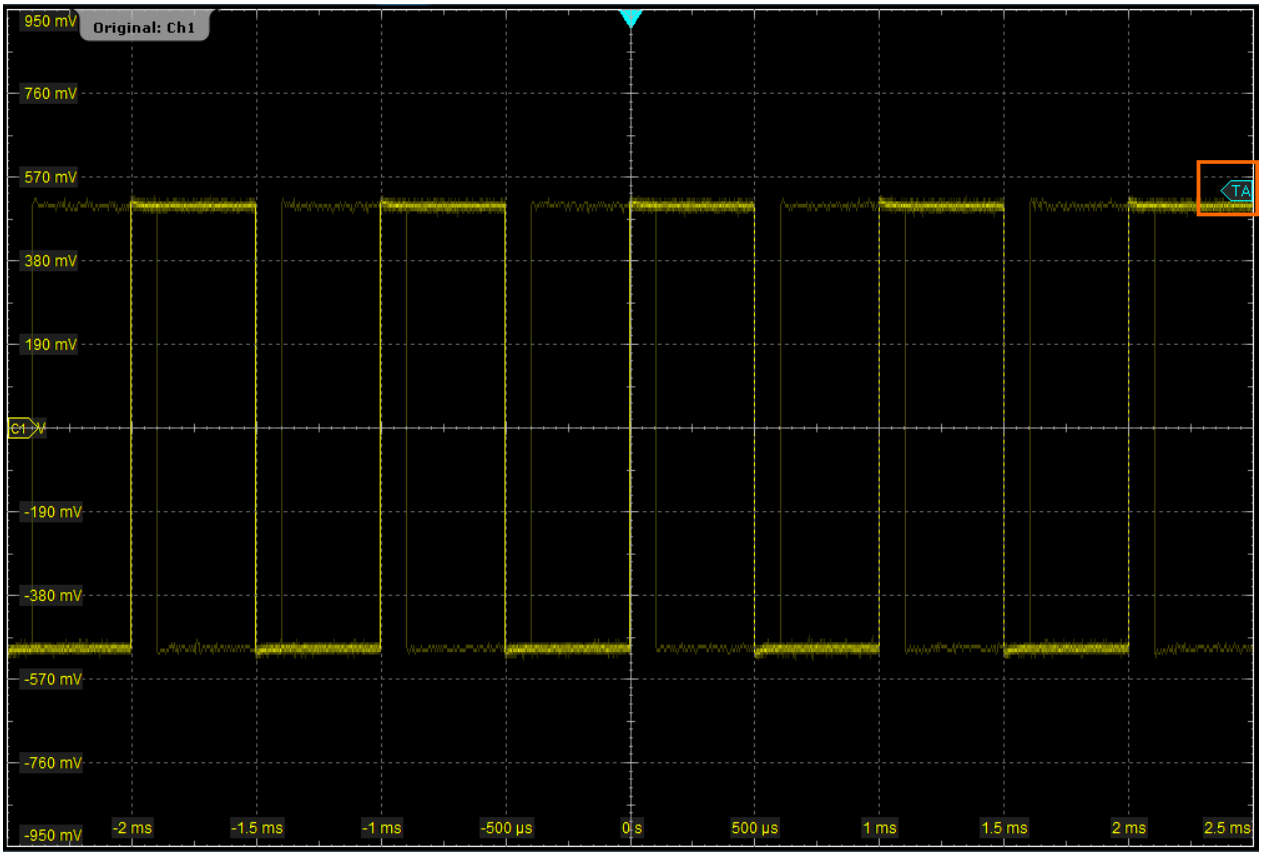
   a) Press the CH1 key again.
   b) Enter *0 V* in the "Offset" field.

   The waveform is now displayed in the center of the display, with the x-axis crossing at 0 V but it might be unstable if the trigger level is above the waveform.

4. Tap the "Show signal bar" icon on the toolbar.

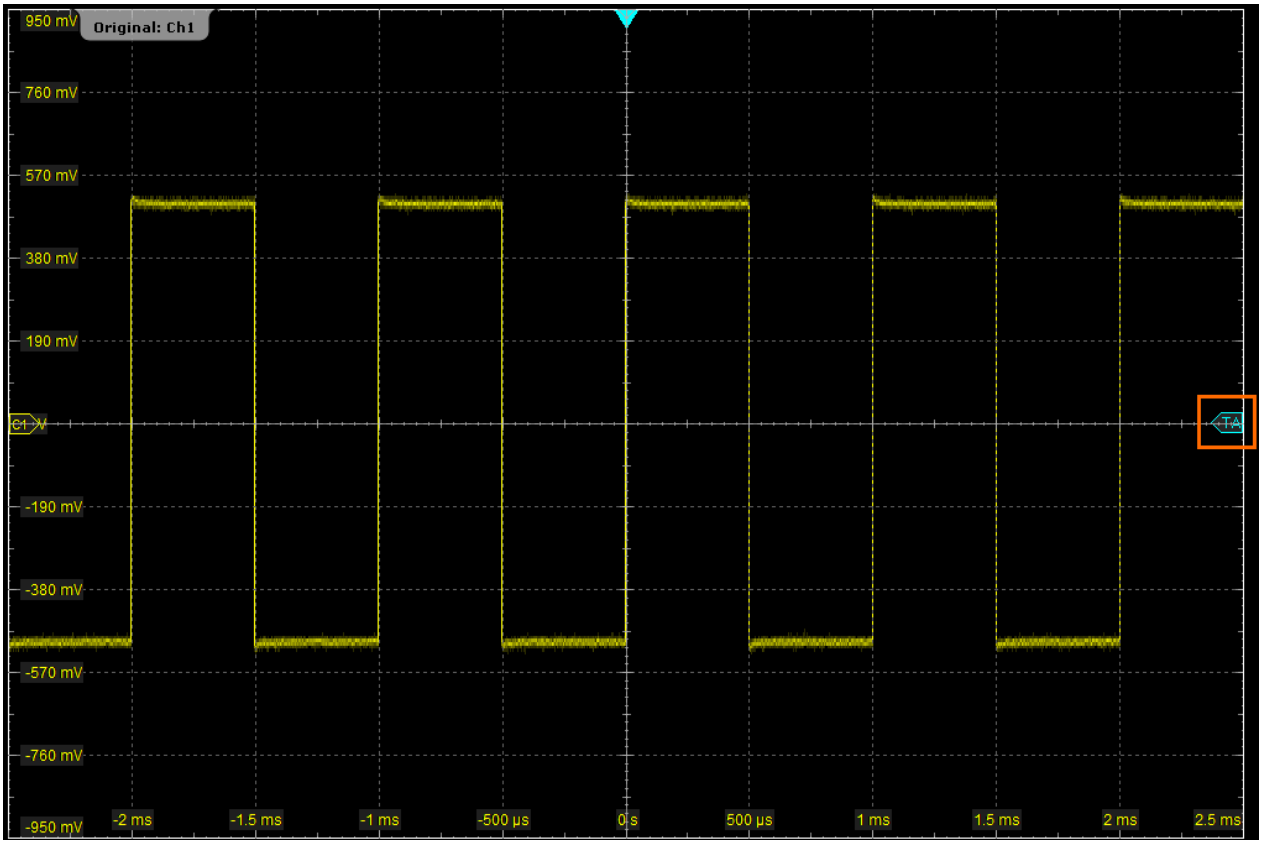
   

   The signal bar disappears, and you can see the trigger level marker on the right.

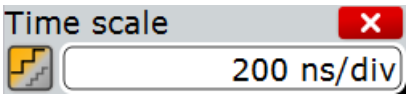


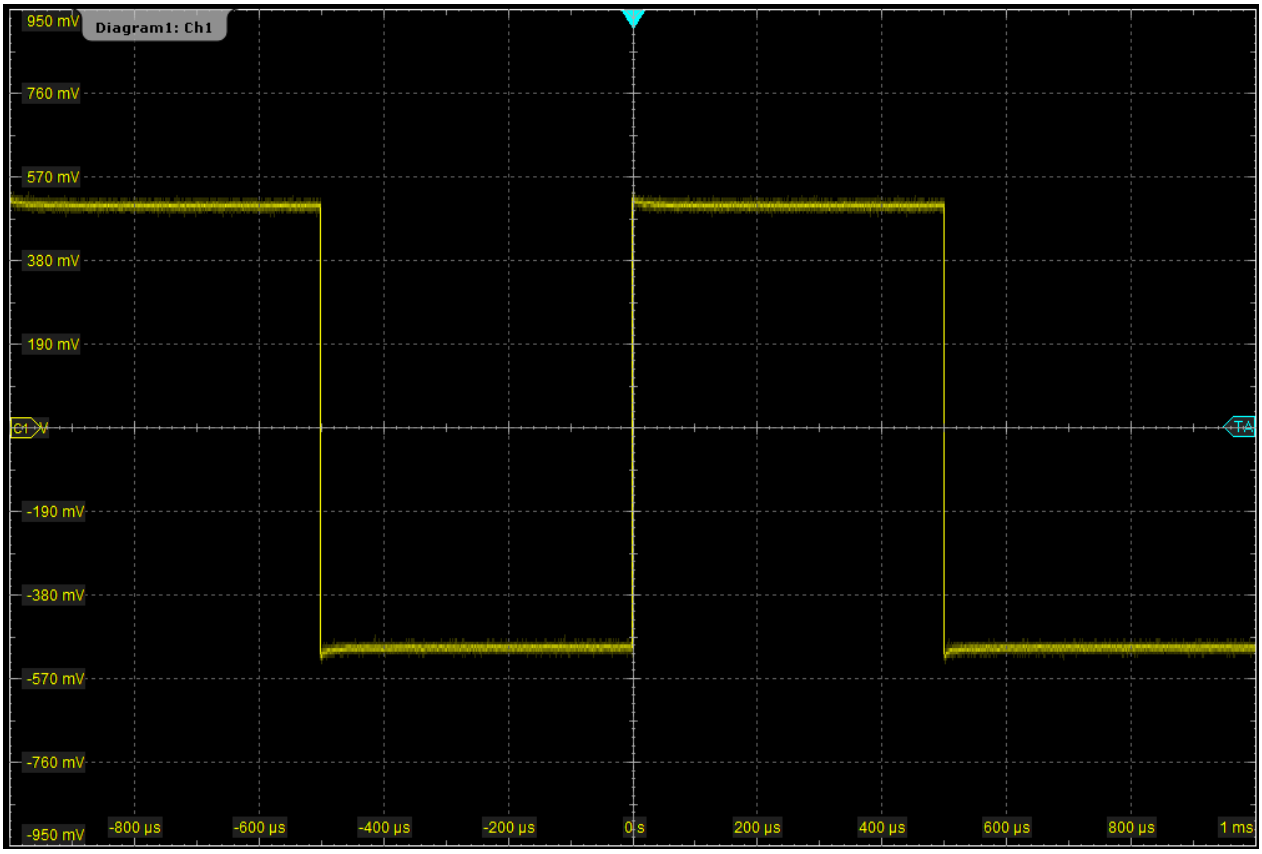
5. Tap the "Find level" icon on the toolbar.

The instrument adjusts the trigger level, and a stable waveform is displayed.



6. To examine one pulse in the signal in more detail, turn the horizontal "Scale" rotary knob.
   The current scale factor per division is displayed in the upper left-hand corner of the display while you turn the knob. You can switch between a small and large step size in the scaling factor by tapping the step icon.





7. To return to the original scaling, you can either turn the rotary knob back in the other direction, or use the UNDO key on the front panel (in the NAVIGATION area). Press the UNDO key repeatedly until the original scaling is displayed. Press the REDO key to retrace the undone steps. Thus, you can toggle between the two displays using the undo and redo keys until you perform a different action. Instead of using the UNDO and REDO keys, you can tap the corresponding icons on the toolbar.

If you use an active single-ended probe, you can measure the DC component of the signal directly at the probe tip by means of the integrated R&S ProbeMeter:

1. On the "Vertical" menu, tap "Probe Setup".
2. Make sure that the correct channel is selected on the left tab.
3. In the "Additional" section, tap "ProbeMeter".

   A result box shows the DC voltage measured by the R&S ProbeMeter.

4.5 Zooming into the Display

Using the SCALE rotary knobs, you can change the scaling of the time base and signal amplitudes in order to enlarge the waveform. If you need to see more details, use one

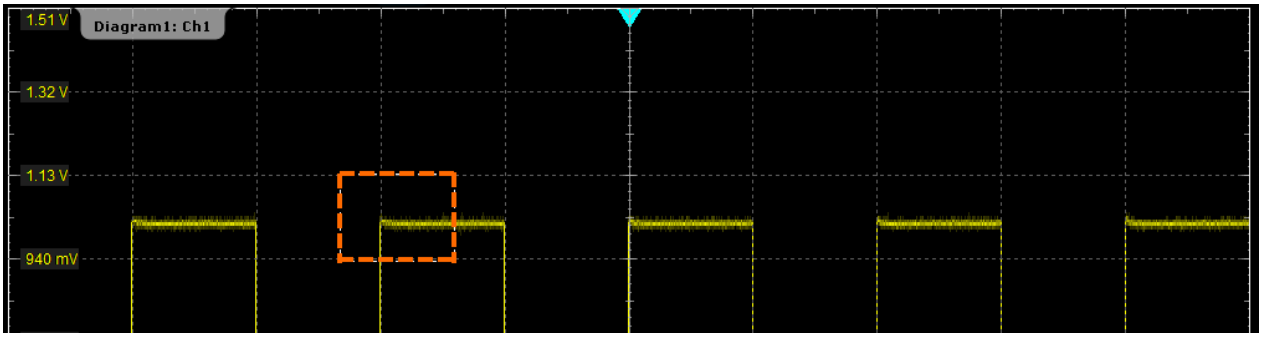
of the zoom functions. The instrument has 4 zoom types, 2 of them you will try out in this chapter.

The usage of zooms is also shown in a short video that is available on the instrument: "Tutorials > Getting Started > Zoom".

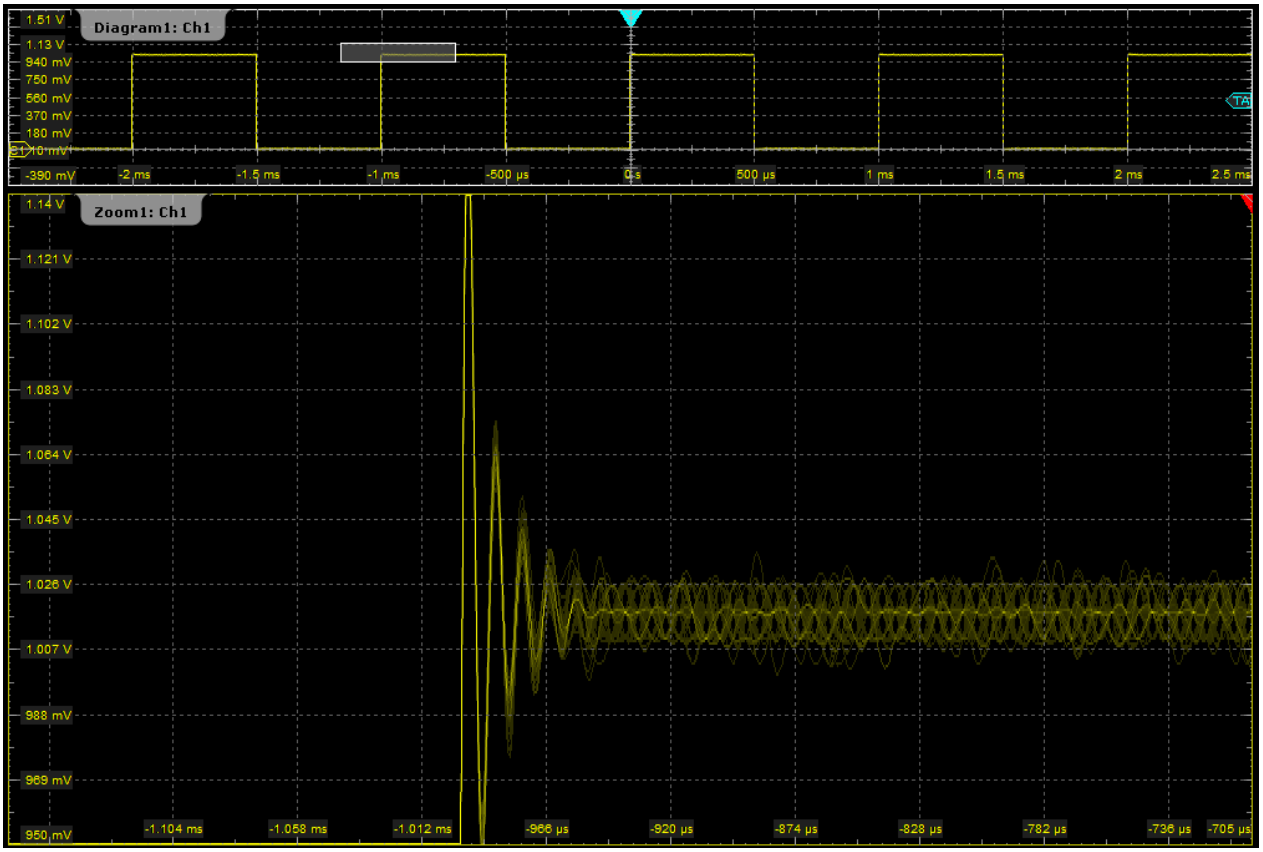
4.5.1 Using the Standard Zoom

1. Restore the default signal channel settings by pressing the PRESET and AUTOSET keys.
2. On the toolbar, tap the "Zoom" icon.

3. Tap the position in the diagram that you want to define as one corner of the zoom area, then drag your finger to the opposite corner of the zoom area.
While you drag your finger on the touchscreen, a dotted rectangle is displayed to indicate the current zoom area. When the rectangle covers the required zoom area, remove your finger.



The indicated area is magnified in a new zoom diagram. The original diagram is displayed with the zoom area indicated as a rectangle.



4. To remove the zoom window and make room on the display for other results, tap the "Delete" icon and then the zoom window.

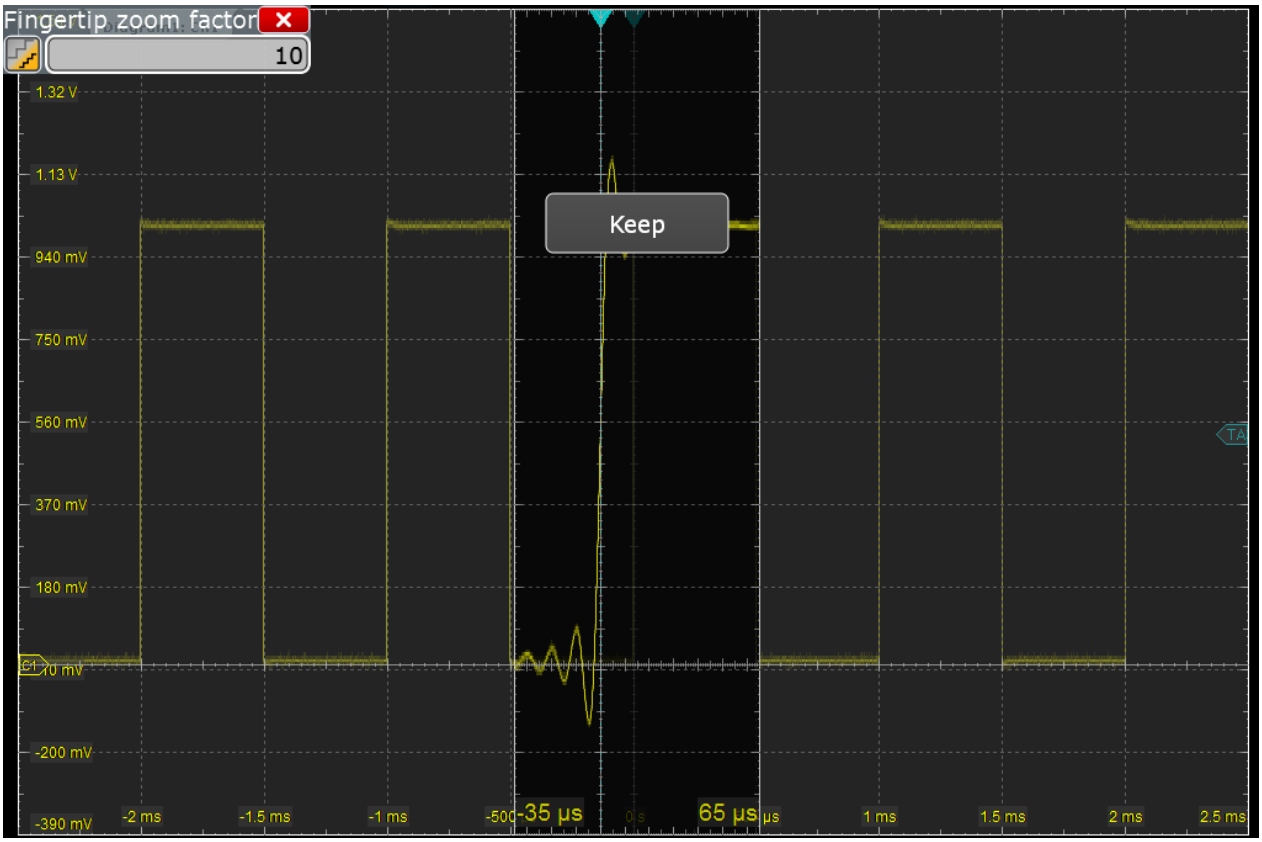
4.5.2 Using the Fingertip Zoom

1. Touch the "Zoom" icon on the toolbar and drag it down until the "Zoom" toolbar menu opens. Release the finger.
2. Tap "Fingertip zoom".

3. Touch and hold the waveform and move your finger slowly in horizontal direction.

Tip: You can turn the Navigation knob to change the zoom factor while holding the waveform.

4. Release the finger when the waveform segement of interest is visible in the zoom.
5. Tap "Keep" to convert the fingertip zoom into a standard zoom diagram.



4.6 Displaying the Waveform History

During a continuous acquisition, the acquired data is stored in the memory and the current acquisition is shown on the display. When the acquisition was stopped and a new acquisition is started with RUN CONT or RUN ×SINGLE, the memory is cleared and written anew. The history accesses and displays the samples that were saved before the current acquisition.

In the following example, you will acquire 10 waveforms, then display the 3 most recent waveforms.

1. Press the ACQUISITION key on the front panel (in the HORIZONTAL area) to open the "Horizontal" settings dialog box.
2. Set the "Average count" to *10* to perform 10 waveform acquisitions.
3. Close the "Horizontal" dialog box.

4. Press the RUN ×SINGLE key on the front panel (in the TRIGGER area) to start the acquisition cycle.

   Ten waveform acquisitions are performed. The most recent acquisition is displayed in the diagram.

5. Press the HISTORY key on the front panel (in the ANALYSIS area).

   The quick access "History" dialog box appears and the history mode is enabled.

6. Tap "Play".

   The ten stored waveforms are displayed one after the other, but very fast.

7. In the "Current acq." field, enter *-4* to display the sixth waveform (counted from acquisition start). The latest acquisition has the number 0, the oldest has -9.

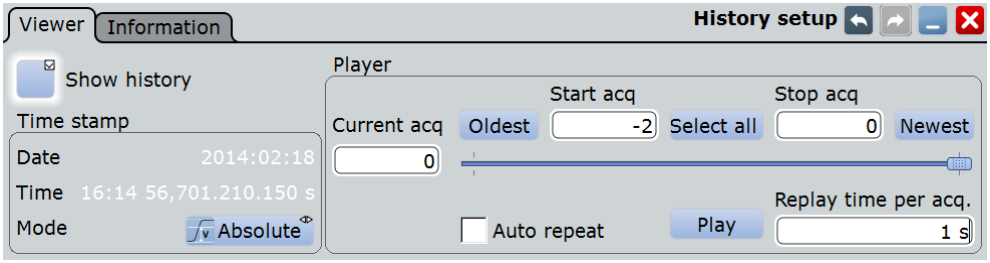
8. Tap the icon to open the "History" setup dialog box.

9. Enter *-2* in the "Start acq" field, then tap "Newest" to enter *0* in the "Stop acq" field.

   Thus the three latest acquisitions will be displayed.

10. In the "Replay time per acq." field, enter *1 s* to display each waveform for one second.

11. Enable the "Auto repeat" option to see the three waveforms repeatedly.



12. Tap "Play" to start the display.
    The currently displayed waveform is indicated in the "Current acq." field.

13. Close the "History" dialog box so you can see the waveform better.

14. Tap "Play" again (now labeled "Running" due to the running display) to stop the display.

15. Close the quick access "History" dialog box.

    The history mode is disabled, and the HISTORY key is no longer illuminated.

4.7 Showing Basic Measurement Results

Using the R&S RTO you can perform and display different measurements simultaneously. The color of the results in the result table corresponds with the source waveform color.

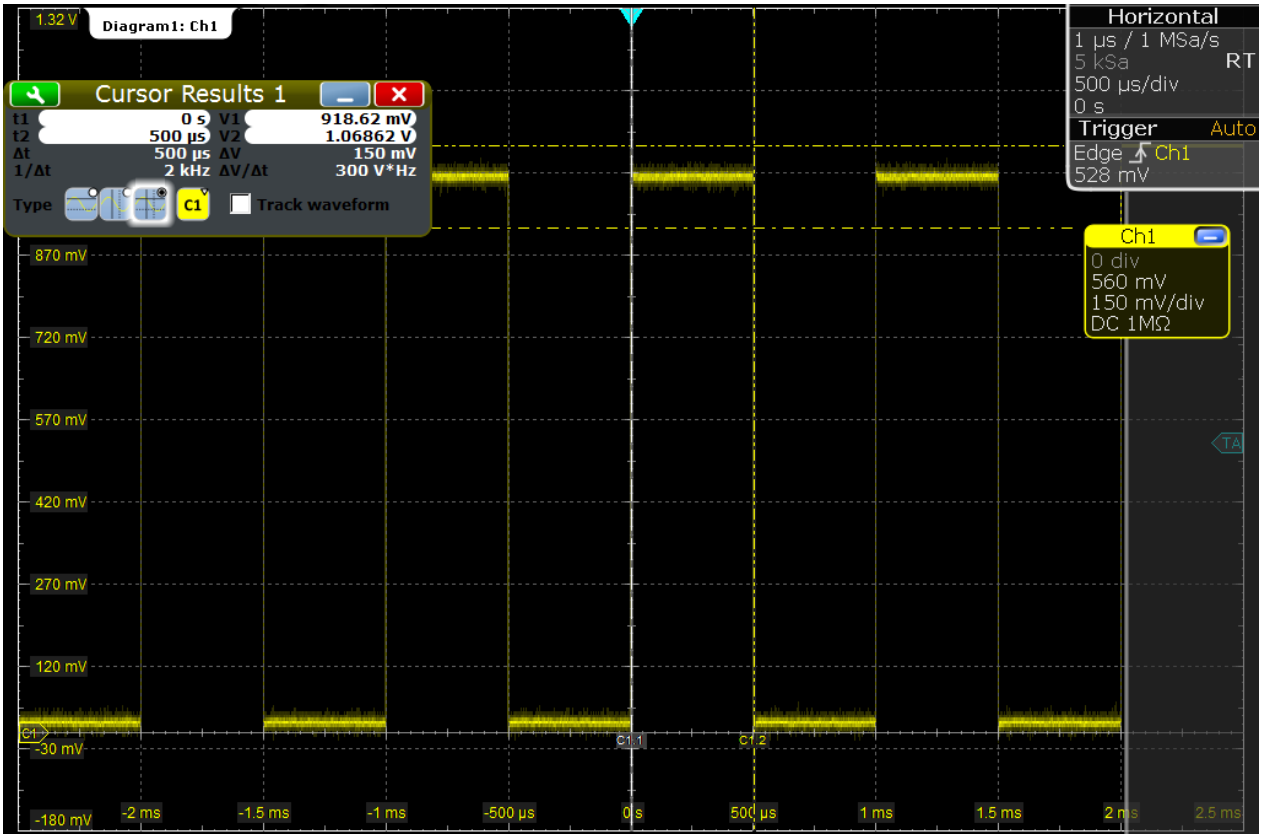
4.7.1 Performing a Cursor Measurement

1. Restore the default signal channel settings by pressing the PRESET and AUTOSET keys.
2. Tap the "Cursor" icon on the toolbar.

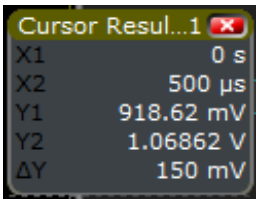
   

3. Tap the diagram in which you want to set the cursors, *or* draw a rectangle on the screen to position the cursor lines.

   The cursor lines appear in the diagram and the "Cursor Results" box opens. The measured values of the waveform at the cursor positions are displayed.
4. You can move the cursor lines in different ways:
   - Touch a cursor line and drag it on the screen.
   - Tap a cursor line to activate it, and turn the Navigation knob to adjust the position.
   - Enter the position values in the result box.



5. To save space in the display, minimize the result box. The most important results are displayed and updated in the result icon, as well.



6. To remove the result icon and make room on the display for other results, tap the red cross on the icon label.

4.7.2 Performing an Amplitude Measurement

In order to measure the voltages of a pulse quickly, perform amplitude measurements in the time domain.

1. Restore the default signal channel settings by pressing the PRESET and AUTOSET keys.
2. Tap the "Measurement" icon on the toolbar.
3. Tap the diagram in which you want to perform the measurement, or draw a rectangle on the screen to define a gate area for which the amplitude is measured.

The "High" measurement is selected and enabled, using the selected (focused) waveform as the source.
The "Measurements" result box with the measured amplitude is displayed.

4. To display statistical results for the measurement, tap the icon in the result box, or press the MEAS key on the front panel (in the ANALYSIS area).
The "Measurements" dialog box is displayed.

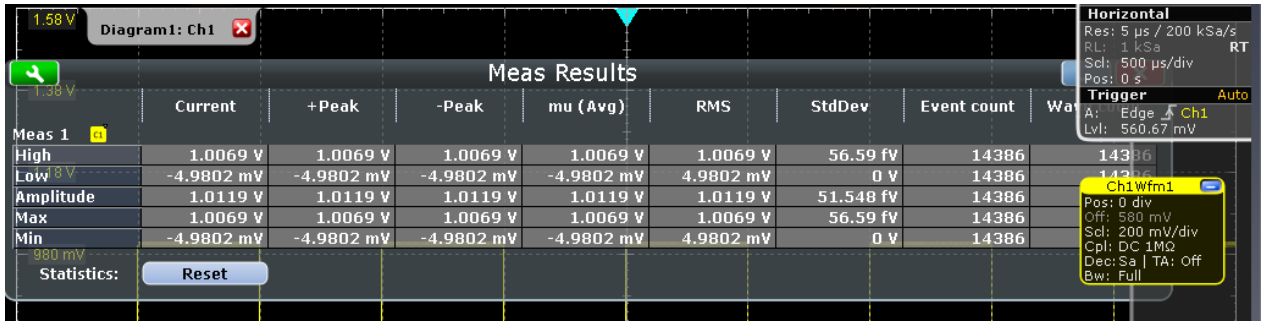
5. Enable the "Statistics" option, and close the dialog box.

   The results in the result box are extended by statistical values.

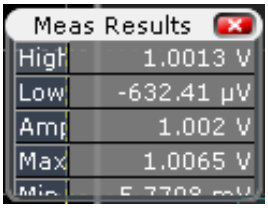
6. To select further measurements, tap the icon in the result box, or press the MEAS key on the front panel to display the "Measurements" dialog box.

7. Under "Additional amplitude/time measurements", tap "Activate..." and select the required measurement types. For example, select *Low*, *Amplitude*, *Min*, and *Max* to display the high level, low level, minimum and maximum values, respectively.

   The measurement results are displayed in the result box.



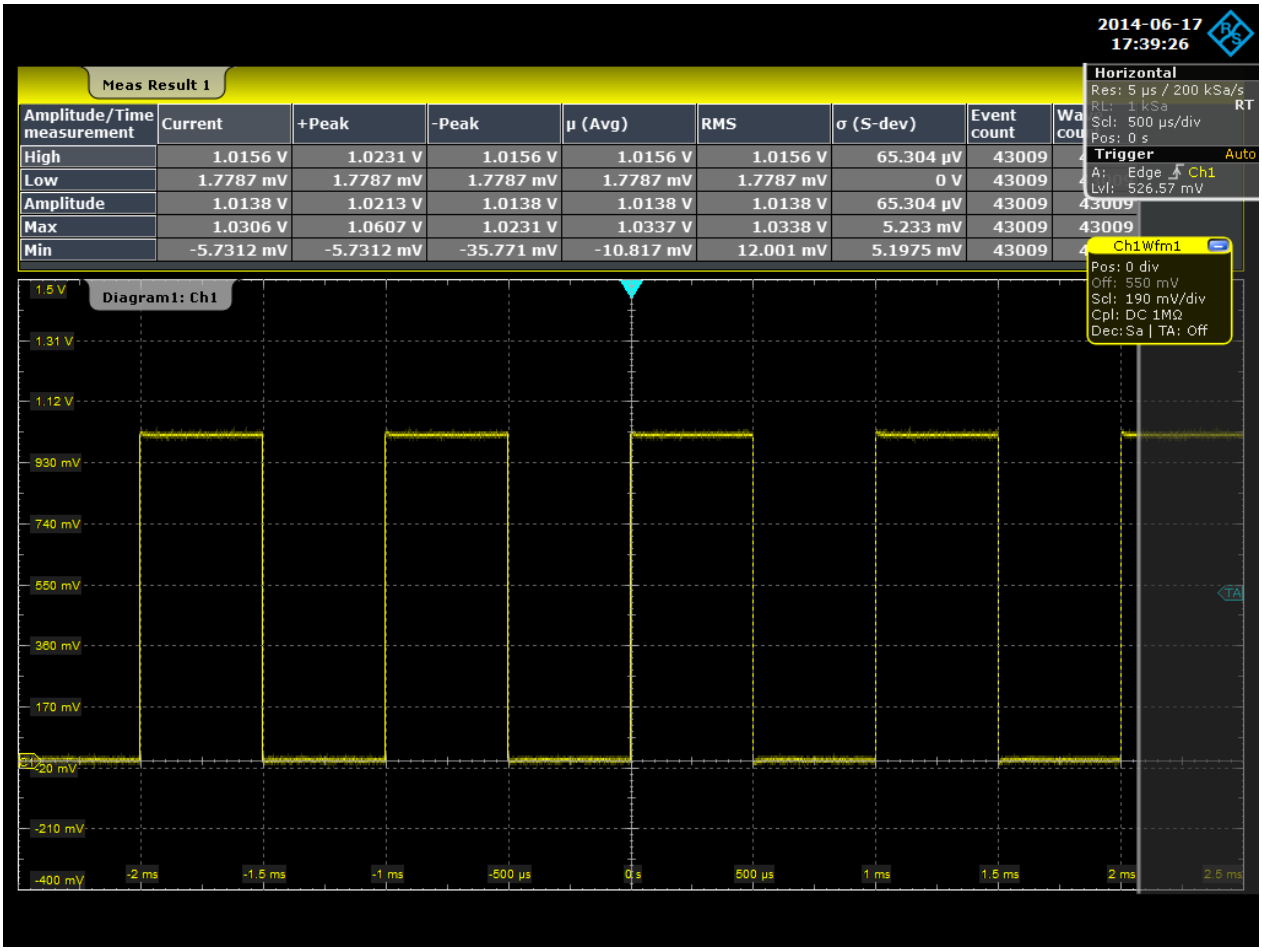
8. To save space in the display, minimize the result box: . The most important results are displayed and updated in the result icon, as well.



9. To view all measurement results without covering part of the waveform display, move the result table to its own diagram area:

   a) Drag the result icon to the diagram area.
   b) Drop the icon in the target area.

   Now you can see both the measurement results and the waveform.



10. Minimize the measurement results display: touch the title of the results box, and draw it to the signal bar.
11. Close the result icon.

4.7.3 Performing and Configuring the Quick Measurement

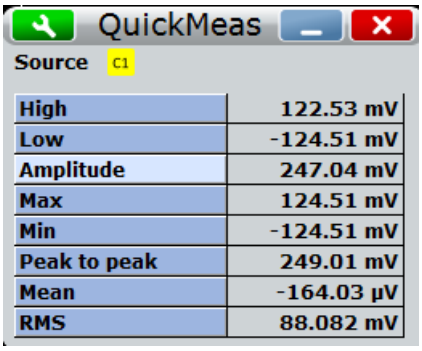
A set of up to eight different measurements on one source can be performed at once, simply by tapping the "Quick measurement" toolbar icon. The results are displayed in a result box. You can configure the measurement types to be included in quick measurement. This way, repeating measurements are performed very quickly.

In the following example, you will start a quick measurement and change the QuickMeas configuration.

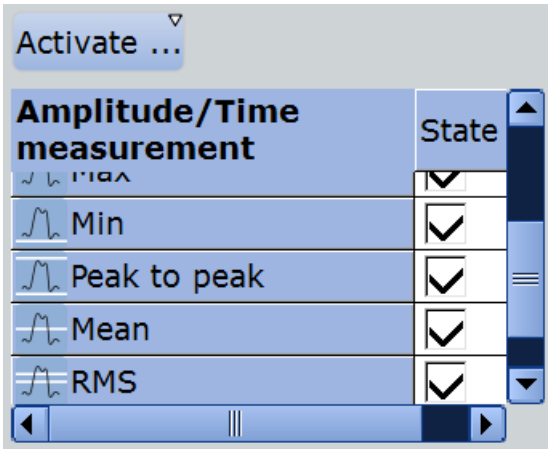
1. Press AUTOSET.
2. Tap the "Quick measurement" icon on the toolbar.

3. Tap the the diagram.

   The result box shows the results of the default quick measurement.



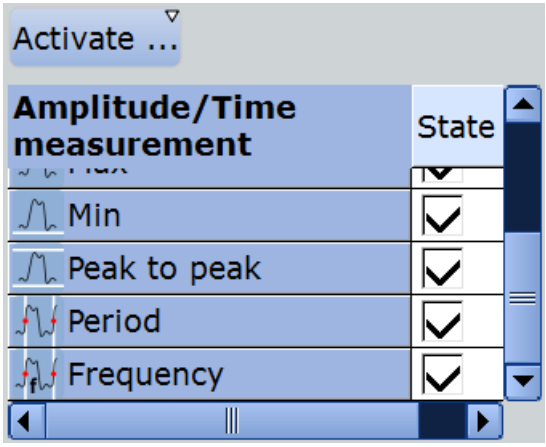
4. Tap the icon to open the "Measurements" dialog box.
5. If necessary, select the "Quick Meas" tab.
6. Scroll down in the table and disable the Mean and RMS measurements.



7. Tap "Activate" and select *Period*.

   Now the result box also shows the result of the period measurement.

8. Tap "Activate" and select *Frequency*.



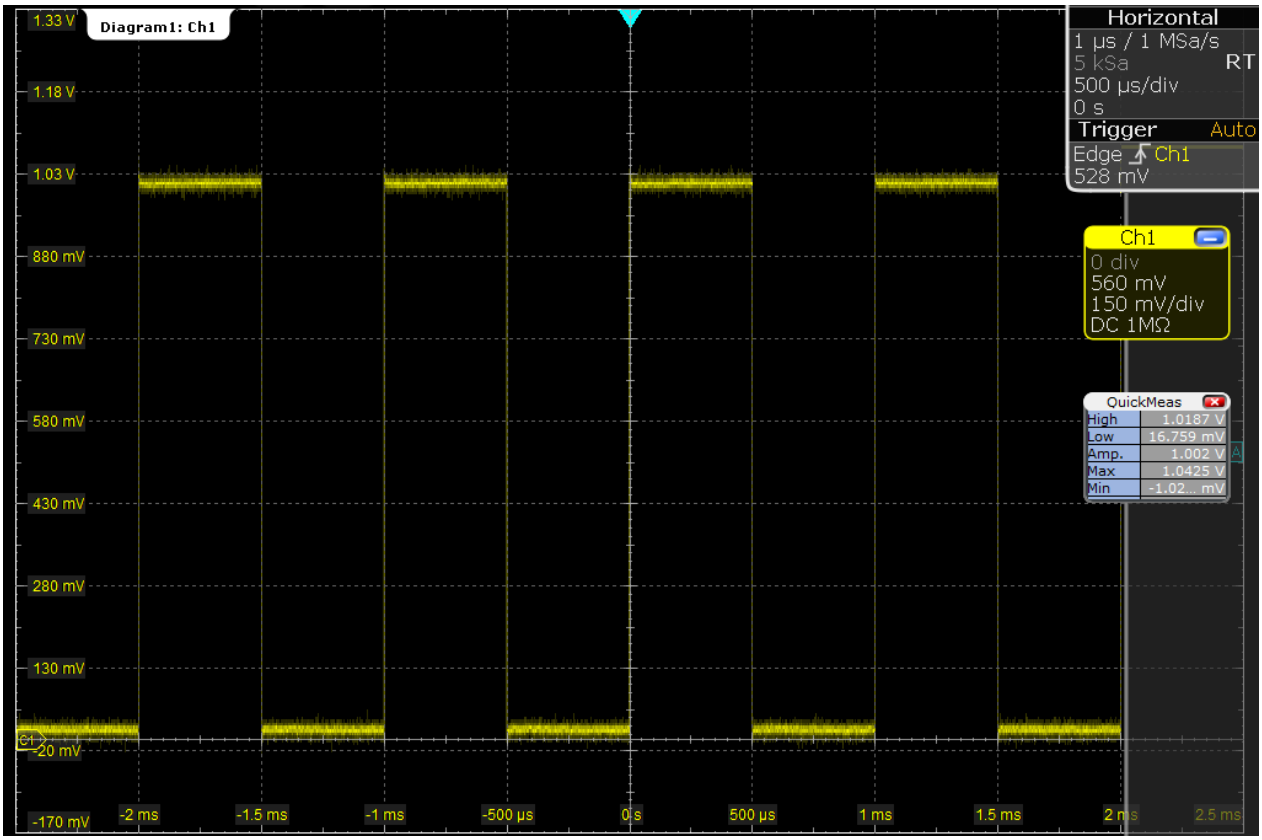
Now the result box also shows the result of the time measurements.

9. Tap "Set as QuickMeas".

   The current configuration is set as default quick measurement and can be repeated until you save another configuration.

10. Close the dialog box.

11. To save space in the display, minimize the result box:
    The most important results are displayed and updated in the result icon, as well.
    Do not close the result icon, as you need the results for the Search example (see chapter 4.10, "Performing a Search", on page 62).



4.7.4 Displaying a Histogram

Histograms are useful to analyze the occurrence of measurement values statistically.

The usage of histograms is also shown in a short video that is available on the instrument: "Tutorials > Getting Started > Histogram".

1. Tap the "Histogram" icon on the toolbar.

2. Tap the diagram in which you want to generate the histogram, or draw a rectangle on the screen to define the area on which the histogram is to be based.

   The histogram range is indicated in the diagram and a vertical histogram is defined and displayed.

3. To display the measurement results for the histogram, tap the "Measurement" icon on the toolbar.

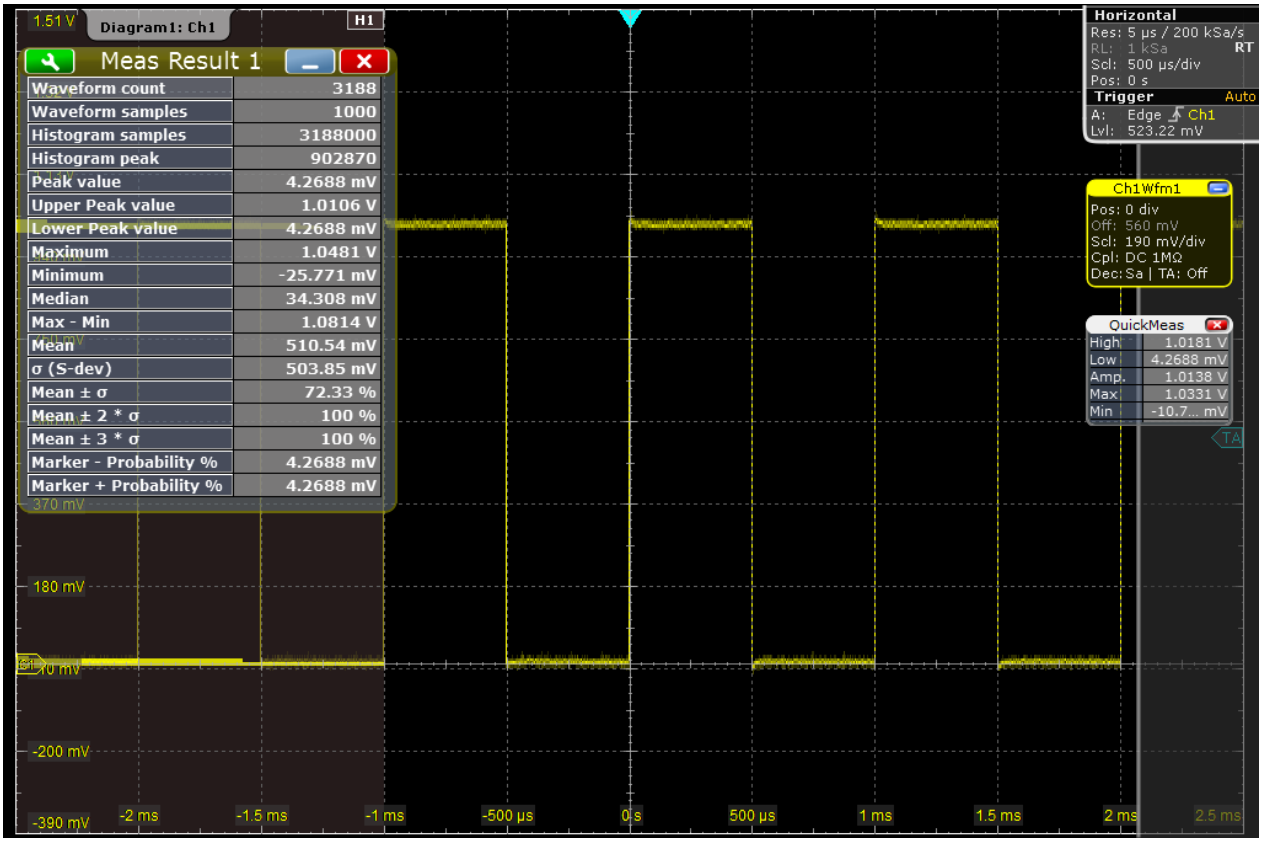
4. Tap the histogram.

   The waveform count for the histogram is displayed.

5. To display further measurement results for the histogram, tap the  icon in the result box, or press the MEAS key on the front panel to display the "Measurements" dialog box.

6. Under "Additional histogram measurements", tap "Activate..." and select the required results.

   The histogram measurement results are displayed in the result box.



7. To finish the measurement, tap the "Close" icon in the result box.
8. To remove the histogram, tap the "Delete" icon on the toolbar and then the histogram. Both the histogram and any measurements based on that histogram are deactivated.

4.8 Performing an FFT Analysis

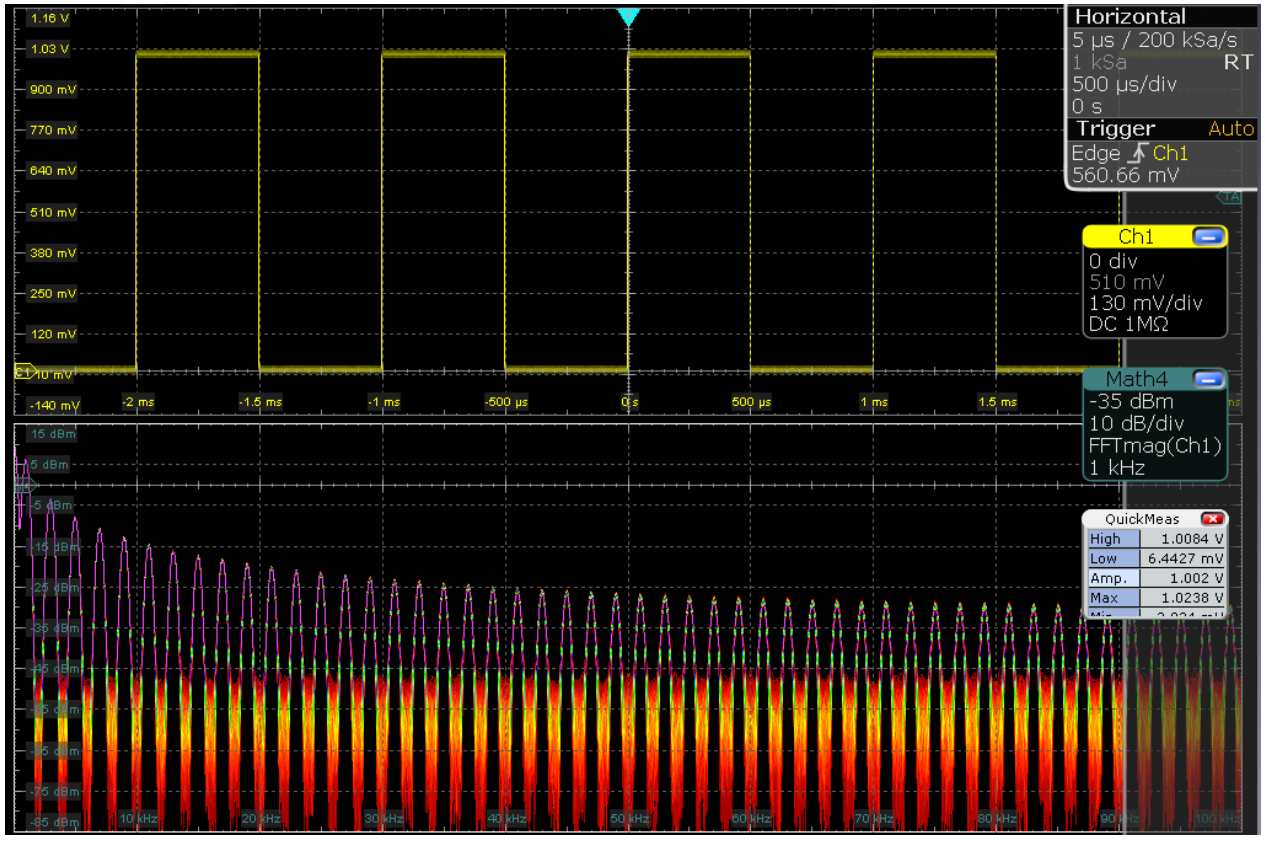
During FFT analysis, a signal in the time domain is converted to a spectrum of frequencies. A basic FFT waveform can be displayed very quickly.

The usage of FFT is also shown in a short video that is available on the instrument: "Tutorials > Getting Started > FFT".

1. Restore the default signal channel settings by pressing the AUTOSET key.

2. Tap the "FFT" icon on the toolbar, then tap the diagram.

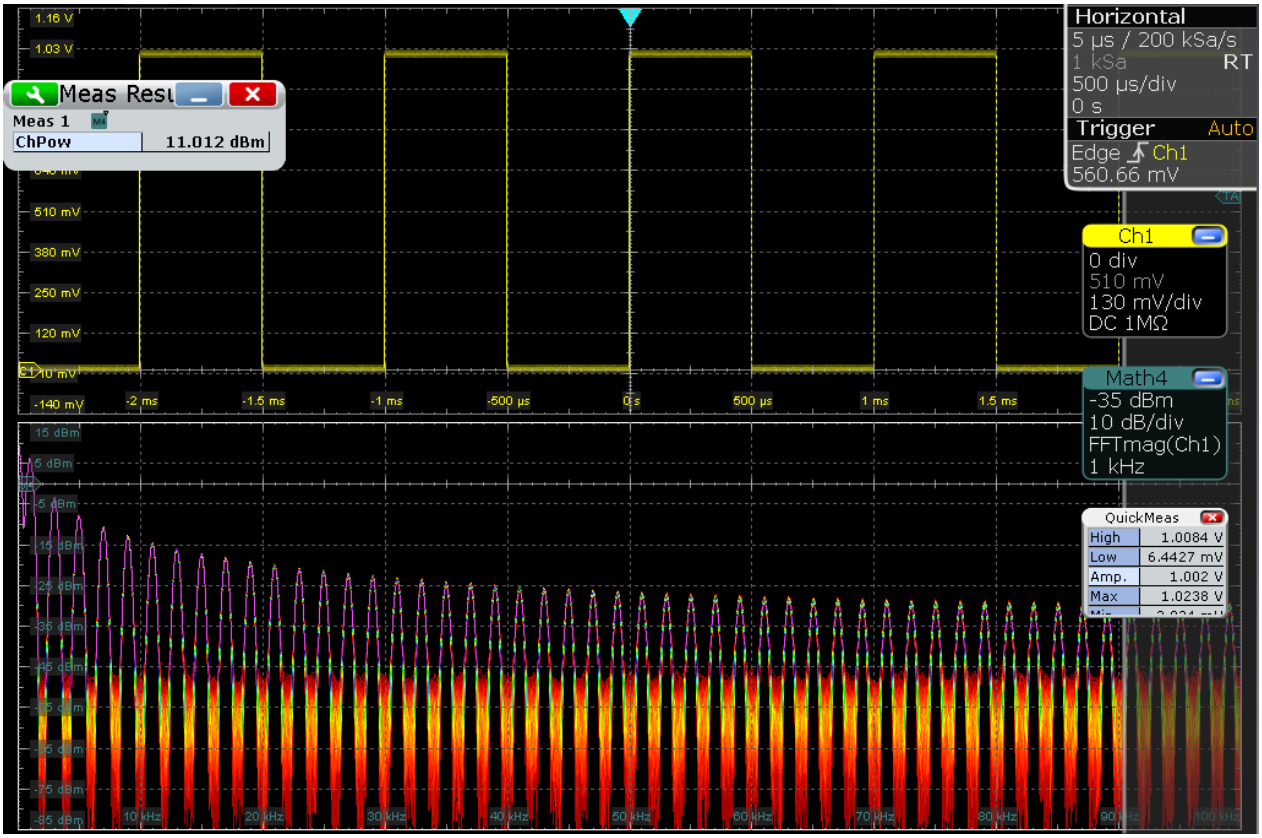
A math waveform is configured that uses the "Mag(FFT(x))" operator with "Ch1Wfm1" as source. The FFT waveform is displayed in a new diagram.



3. To perform a spectrum measurement on the math channel, tap the "Measurement" icon on the toolbar.

4. Tap the FFT waveform.

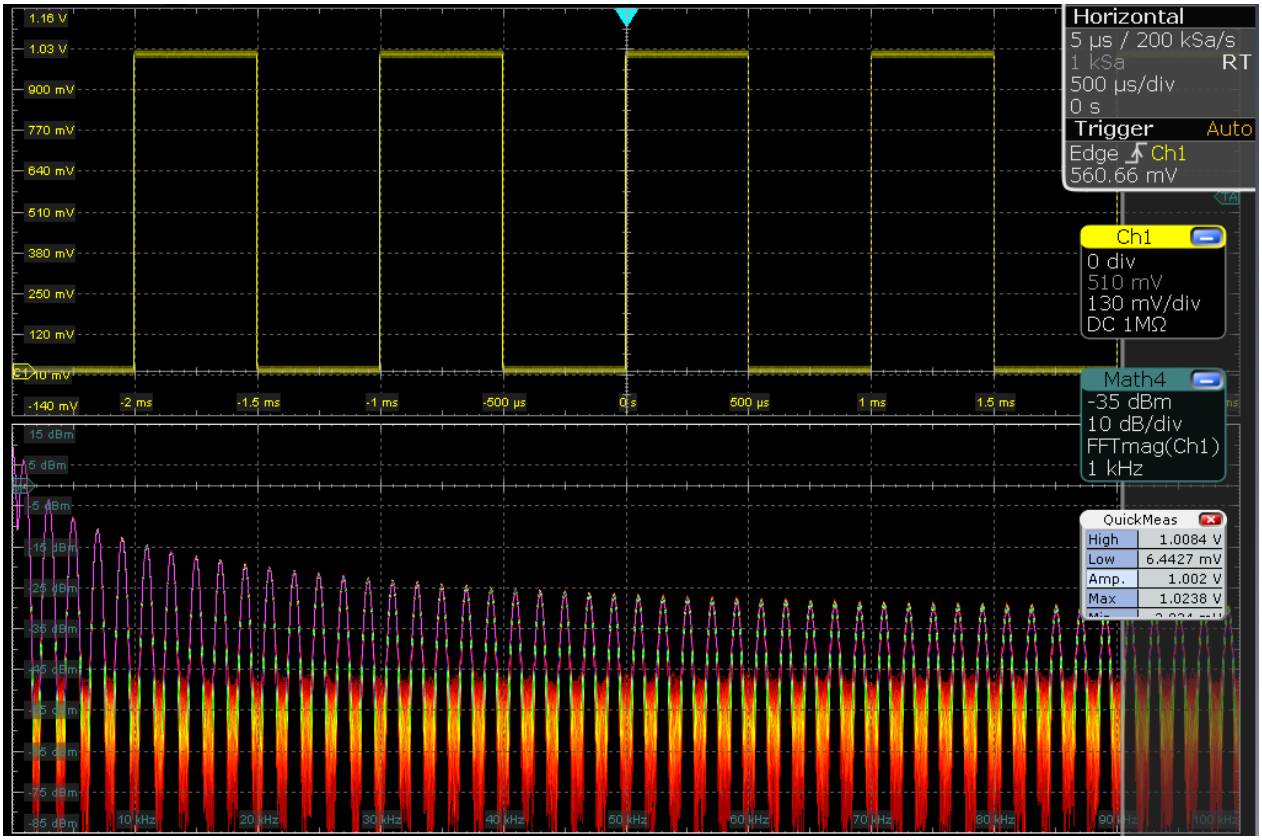
   The spectrum measurement results are displayed in a result box.



5. Double-tap the FFT waveform.

   The "FFT Setup" dialog box opens.

6. Set the "Center frequency" to *10 kHz*. The instrument adjusts the frequency span automatically.
   Close the dialog box.



7. To remove the FFT results, tap the "Delete" icon and then the FFT waveform.

8. Close the "Measurement" result box.

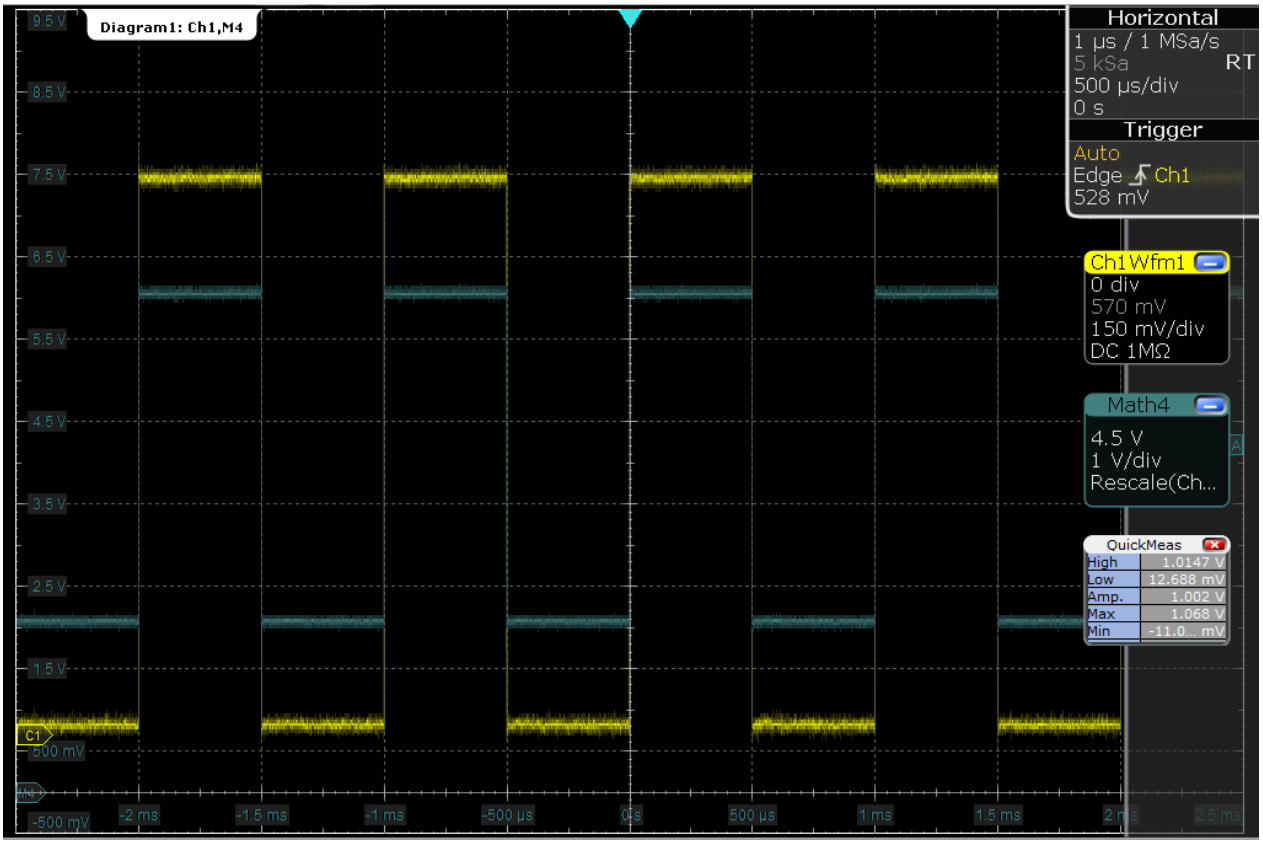
4.9 Performing Mathematical Calculations

In addition to the measured waveforms, you can display calculated data to compare the current measurement result with.

For example, you can rescale the waveform and display it in the same diagram as the original waveform.

1. Press AUTOSET.
2. Press the MATH key.
3. In the "Setup" tab, select the "Basic" subtab.
4. Tap the "Source1" icon and select *Ch1Wfm1*.
5. Tap the "Operator" icon and select *Rescale*.
6. For "a", enter the vertical scaling factor, e.g. *4*.

7. Under "b", enter the vertical position offset, e.g. *2*.
   Look at the lower part of the dialog box and note that the instrument adjusts the "Vertical scale" and "Vertical offset" of the math waveform automatically.
8. Tap "Enable" to display the first math waveform.
   The original and the rescaled waveforms are displayed.
9. Close the "Math" dialog box.



10. To remove the math waveform, tap the "Delete" icon and then the math waveform.
    Or, tap the signal icon of the math waveform to minimize the waveform, and then close the signal icon.

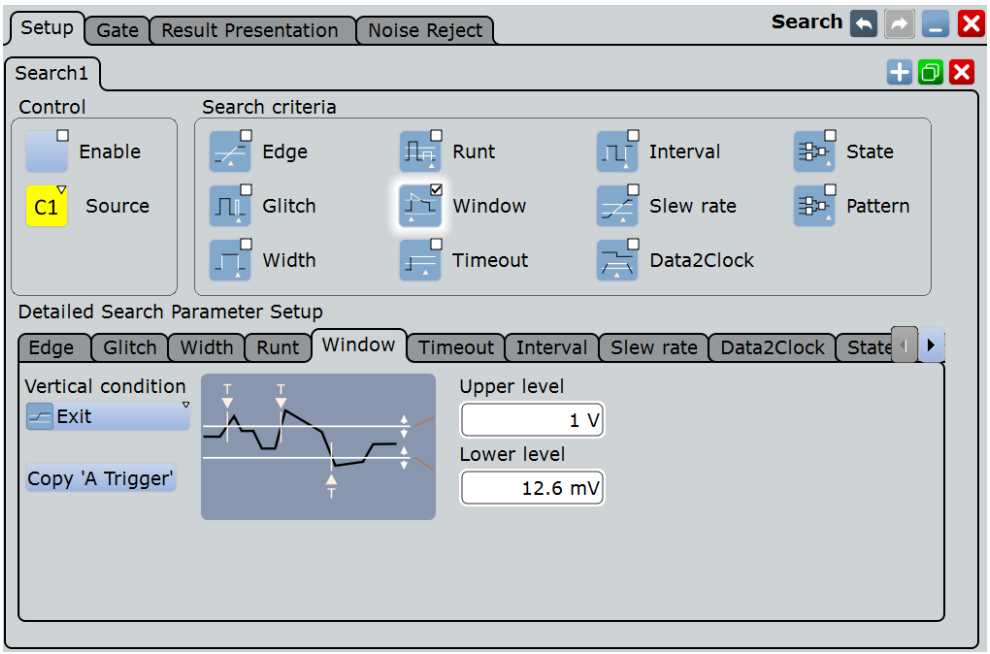
4.10 Performing a Search

In the following search, you will detect positive and negative overshoots, i.e. values that exceed the high or low levels. These events can be found with the windows search.

To determine the search conditions you can use the results of the measurement example described in chapter 4.7.3, "Performing and Configuring the Quick Measurement", on page 54.

To configure a search for overshoots

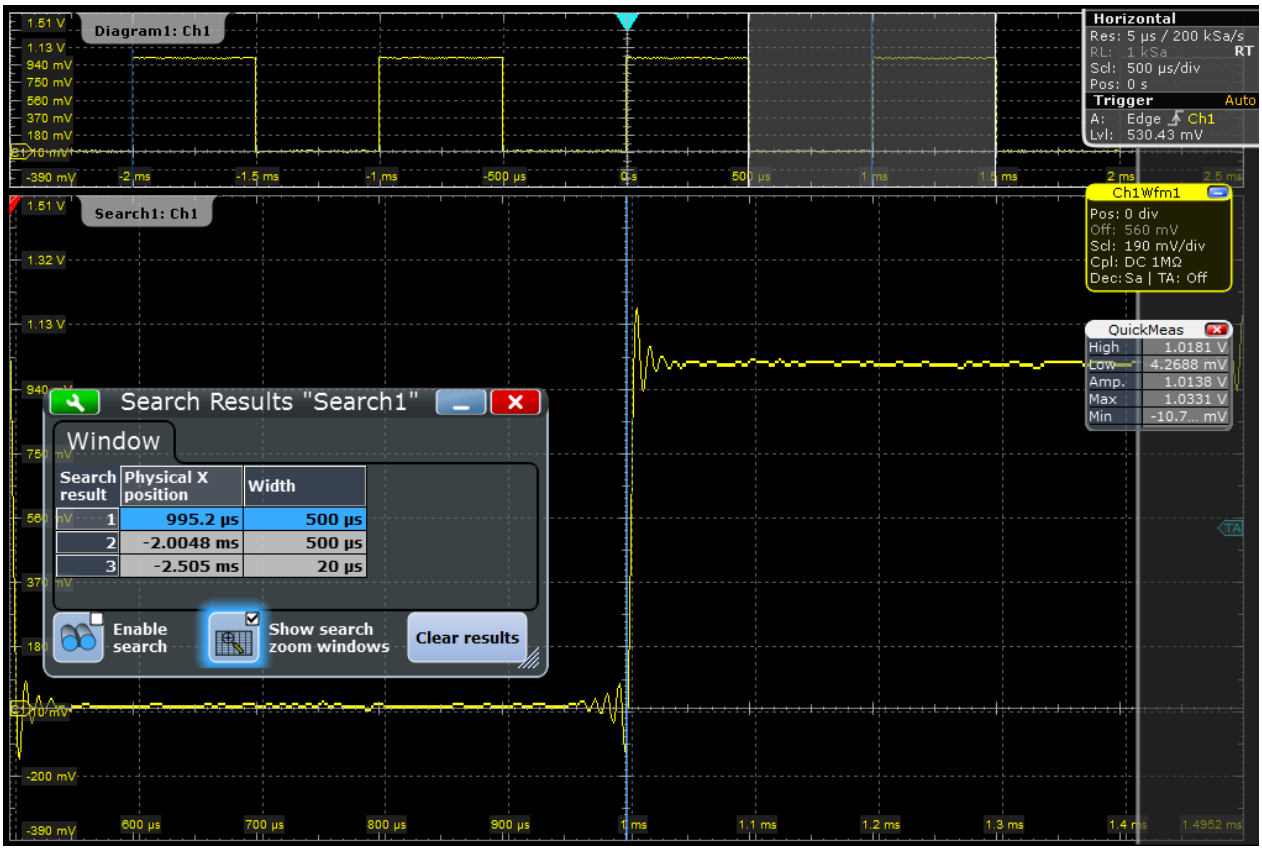
1. Press the SEARCH key on the front panel (ANALYSIS area).
2. Select C1 as the "Source".
3. Define the search criteria: Enable "Window".
4. In the "Window" tab, define the search conditions:
   a) As the "Upper level", enter the result of the "High" level measurement.
   b) As the "Lower level", enter the result of the "Low" level measurement.
   c) As the "Vertical condition", select *Exit* to find values that are outside the range defined by the high and low levels.



5. Select "Enable" to start the continuous search on the acquired data.
6. Close the "Search" dialog box.
7. In the "Search Results" box, select "Show search zoom windows".

   The acquisition stops, and the detected overshoots of the last acquisition are listed in the search result table. The last result that was found is displayed in the search zoom window. Vertical lines indicate the time values for which a result was found.

8. In the results table, tap the row of the search result that you want to display in the search zoom diagram.



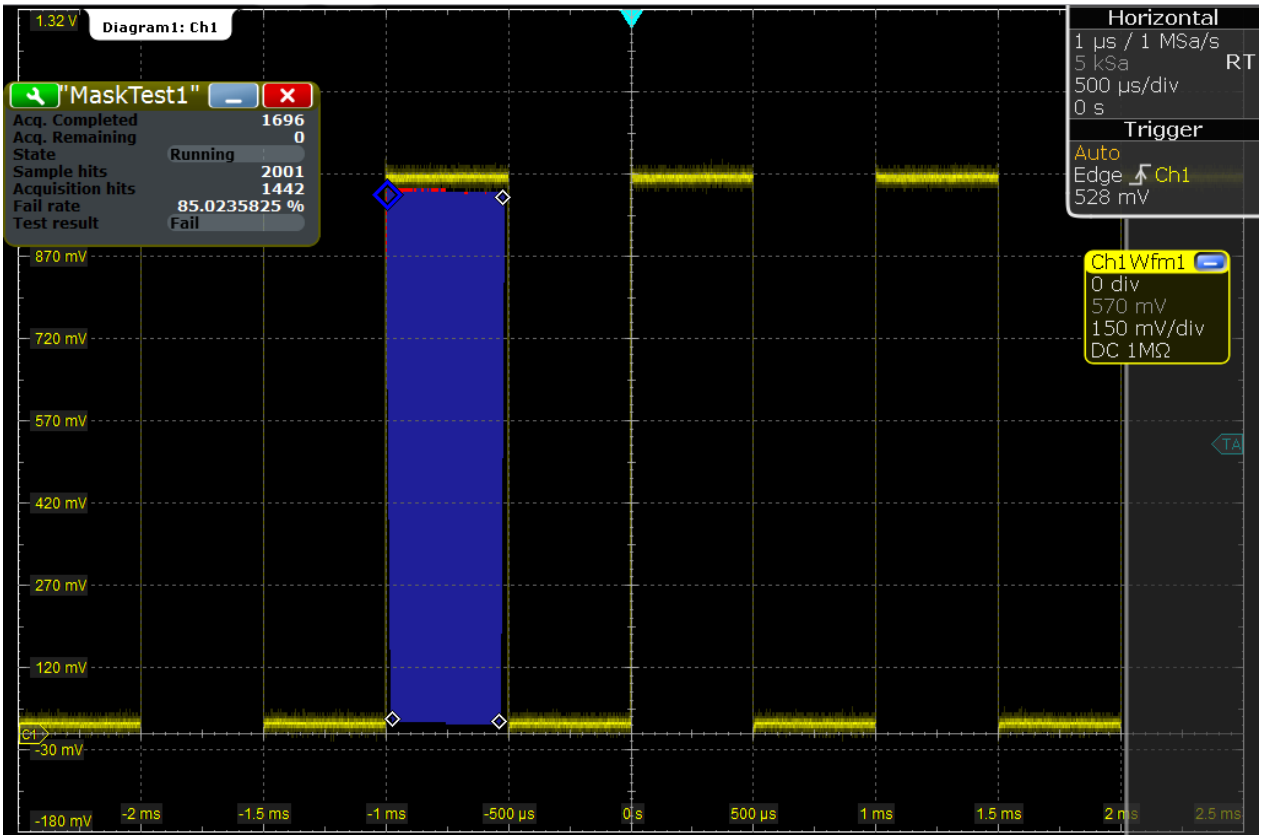
4.11 Performing a Mask Test

In the following example you will perform a mask test to determine whether the signal exceeds a rectangular area.

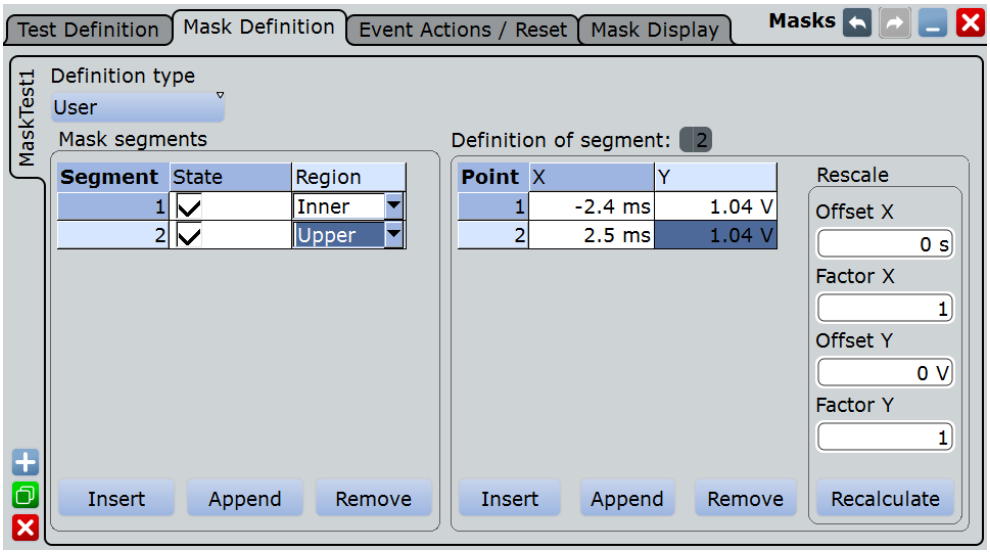
The usage of masks tests is also shown in a short video that is available on the instrument: "Tutorials > Getting Started > Mask Test".

1. Restore the default signal channel settings by pressing the PRESET and AUTOSET keys.
2. Tap the "Masks" icon on the toolbar.

3. Tap the corner points of the first mask segment on the touchscreen. Select the corner points of one complete pulse, with a minor offset to the inside. To finish the mask definition, double-tap the last point.



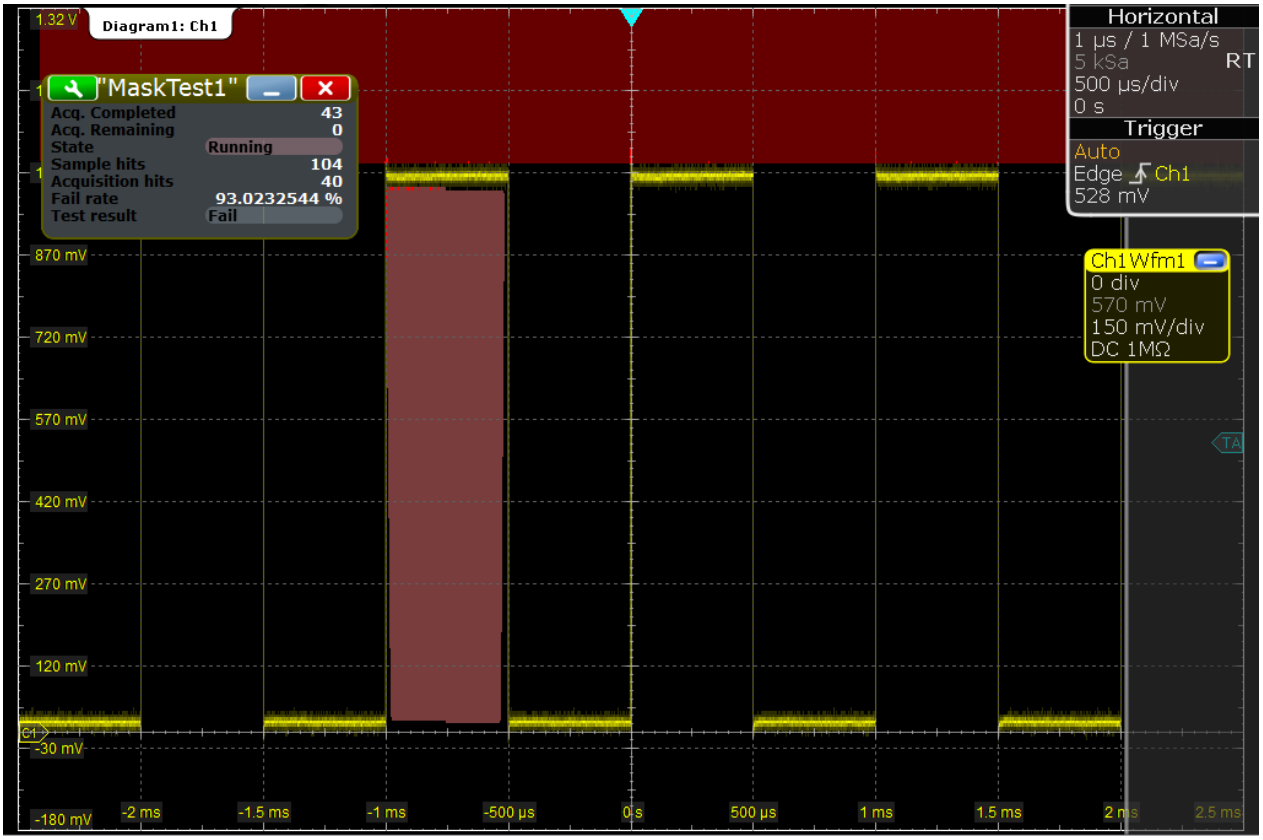
4. To define the further mask test settings, press the MASKS key on the front panel (in the ANALYSIS area), and select the "Mask Definition" tab.
5. If necessary, correct the mask segment points you defined graphically in the "Mask Definition" tab. In the "Region" column of the mask segment, "Inner" is selected. That means, a mask hit is detected if the signal is inside the segment.
6. Insert another mask segment above the positive pulse:
   a) Tap the "Append" button under "Mask segments".
   b) In the "Region" column of the new mask segment, select "Upper". In this case, a mask hit is detected if the signal is above the mask limit line.
   c) Under "Definition of segment", tap "Insert" twice to insert two points.
   d) Enter the x and y-values to define a line beneath which the values of the positive pulse should remain.



7. Tap the icon in the result box, and select the "Test Definition" tab.
8. Select channel 1 as the "Source".
9. Define the number of tolerable sample hits in the "Tolerance" field.

   A test has failed if the number of sample hits exceeds the limit of "Violation tolerance" hits.
10. Select the "Event Action / Reset" tab.
11. For the "Stop acquisition" action select *On violation*. If the violation tolerance is exceeded, acquisition is stopped.

    The results of the mask test are shown in the "MaskTest" results box. Mask hits are also indicated as red points in the mask segment in the diagram.



12. Press RUN CONT to start the next acquisition and watch the screen.
13. Close the "MaskTest" results box by tapping the red cross in the label.

4.12 Printing and Saving Screenshots

You can print or save screenshots of the current display to document your results. In the following example, you will print the current display as a black and white graphic with inverted colors, i.e. a dark waveform is printed on a white background. Then you will save the screenshot to a file.

1. Open the "File" menu and tap "Print Setup".
2. Tap "Color" and select "Black and white".
3. Enable "Inverse color".
4. To add a textual comment or highlight a special area of the waveform, tap "Edit image".

   The print image is opened in the Paint application. Edit the image as necessary, then save the file and close the Paint application to return to the "Print" dialog. Then print or save the (edited) image as described in the following procedure steps.

5. If a printer is connected to the instrument, or the instrument is connected to the network, select an installed printer in the printer selection box. Printing to a file is also possible using one of the "RS Printer" drivers for JPG, PDF, PNG, and TIFF files.
6. Tap "Print" to print the image to the selected printer or printer driver. The result is a monochrome image.
7. Tap "Save" to save the image to a file.

   The result is a greyscaled image. The default file name is `Screenshot_<date>_<index>_<time>.png`. It is saved to the following directory:
   `C:\Users\Public\Public Documents\Rohde-Schwarz\RTx\ScreenShots`

4.13 Saving Data

After a measurement with the R&S RTO you can save the resulting waveform data for further evaluation or comparison. You can also save measurement results, and device settings in order to repeat or restore previous measurements.

- "Saving waveform data" on page 68
- "Saving data of an acquisition series" on page 69
- "Saving measurement results" on page 69
- "Saving and restoring device settings" on page 70

Saving waveform data

1. Press the FILE key on the front panel (in the SETUP area on the left).
2. Select the "Waveforms/Results" tab.
3. Check the "Source" and set "Scope" to "Full Waveform".
   If a cursor, zoom or measurement gate is defined, you can use these settings to export only a part of the waveform.
4. Under "Save to file", tap "Save As" to open the file selection dialog box.
5. The default storage directory is shown in the file selection dialog box:
   `C:\Users\Public\Public Documents\Rohde-Schwarz\RTx\RefWaveforms`
6. Tap the keyboard icon and enter *Waveform1* on the online keyboard.

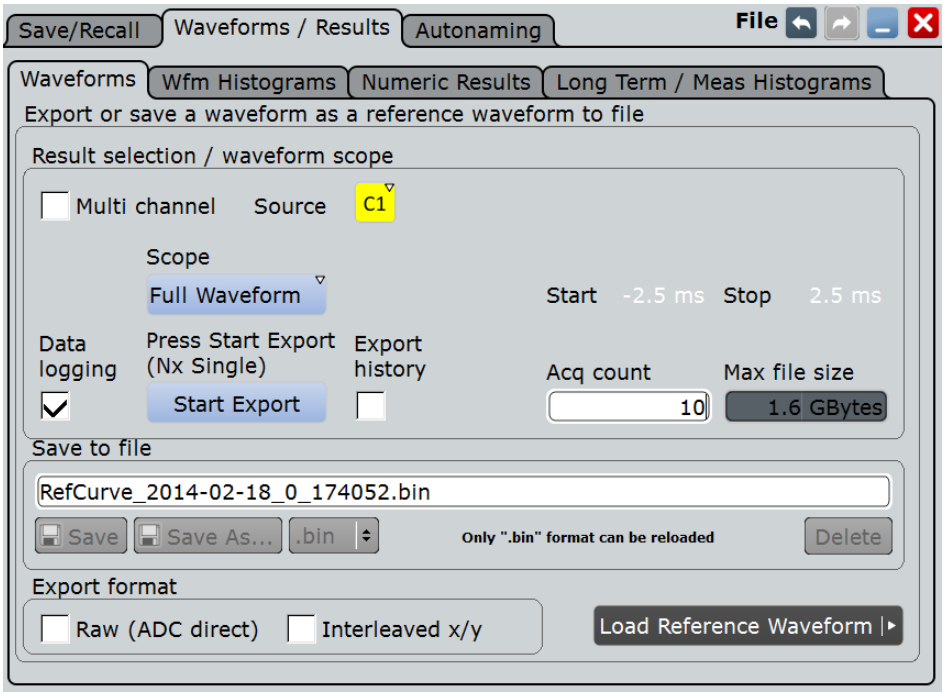
   
7. Tap "ENTER" to close the online keyboard.

8. Select the file type: "*.bin".
9. Tap "Save".

   The waveform data is saved to the files `Waveform1.Wfm.bin` and `Waveform1.bin` in the selected directory.

Saving data of an acquisition series

1. Press the FILE key on the front panel.
2. Select the "Waveforms /Results" tab.
3. Set the export scope of the waveform:
   a) Check the "Source" and set "Scope" to "Full Waveform".
   b) Tap "Data logging" to enable export all waveforms of a running acquisition.
   c) Enter "Acq count" = *10*, the number of subsequent waveforms to be saved.



4. Tap "Start Export" to save the waveforms to the file that is named under "Save to file".

Saving measurement results

1. Perform a measurement as described in chapter 4.7.2, "Performing an Amplitude Measurement", on page 52.
2. Tap the icon in the result box.
3. Tap the "Result export" button in the "Setup" tab.
4. On the "Numeric Results" tab, select the results to be saved.

5. For further usage of the results, select the "CSV-Delimiter" that is used to convert the values in columns. For MS Excel, the semicolon is recommended.
6. Tap "Save".

   The results are saved to the following folder:
   `C:\Users\Public\Public Documents\Rohde-Schwarz\RTx\ResultBoxExport`
   The file name is created according to the autonaming settings.

Saving and restoring device settings

1. Press the FILE key on the front panel.
2. Select the "Save/Recall" tab.
3. Select the "Settings" tab.
4. Tap "Save As" and enter the path and file name.
   `C:\Users\Public\Public Documents\Rohde-Schwarz\RTx\SaveSets\Settings_Meas1.dfl`
5. Tap "Save".
6. Press the PRESET key on the front panel to restore the default instrument settings.
7. In order to repeat the initial measurement, load the saved device settings.
   Tap the"Load saveset" icon on the toolbar.

8. Use the buttons on the left and the right to scroll the stored savesets. The file name and a screenshot are shown it identify the correct saveset.
9. Tap "Load".

   The device and measurement settings are restored and you can repeat the measurement.

5 Operating the Instrument

There are three ways to operate the R&S RTO.

Manual operation

Use the touchscreen, keys and rotary knobs, or an optional mouse and/or keyboard. The principles of manual operation are explained in this section.

Remote control

Create programs to automatize repeating settings, tests, and measurements. The instrument is connected to a computer running the program.

This way of operation is described in the Operating Manual, chapter "Remote Control Commands".

Remote operation (Windows 7)

The remote desktop connection of Windows Embedded Standard 7 can be used for instrument control and file transfer. Even on computers with non-Windows operating systems, a remote desktop connection is possible using RDP applications.

Remote operation (Windows XP)

The Remote Desktop Connection of Windows XP is not supported for instrument control. Remote Desktop can only be used for file transfer from and to the instrument.

Remote monitoring and control of the instrument from a connected computer is possible with a standard web browser and the common cross-platform technology Virtual Network Computing (VNC). You have to install the VNC server on the R&S RTO. Installation and configuration is described in the Application Note "Remote Monitoring and Control of the R&S RTO with a Web Browser", available on the Rohde & Schwarz Internet.

5.1 Means of Manual Interaction

The R&S RTO provides the following means of manual interaction, which you can use alternatively or complementary:

- Touchscreen:
  Using the touchscreen is the most direct interaction way. Use your finger to place waveforms on the screen, mark areas for zoom and histograms, set parameters in dialog boxes, enter data, and much more. Most of the control elements and actions on the screen are based on the Windows concept, and you will easily become familiar with the user interface.
  Tapping the screen works like clicking mouse buttons:
  – Tap = click: Selects a parameter or provokes an action.

  - Double-tap = double-click has the same effect as touch and hold = right-click: Opens a toolbar menu, or the on-screen keyboard or keypad, or a specific editor if available

- Function keys and rotary knobs:
  The front panel provides nearly all functions and controls to operate the instrument in the classic ways, without touchscreen. As an exception, the signal bar cannot be used with front panel controls.
- Optional mouse and/or keyboard:
  These devices work conform to Microsoft standards on the screen. The navigation keys on the front panel correspond to the keys on the keyboard.

The usage of the touchscreen and navigation keys is described in detail in the following sections.

5.2 Information on the Display

The touchscreen display of the instrument shows not only waveforms and measurement results, but also information and everything that you need to control the instrument. All waveform-related display elements are shown in figure 5-1. An overview of control elements - like dialog box, toolbar - is given in chapter 3.1.1, "Touchscreen Display", on page 20.

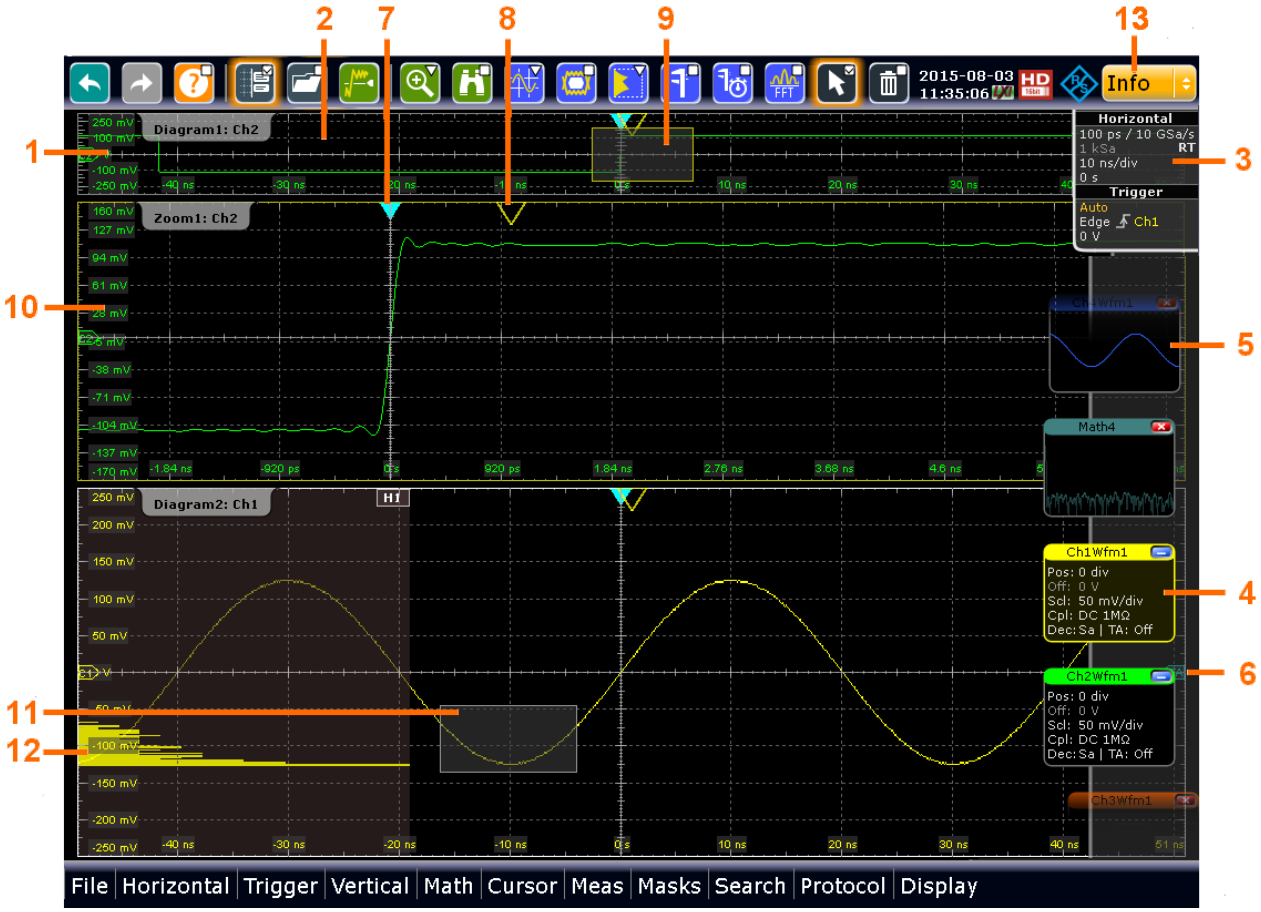


Fig. 5-1: Display information

1 = Diagram
2 = Grid
3 = Horizontal and trigger label
4 = Signal icon with main vertical and acquisition settings
5 = Signal icon with minimized live signal view
6 = Trigger level
7 = Trigger position
8 = Reference point (Distance from trigger position to reference point = horizontal position)
9 = Zoom area
10 = Zoom diagram
11 = Histogram area
12 = Histogram
13 = Messages

Diagrams

A diagram shows one or more waveforms: channel, reference, and math waveforms together with histograms, masks etc. Zoom details appear in separate zoom diagrams, also XY-waveforms appear in separate diagrams.

By default, the diagram name contains the diagram number and the short names of the waveforms shown inside. To change the diagram name, touch and hold the tab name. The on-screen keyboard opens to enter the new name. Names must be unique.

To arrange the diagrams on the screen, the Rohde & Schwarz SmartGrid function helps you to find the target place simply and quickly. A tabbed view is also possible, and you can adjust the diagram size.

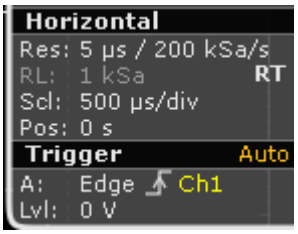
For details, see "To arrange a waveform using the SmartGrid" on page 84.

Grid

The grid shows the vertical and horizontal divisions. The division lines are labeled with the correspondent values. The grid labels have the color of the waveform to which they belong. If several waveforms are shown in one diagram, the grid has the color of the selected waveform.

Horizontal and trigger labels

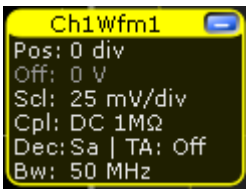
The horizontal and trigger labels on the signal bar show the current time base and trigger settings. If you tap a label, the relevant dialog box opens with the tab used at last.



Res = Resolution / sample rate
RL = Record length
RL (right) = RT - real time, IT - interpolated time
Scl = Timebase, horizontal scale
Pos = Horizontal position
Auto | Normal = Trigger mode
A = Trigger type, slope, and source of the A-event
Lvl = Trigger level

Signal icons on the signal bar

Each waveform is represented by a signal icon. For an active waveform, which is shown in a diagram, the signal icon displays the signal label with the main vertical and acquisition settings for the waveform. The icon can also display a signal view, that is the minimized live waveform.



Pos = Vertical position
Off = Offset
Scl = Vertical scale
Cpl = Coupling
TA = Waveform Arithmetic
Dec = Decimation
Bw = Bandwidth

You can place the signal bar on the left or right side of the screen, hide it, and change the color and transparency of the bar.

In figure 5-1, the signal icons Ch1Wfm1 and Ch2Wfm1 show the signal label, and the waveforms are displayed in diagrams. All other waveforms are minimized and shown in the signal view.

Trigger position and trigger level
The blue markers show the horizontal position of the trigger and the vertical trigger level. You can tap and move the trigger markers in the diagram to set the positions graphically. The trigger point is the zero point of the diagram.

The trigger position can be moved outside the diagram. A red trigger position marker indicates that the trigger position is not visible.

Reference point
The reference point marks the rescaling center. If you modify the time scale, the reference point remains fixed on the screen, and the scale is stretched or compressed to both sides of the reference point.

You can define the position of the reference point on the screen, and its time distance from the trigger point of the diagram.

Zoom diagram and zoom area
Zoomed waveforms are shown in separate zoom diagrams, additionally to the waveform diagrams. On the original waveform diagram, a rectangle indicates the zoomed section of the waveform - this is the zoom area. You can modify the zoom area by dragging the rectangle as a whole, and by dragging its sides - tap the zoom area to toggle between these modes. Furthermore, you can set exact positions.

The frames of the zoom area and the associated zoom diagram have the same color, different zooms are marked with different colors. So it is easy to assign zoom area and zoom diagram.

As for waveform diagrams, you can change the name of the zoom diagram. A zoom in a zoom and coupled zooms are also possible.

All zooming possibilities are described in detail in the "User Manual", chapter "Zoom".

Histogram and histogram area
A histogram shows the frequency of occurrence of voltage or time values in a bar chart directly in the diagram. The rectangular histogram area indicates the part of the waveform that is considered in the histogram. The vertical histogram counts the voltage values, and the horizontal histogram counts time values. You can switch between vertical and horizontal mode, and modify the histogram area by dragging the rectangle as a whole, by dragging its sides, or by setting exact positions.

Messages
A yellow or red Info button on the toolbar points to the status messages of the instrument. You can open the message box by tapping the button. See also: chapter 5.9, "Messages", on page 93.

5.3 Toolbar

The toolbar provides direct access to important control and measurement functions, it shows current date and time, and an information box with status messages of the instrument.

A little triangle in the upper right corner of the icon means, that a menu is available where you can select the required function.

A little square in the upper right corner of the icon means, that the function can be activated or deactivated.

By default, the toolbar shows the most frequently used functions. You can configure the content of the toolbar and hide the date/time display, see chapter 5.3.3, "Toolbar Configuration", on page 81.

5.3.1 Using the Toolbar

Using the toolbar is easy and straightforward.

Some of the toolbar functions are one-click actions. These actions are performed immediately when you tap the icon.

Other toolbar functions are analyzing functions. These are interactive actions.

To use analyzing functions (interactive actions)

1. If several waveforms are shown in the diagram, tap the "Select" icon and then the waveform that you want to analyze.

   The waveform gets the focus, and the grid labels have the color of the selected waveform.

2. Tap the icon of the function.
3. Tap the required diagram, or drag a rectangle on the diagram to mark the area to be analyzed.

To select a function on a toolbar menu

Icons with a little triangle in the upper right corner show the last selected function. A short tap on the icon activates the displayed function. To change the function, proceed as follows:

1. Touch the icon and drag your finger down.
2. When the menu has opened, remove the finger.
3. Tap the required function on the menu.

   The function is selected, and its icon is shown in the toolbar.

The toolbar handling is also shown in a short video that is available on the instrument: "Tutorials > Getting Started > Toolbar".

5.3.2 Toolbar Functions

This chapter describes all toolbar functions in detail.

One-click actions	Interactive actions
Undo	Zoom functions
Redo	Search
Show tooltips and help	Cursor measurements
Show signal bar	Masks
Load saveset	Histogram functions
Find level	Automatic measurement
Save settings	Quick measurement
Save screenshot	FFT
Clear screen results	Select
Autoset / Preset	Delete
Run Cont	Label
Run Single	Update reference waveform
	Save waveform

You can configure the content of the toolbar and hide the date/time display, see chapter 5.3.3, "Toolbar Configuration", on page 81.

The following list describes at first the default toolbar functions and then the additional functions.

Undo
Undoes the last setting actions step by step. Some actions cannot be revoked: locking the touchscreen with T-SCREEN LOCK, and saving data. The undo stack is deleted during the following actions: Reloading settings from file, and reference waveform actions (save, load and preset with active reference waveform).

Redo
Recovers the undo steps in reverse order.

Show tooltips and help
Enables the tooltip display. A short description appears when you tap a parameter in a dialog or result box. To open the corresponding help topic in the online help, tap the "Show Help" button in the lower right corner of the tooltip. See also: chapter 5.10, "Getting Information and Help", on page 93.

Show signal bar
Shows and hides the signal bar.

The look and the behavior of the signal bar can be configured, see chapter 5.6, "Using the Signal bar", on page 87.

Load saveset
Opens a window to select and load instrument settings that were previously stored in a saveset. A graphical preview helps you to find the required settings.

Find level
Analyses the signal and sets the trigger level to the middle of the signal peaks.

Zoom functions
The zoom icon on the toolbar shows the last selected zoom type. A short tap on the icon activates the selected zoom. If you touch the icon and drag your finger down, a menu opens where you can select another zoom type.

Standard zoom ← Zoom functions
Displays a magnified section of the diagram in an additional zoom diagram. It is a display zoom, instrument settings are not changed.

Tap the icon and drag a rectangle on the diagram to mark the zoom area. An additional zoom diagram appears. You can use the tool also repeatedly on the zoom diagram to get a more detailed view.

Touch and hold the zoom area to open the "Zoom" dialog box.

Hardware zoom ← Zoom functions
Changes the instrument settings - horizontal and vertical scales as well as trigger level and offset - to display a part of the diagram in greater detail.

Tap the icon and drag a rectangle on the diagram to mark the area to be zoomed. The diagram changes and shows the magnified area. To return to the previous display, use the "Undo" function.

Coupled zoom ← Zoom functions
Creates a coupled zoom area and its related zoom diagram. If you change the size of one zoom area, the size of all coupled zoom areas is changed as well.

First, create a zoom using the "Zoom" icon. Then tap "Coupled zoom" and tap the existing zoom area. The zoom area is duplicated. Drag the duplicate to the required position.

Fingertip zoom ← Zoom functions
Magnifies the waveforms around your fingertip.

Tap the icon and put your finger on the waveform. The touched part of the waveform is displayed in a magnifier. You can change the zoom factor using the Navigation knob. Drag your finger on the screen to move the magnifier.

Search
Performs a search according to the settings in the "Search Setup" dialog box. The search results appear on the screen.

Tap the icon and then tap diagram with the waveform to be searched. The search is performed on the selected waveform.

Cursor measurements
The cursor icon on the toolbar shows the last selected cursor type. A short tap on the icon activates the selected cursor. If you touch the icon and drag your finger down, a menu opens where you can select another cursor type: horizontal cursors, vertical cursors, or both.

Select the cursor type and then tap the diagram where you want to set the cursors, or draw a rectangle in the diagram to position the cursor lines. The resulting cursor lines measure the selected waveform. The results appear in the "Cursor Results" box. You can adjust the cursor source, type and position in the result box. Move the cursor lines by dragging them in the diagram, or by turning the navigation knob. Pressing the knob switches the parameter to be changed.

Masks
Starts the on-screen mask definition and the testing against the defined mask.

Tap the icon and then tap the points that build the mask. Double-tap the last point to finish mask definition. Now you can move the mask on the screen.

To configure the mask test settings, tap the  icon in the "Mask" result box.

Histogram functions
The histogram icon on the toolbar shows the last selected histogram type. A short tap on the icon activates the selected histogram. If you touch the icon and drag your finger down, a menu opens where you can select another histogram type: horizontal histogram, or vertical histogram.

Tap the icon and then drag a rectangle on the diagram to mark the histogram area. The histogram for the selected waveform appears.

Touch and hold the histogram area to open the "Histogram" dialog box.

Automatic measurement
Starts an automatic measurement.

You can start up to 8 automatic measurements to run in parallel. The "Automatic measurment" icon starts the measurements one after the other.

Tap the icon and then tap the diagram with the waveform to be measured.

To configure the measurement or select a different measurement type, tap the  icon in the "Measurement" result box.

Quick measurement
Performs a set of measurements on the selected waveform. You can configure up to 8 measurement types to be included in quick measurement.

Tap the icon and then tap the diagram with the waveform to be measured.

FFT
Transforms a waveform to the frequency spectrum by fast Fourier transformation (FFT). The FFT trace appears in a new diagram.

Tap the icon and then tap diagram with the waveform to be transformed. The FFT diagram is created from the selected waveform.

To configure FFT settings, double-tap the FFT diagram.

Select
Enables the select mode to move and modify objects on the touchscreen. The select mode is activated automatically when an analyzing function is completed.

Delete
Removes zoom and histogram areas and their associated diagrams; measurement areas and their associated results; and mask segments. The icon also switches off a waveform.

Tap the icon and then tap the area or diagram to be deleted, or the waveform to be switched off.

Save settings
Saves the current instrument settings in a saveset. The filename is created according to the autonaming pattern. You can reload the saveset using the "Load saveset" toolbar icon, or using FILE > "Save/Recall" > "Settings".

Save screenshot
Saves a screenshot of the current display using the settings defined in "File" menu > "Print Setup".

Clear screen results
Resets all measurement results including long term measurement and statistic results and deletes the current measurement waveforms.

Autoset / Preset
Performs an autoset or a preset to a default state, respectively. The icons have the same functionality as the corresponding keys on the front panel. They are useful when you control the instrument remotely.

Run Cont
Starts and stops the continuous acquisition. The icon has the same functionality as the corresponding key on the front panel. It is useful when you control the instrument remotely.

Run Single
Starts a defined number of acquisition cycles. Press the key again to stop running acquisitions. The icon has the same functionality as the corresponding key on the front panel. It is useful when you control the instrument remotely.

Label
Defines a waveform label that names or explains the waveform. Tap the icon and then tap the waveform to be labeled. If you tap the display background, the label is assigned to the selected waveform. Enter the label text using the onscreen keyboard. The text is shown in the same color as the assigned waveform. You can drag the label to another position.

Update reference waveform
Copies the selected source waveform with all its settings to the reference waveform. If the acquisition is running, the reference waveform is a snapshot. You can configure up to four reference waveforms. Select the required REference Waveform (R1 to R4) in the toolbar menu of the icon.

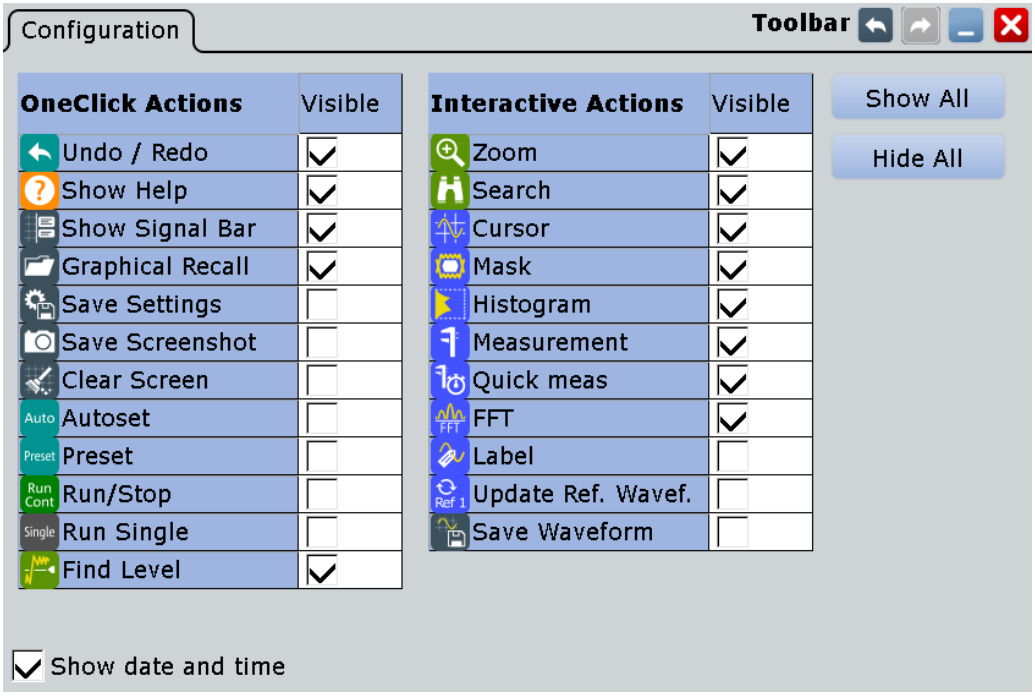
Save waveform
Exports the waveform data to file using the settings defined in FILE > "Waveforms / Results" > "Waveforms". The file name is created according to the autonaming pattern

Tap the icon and then tap the waveform to be exported. If you tap the display background, the selected waveform is exported, or a multi-channel export is performed if configured.

5.3.3 Toolbar Configuration

You can configure the contents of the toolbar so that only the functions you use are displayed. Furthermore, date and time can be hidden. The toolbar configuration is part of the user preferences. It is retained when you switch off and on the instrument, and you can save it in the user preferences and user-defined preset.

1. On the "Display" menu, select "Toolbar".
2. Enable the "Visible" option for all functions you need, and disable the functions that you do not need.
3. To hide the current date and time on the toolbar, disable "Show date and time".



Visible
Defines the visibility of selected toolbar icons.

Show All
Displays all available toolbar icons.

Hide All
Hides all toolbar icons.

Show date and time
Displays the current date and time on the toolbar.

5.4 Working with Waveforms

The R&S RTO can create and display several types of waveforms:

- Channel waveforms:
  Up to three waveforms per input channel can be shown. For a four-channel instrument, 12 channel waveforms are available.
- Reference waveforms:
  Four waveforms can be used as reference for comparison and analysis.
- Math waveforms:
  Four mathematic waveforms can be created with mathematic operations performed on channel, reference, and other math waveforms.
- Zoom waveforms:
  Show the details of a waveform.

- XY-waveforms:
  Four XY-waveforms can be created. Each XY-waveform is built from the voltage values of two source waveforms.
- Digital waveforms:
  The Mixed Signal Option R&S RTO-B1 provides 16 digital channels grouped in two logic probes (pods) with 8 channels each.

Waveform handling

With R&S RTO, a large number of waveforms can be used for signal analysis. To handle this multitude while keeping track of it, the R&S RTO provides intelligent support:

- The color system helps to distinguish the waveforms. The color of the vertical rotary knobs indicates the signal that is focused (selected). The color of each waveform can be changed, the color of its signal icon and of the illuminated keys is adjusted to the new color. Alternatively, a color table can be assigned to a waveform. Settings: DISPLAY > "Signal Colors / Persistence" tab.
- Waveforms can be minimized to signal icons showing a small real-time signal view. Thus, more space in the diagram area is available without switching waveforms off.
- Diagrams are displayed on tabs – you can arrange them side by side or one above the other. To change the diagram name, touch and hold the tab name. The on-screen keyboard opens to enter the new name.
- The Rohde & Schwarz SmartGrid function helps to arrange the diagrams when dragging a signal icon to the diagram area.

Waveform states

Depending on its place on the screen and the effect of settings, a waveform has one of the following states:

- Off
- Active: The waveform is shown in a diagram
- Selected: One of the active waveforms that has the focus. In each diagram, one of the assigned waveforms is selected – it appears "on top" in the diagram, and the grid labels have the color of the selected waveform. Some of the toolbar functions, like cursor and histogram measurements are performed on the selected waveform. All waveform-specific settings are applied to the selected waveform of the selected diagram. The vertical POSITION and SCALE knobs, and the SIGNAL OFF key are illuminated with the color of the selected waveform.
  In figure 5-1, "Ch1Wfm1" is the selected waveform: The frames of the diagram and the signal icon are highlighted.
- Minimized: The waveform is shown as real-time signal view in its signal icon

To switch a waveform on

A channel waveform is activated as soon as you connect the probe. You can switch it on and off according to your needs.

► Choose one of the following ways:

  - Press the channel key.
  - In the "Vertical" dialog box, tap the "Enable" icon of the waveform.

The waveform is now active and appears in the diagram.

To select a waveform

► Choose one of the following ways:

- Tap the waveform in the waveform diagram.
- To select a channel, reference, or math waveform, press the corresponding key.
- Tap the signal icon.
  This works only if the "Click on signal icon" setting is set to "Hardkey logic", see "To set the action on tapping the signal icon" on page 88.

Note: Zoom waveforms in zoom diagrams cannot be selected.

To minimize a waveform

► Choose on of the following ways:

- Tap the "Minimize" icon in the upper right corner of the waveform's signal label in the signal bar.
- Drag the waveform from the diagram to the signal bar.
- Tap the signal icon.
  This works only if the "Click on signal icon" setting is set to "Minimize", see "To set the action on tapping the signal icon" on page 88.

The waveform disappears from the diagram and the minimized signal view is shown in the signal icon.

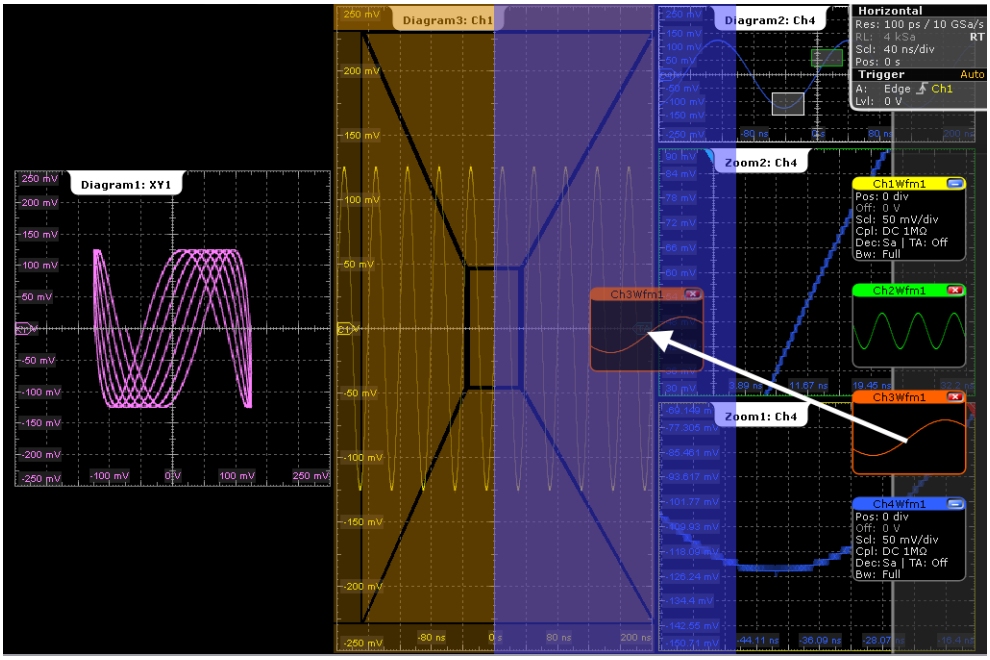
Tip: To set the waveform back to its previous diagram immediately, use "Undo".

To arrange a waveform using the SmartGrid

You can arrange waveforms in one of the existing diagrams, or in a new diagram.

The usage of the SmartGrid is also shown in a short video that is available on the instrument: "Tutorials > Getting Started > SmartGrid".

1. Drag the signal icon to the diagram area.
   The Rohde & Schwarz SmartGrid appears and a blue area shows where the waveform will be placed.
2. Drop the waveform in the target area.
   The waveform appears in an existing or in a new diagram and it is selected for further actions.



3. To change the size of the new diagram, drag its edge to the required position.

The diagram layout depends on the position where you drop the signal view, in relation to an existing diagram.

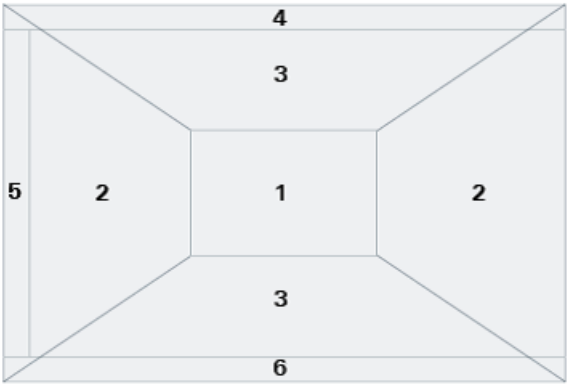


Fig. 5-2: SmartGrid positions

1 = In the existing diagram, overlay of signal
2 = New diagram on the left or right
3 = New diagram above or below
4 = New diagram on top of the existing diagram
5 = XY-diagram
6 = YX-diagram

To switch off a waveform

► Do one of the following:

- Select the waveform, and then press the SIGNAL OFF key.

- To switch off a minimized waveform, tap the "Close" icon in the upper right corner of the minimized signal view.
- Disable the "Show channel" setting in the "Vertical" dialog box.
- Tap the "Delete" icon (Recycle bin) in the toolbar, and then the waveform.
  If several waveforms overlap or lie close together, the upper (selected) waveform is switched off.

5.5 Displaying Results

The results of automatic or cursor measurements, mask tests, and searches are displayed immediately in a result box.

There are three ways to display the results:

- In a floating result box in front of the diagrams, which you can move on the display
- In a minimized view (result icon) on the signal bar
- In a diagram

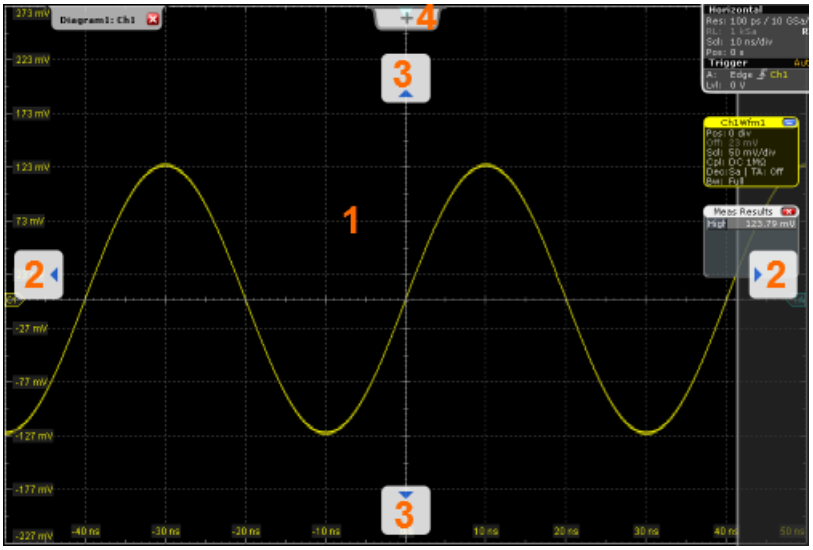
The default position and the font size can be adjusted.

To arrange the result box on the display

1. Tap the "Minimize" icon in the floating result box.

   The result box is closed, and a result icon with the result values is added to the signal bar.

2. Drag the result icon from the signal bar to the diagram area and drop it on one of the buttons. If you drop it somewhere else, a floating result box is created.



1 = Floating result box
2 = Table in a diagram on the left or right
3 = Table in a diagram above or below
4 = New tab

The results are displayed in the specified area of the screen.

3. To move the result table from the diagram back to the signal bar, tap the tab name and drag it back to the signal bar.

To open the correspondig setup dialog box

► In the result box, tap the icon.

The dialog box with corresponding settings opens.

To define the default position of results

1. Press the DISPLAY key on the front panel.
2. In the "Display" dialog box, select the "Diagram Layout" tab.
3. Under "Result box", select the "Default position":
   - "Preview": result icon on the signal bar
   - "Floating": floating result box in front of the diagrams

To adjust the font size in result boxes

1. Press the SETUP key.
2. Select the "Screen" tab.
3. Set the "Result dialog font size".

5.6 Using the Signal bar

The signal bar can hold a large number of signal and result icons. Signal icons represent the waveforms, serial buses and parallel buses, while result icons are minimized result boxes showing measurement and search results.

To scroll the signal bar

If the signal bar contains more than four icons, not all icons are visible on the display.

► Touch one of the icons and move it up or down until the required icon appears.

To switch on and off the signal bar

If you need the complete screen to see the diagrams and results, you can switch off the signal bar completely.

► Tap the "Show signal bar" icon on the toolbar.

Alternatively, tap "Signal Bar" on the "Display" menu.

To change the position of the signal bar

► Touch the "Horizontal" label on the top of the signal bar and drag the it to the opposite side of the screen.

To set the action on tapping the signal icon

You can define what happens when you tap a signal icon: Either the waveform is minimized, or it is selected (gets the focus).

1. Press the DISPLAY key on the front panel.
2. In the "Display" dialog box, select the "Diagram Layout" tab.
3. Under "Signal bar", tap "Click on signal icon".
4. Select the action on clicking/tapping:
   - "Minimize": The waveform switches from the diagram to the signal icon and is shown as small real-time preview.
   - "Hardkey logic": Selects the waveform for further operation.

To configure auto-hide

The signal bar can be hidden if the displayed information has not changed for a defined time, and is displayed again automatically when a setting in the signal bar changes. The signal bar does not hide entirely, it simply fades and becomes less visible in the display.

1. Press the DISPLAY key on the front panel.
2. In the "Display" dialog box, select the "Diagram Layout" tab.
3. Select "Auto-hide".
4. Define the hiding properties:
   - "Hide bar after": the time after which the bar is hidden if no changes occur
   - "Hiding transparency": Transparency of the hidden signal bar on a scale from 20% (low transparency) to 70% (high transparency)
   - Hide head also: the horizontal and trigger labels are also faded

To change the colors

If you want to highlight the signal bar, you can change the "Fill color" and "Border color" of the bar.

1. Press the DISPLAY key on the front panel.
2. In the "Display" dialog box, select the "Diagram Layout" tab.
3. Tap "Border color" to change the color of the signal bar frame, or "Fill color" to change the fill color of the bar.
4. In the "Adjust Colors" dialog box, select the color to be used.

5. To use a color that is not yet defined, tap "Userdefined Colors" and define the new color settings. To see the effect of a setting change in the "Preview" area, enter the value and press the ENTER key.
6. Tap "OK."

   The signal bar is displayed in the new colors.

5.7 Accessing the Functionality

All functionality is provided in dialog boxes as known from computer programs. You can control the instrument intuitively with the touchscreen. This section provides an overview of the accessing methods and describes how to use the dialog boxes.

Each dialog box has four icons in the upper right corner:

	Go back: opens the previously opened dialog box.
	Go forward: opens the next dialog box.
	Minimizes the dialog box to a small box that only contains the last selected function.
	Closes the dialog box.

For direct access to important control and measurement functions use the toolbar, see chapter 5.3, "Toolbar", on page 76.

To open a dialog box

► Perform one of the following actions:

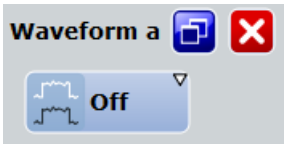
- Tap the required menu, and then the menu entry.
- Press the function key on the front panel.
- If a results box is open, tap the  icon to open the corresponding dialog box.
- Touch and hold the signal icon to open the corresponding "Vertical" dialog box. For XY-waveforms, the "XY Diagram" tab opens.
- Tap the horizontal or trigger label to open the "Horizontal" or "Trigger" dialog box, respectively.

To minimize a dialog box

If you need to change only one setting during analysis, and you need to change it often, you can reduce the dialog box to a small box that only contains the required setting.

1. Tap the function that you need to modify.
2. Tap the "Minimize" icon in the upper right corner of the dialog box.

   The dialog box turns into a small box that contains only the "Wfm Arithmetic" setting.



3. To restore the complete dialog box, tap the "Maximize" icon in the small box.

To close a dialog box

► Tap the "Close" icon in the upper right corner.
Or:
Press the ESC key on the front panel.

To select an option in a dialog box

► Tap the required option.
Or:
Press the FIELD LEFT and FIELD RIGHT keys to navigate to the required option and then press the CHECKMARK key.

To select an option in a list

If many options are available - for example, for the trigger type - the options are provided in a list. The current selection is shown on the list button.

► Tap the list button, and then tap the required option.
Or:
Use the front panel keys:

a) Press the FIELD LEFT and FIELD RIGHT keys to navigate to the list button.
b) Press the CHECKMARK key to open the list.
c) Press the UP ARROW and DOWN ARROW keys to navigate to the required option in the list.
d) Press the CHECKMARK key to select the marked option.

5.8 Entering Data

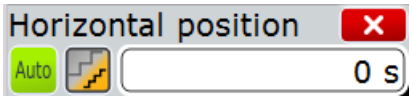
Most important parameters have their own rotary knobs on the front panel. The parameters on the POSITION and RESOLUTION / RECORD LENGTH keys can be toggled

by pressing the knob. When you press or turn a knob, the input box appears with the parameter name and current value.

For data input in dialog boxes, the touchscreen provides an on-screen keypad to enter numeric values and units. For text input, the on-screen keyboard with English key layout is used.

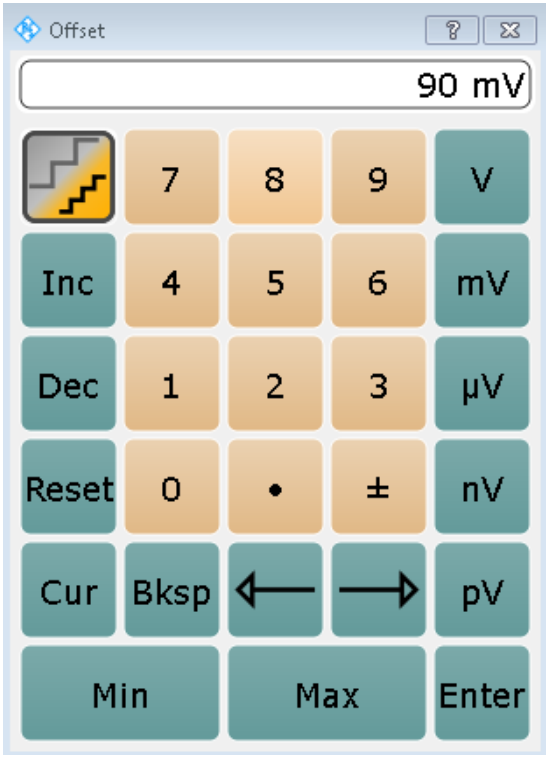
Using rotary knobs

1. Turn the knob to change the value.
2. Tap the "Steps" icon in the input box or press the knob to toggle the increment.
3. Tap the "Auto" icon to set the parameter to the autoset value if available.



To enter values with the on-screen keypad

1. Double-tap the entry field to open the on-screen keypad.

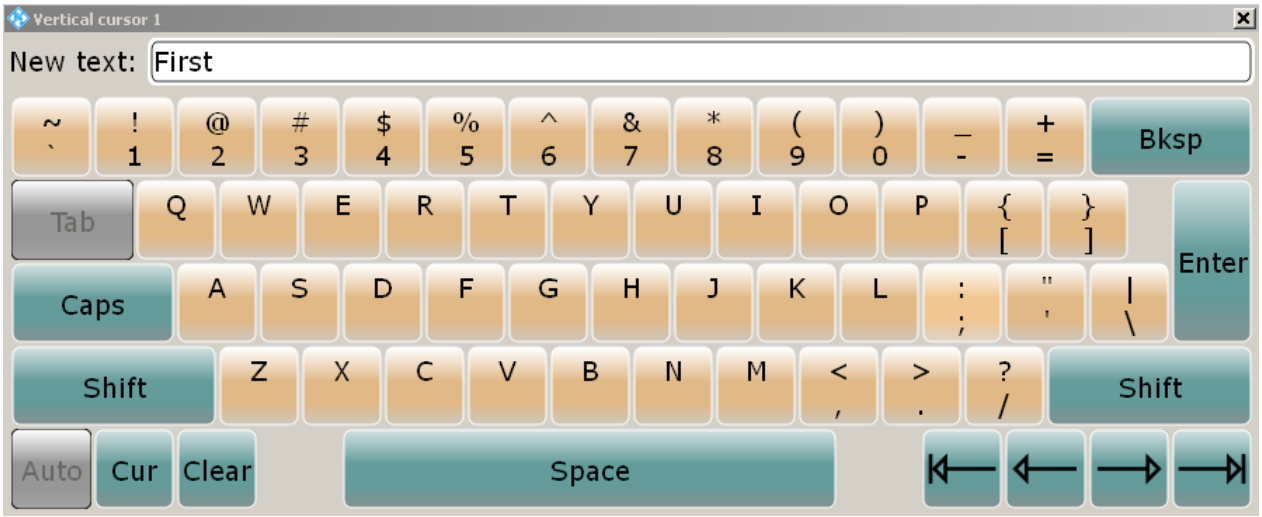


2. Enter the numeric value using the following methods:
   - To use the default value, tap "Reset" (if available).
   - To use the minimum or maximum value, tap "Min" or "Max", respectively.
   - To increase the displayed value in fixed steps, tap "Inc". To decrease the value in fixed steps, tap "Dec". To toggle between small steps and large steps, tap the "Steps" icon.

- To get the value that was used before the keypad was displayed, tap "Cur".
- To enter a user-defined value, tap the numbers and complete the entry by tapping the unit button.
  - The arrow buttons move the cursor left or right.
  - "Bksp" deletes the last character before the cursor.
  - ± changes the sign of the value.

To enter data with the on-screen keyboard

1. If it is not opened automatically, double-tap an entry field to open the on-screen keyboard.



2. Enter the text as you would on a normal keyboard.
   Tap "Caps" to enter a series of capitals, or tap "Shift" to enter one capital character.
   Tap "Cur" to use the currently defined value, that is, the value that was used before the keyboard was displayed.
   Tap the arrow buttons to move the cursor left or right.
   Tap "Bksp" to delete the last character before the cursor.
3. Tap "Enter" to complete the entry.

To enter numeric data in a dialog box with navigation controls

1. Press the FIELD LEFT and FIELD RIGHT keys to navigate to the entry field.
2. To change the value with a small step size, turn the rotary knob.
   Alternatively, press the UP ARROW and DOWN ARROW keys for a larger step size.

If you edit numeric data in tables, the entry field must be in edit mode: Press ENTER, or the CHECKMARK key, or the navigation rotary knob to activate the edit mode.

5.9 Messages

Status messages of the instrument are displayed for a few seconds, then they are shown in a message box in the upper right corner of the screen. By default, the message box is closed. You can open it to read the messages and to delete them.

► Tap the yellow "Info" button to open and close the message box.

If no messages are available, the "Info" button is hidden.

Important messages are indicated by a red "Info" button. These messages cannot be deleted, they remain until the problem is solved.

5.10 Getting Information and Help

In many dialog boxes, graphics are included to explain the way a setting works. For further information, you can use the following sources:

- Tutorials demonstrate the general usage of the R&S RTO, for example, how to use the SmartGrid.
- Tooltips give a short description of the parameter.
- The context help provides functional description on a setting, and the corresponding remote command.
- The general help explains a dialog box, provides instructions, and general information.

5.10.1 Displaying Tutorials

Tutorials are silent movies, which are available directly on the instrument, on the Documentation CD-ROM on the "Movies" tab, and on the Internet. They show basic usage aspects.

To see a tutorial on the instrument

1. On the menu, tap "Tutorials".
2. Tap "Getting Started".
3. Tap the tutorial that you want to see.

5.10.2 Displaying Help

To display tooltips and context help

1. Enable the "Tooltip" icon on the toolbar.

2. Tap the parameter for which you need information.

   The tooltip opens.

3. To open the corresponding help topic, tap the "Show Help" button in the lower right corner of the tooltip.

   The "Help" window opens and displays the comprehensive description and the corresponding remote command. You can browse the help for further information.

   Note: With touchscreen, the tooltip display disables automatically when you tap a parameter. To show another tooltip, tap the tooltip icon again. If you use a mouse, the tooltip display remains on until you switch it of. The tooltip appears when you move the mouse on a parameter.

To open general help

► Press the yellow HELP button on the left side of the screen.

If a dialog box is open, the help topic for the current tab is shown. Otherwise the "Contents" page appears.

5.10.3 Using the Help Window

The Help window contains several tabs:

- "View" - shows the selected help topic
- "Contents" - contains a table of help contents
- "Index" - contains index entries to search for help topics
- "Search" - provides text search

The Help toolbar provides some buttons:

- To browse the topics in the order of the table of contents: Up arrow = previous topic, Down arrow = next topic
- To browse the topics visited before: Left arrow = back, Right arrow = forward
- To increase or decrease the font

To navigate the Help, use the touchscreen. Alternatively, you can also use the navigation keys on the front panel.

To search for a topic in the index

The index is sorted alphabetically. You can browse the list, or search for entries in the list.

1. Switch to the "Index" tab.
2. Select the "Keyboard" icon besides the entry field.
3. Enter the first characters of the keyword you are interested in.

   The entries containing these characters are displayed.
4. Double-tap the suitable index entry.

   The "View" tab with the corresponding help topic is displayed.

To search topics for a text string

1. Switch to the "Search" tab.
2. Select the "Keyboard" icon besides the entry field.
3. Enter the string you want to find.
   If you enter several strings with blanks between, topics containing all words are found (same as AND operator).

   For advanced search, consider the following:
   - To find a defined string of several words, enclose it in quotation marks. For example, a search for *"trigger qualification"* finds all topics with exactly *"trigger qualification"*. A search for *trigger qualification* finds all topics that contain the words *trigger* and *qualification*.
   - Use "Match whole word" and "Match case" to refine the search.
   - Use operators AND, OR, and NOT.

To close the Help window

► Select the "Close" icon in the upper right corner of the help window.
Or:
Press the ESC key on the front panel.

6 Setting Up the Instrument

Basic setup procedures for the instrument are the following:

6.1 Performing a Self-alignment

The self-alignment aligns the data from several input channels vertically and horizontally in order to synchronize the time bases, amplitudes and positions. The self-alignment process includes a basic hardware check.

Recommendation on performing the self-alignment:

- when putting the instrument into operation for the first time
- after a firmware update
- once a week
- when major temperature changes occur (> 5°)

NOTICE

Warm-up and prepare the instrument

Make sure that the instrument has been running and warming up before you start the self-alignment. The minimum warm-up time is indicated in the data sheet.

Remove the probes from the input connectors.

1. From the "File" menu, select "Selfalignment".
2. On the "Control" tab, tap "Start Alignment".

   The alignment is performed, the process might take several minutes. A message box informs you about the running process, wait until this message box closes. The overall pass/fail result is shown in the "Overall alignment state" field. The results of the individual alignment steps for each input channel are indicated in the "Results" tab. This information is mainly required if problems arise.

6.2 Aligning the Touchscreen

When the device is delivered, the touchscreen is initially calibrated. However, to ensure that the touchscreen responds to the finger contact correctly, a touchscreen alignment is required.

Alignment of the touchscreen is useful:

- At first use
- If the position of the instrument has been changed and you cannot look straight on the screen
- If another person operates the instrument
- If you notice that touching a specific point on the screen does not achieve the correct response

1. Press the SETUP key.
2. Select the "Screen" tab.
3. Tap "Touchscreen Calibration".

   A blinking cross appears in the lower left corner of the screen.
4. Touch and hold the cross until "OK" is shown.
5. Repeat this action for the crosses in the other corners.
6. Tap the R&S logo button in the task bar to display the instrument's user interface.

6.3 Setting the Display Language

You can change the language in which the dialog boxes, result boxes and other screen information is displayed. A reboot of the instrument is not necessary.

1. Press the SETUP key.
2. Select the "System" tab.
3. Tap the "Language" button. The button shows the current language.
4. Select the required language.

   The instrument changes the language after a few seconds.

6.4 Adjusting Passive Probes

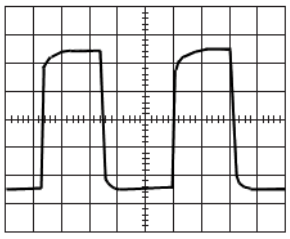
R&S RT-ZP10 passive probes are already pre-compensated to the R&S RTO front-end characteristics, and a compensation procedure is not required.

If you use other passive probes, the R&S RTO allows you to compensate it when it is connected to the instrument the first time. Compensation matches the probe cable capacitance to the oscilloscope input capacitance to assure good amplitude accuracy from DC to upper bandwidth limit frequencies. A poorly compensated probe reduces the performance of the probe-oscilloscope system and introduces measurement errors resulting in distorted waveforms and inaccurate results.

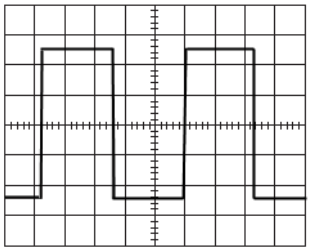
Two connector pins are located on the front panel. The right pin is on ground level. The left pin supplies a square wave signal with 1 kHz for low frequency probe compensation.

1. Connect the BNC connector of the probe to input CH1.
2. Connect the probe's ground connector to the right compensation pin, and the tip with the left pin.
3. Press AUTOSET.

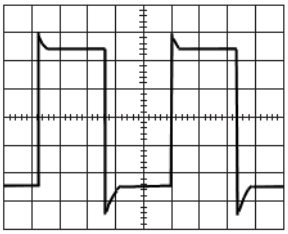
   A square wave appears on the display.
4. Adjust the compensation trimmer of the probe to optimum square wave response. For details, refer to the documentation of your probe.



undercompensated



optimum



overcompensated

Index

I

K

L

M

N

O

P

Q

R

X

Z